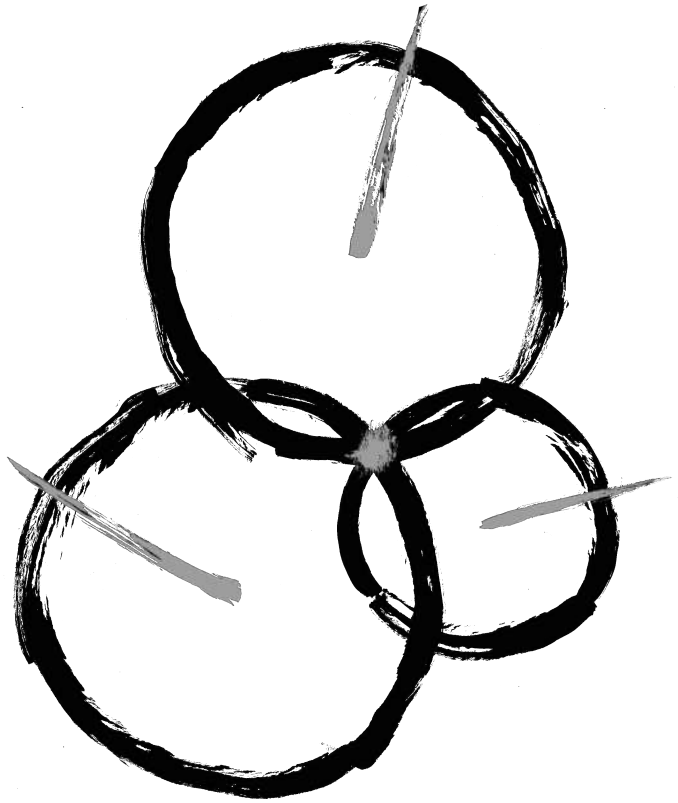
The Commission on Higher Education
in collaboration with the Philippine Normal University

Teaching Guide for Senior High School

DISASTER READINESS AND RISK REDUCTION

CORE SUBJECT

This Teaching Guide was collaboratively developed and reviewed by educators from public and private schools, colleges, and universities. We encourage teachers and other education stakeholders to email their feedback, comments, and recommendations to the Commission on Higher Education, K to 12 Transition Program Management Unit - Senior High School Support Team at k12@ched.gov.ph. We value your feedback and recommendations.



Published by the Commission on Higher Education, 2016
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Introduction

As the Commission supports DepEd's implementation of Senior High School (SHS), it upholds the vision and mission of the K to 12 program, stated in Section 2 of Republic Act 10533, or the Enhanced Basic Education Act of 2013, that "every graduate of basic education be an empowered individual, through a program rooted on...the competence to engage in work and be productive, the ability to coexist in fruitful harmony with local and global communities, the capability to engage in creative and critical thinking, and the capacity and willingness to transform others and oneself."

To accomplish this, the Commission partnered with the Philippine Normal University (PNU), the National Center for Teacher Education, to develop Teaching Guides for Courses of SHS. Together with PNU, this Teaching Guide was studied and reviewed by education and pedagogy experts, and was enhanced with appropriate methodologies and strategies.

Furthermore, the Commission believes that teachers are the most important partners in attaining this goal. Incorporated in this Teaching Guide is a framework that will guide them in creating lessons and assessment tools, support them in facilitating activities and questions, and assist them towards deeper content areas and competencies. Thus, the introduction of the **SHS for SHS Framework.**

SHS for SHS Framework

The SHS for SHS Framework, which stands for "Saysay-Husay-Sarili for Senior High School," is at the core of this book. The lessons, which combine high-quality content with flexible elements to accommodate diversity of teachers and environments, promote these three fundamental concepts:

SAYSAY: MEANING

Why is this important?

Through this Teaching Guide, teachers will be able to facilitate an understanding of the value of the lessons, for each learner to fully engage in the content on both the cognitive and affective levels.

HUSAY: MASTERY

How will I deeply understand this?

Given that developing mastery goes beyond memorization, teachers should also aim for deep understanding of the subject matter where they lead learners to analyze and synthesize knowledge.

SARILI: OWNERSHIP

What can I do with this?

When teachers empower learners to take ownership of their learning, they develop independence and self-direction, learning about both the subject matter and themselves.

About this Teaching Guide

The Philippines is frequently cited as among the top countries most at risk to disasters. While disasters can arise from man-made sources, the most inevitable ones come from natural phenomena. Even without scientific scrutiny, every Filipino is familiar with the impacts of typhoons, earthquakes, volcanic eruptions, and fires to everyday life and to national development. This makes learning about disaster preparedness aligned with everyone's interests.

This teaching guide for the Disaster Readiness and Risk Reduction (DRRR) subject of the Philippines' K-12 Curriculum provides a lesson-by-lesson framework for educators to help learners attain the target competencies and outcomes. The challenge with teaching a subject like DRRR is its multi-disciplinary nature, bringing together biological, geophysical, socio-cultural, political, and economic factors. This in itself is an opportunity to make these various subject matters relevant to the lives of the people even if studying disasters leans toward the sciences. With the use of these teaching guides, the teacher will be able to handle a diverse set of materials that will enrich their existing knowledge on the natural and social sciences. They will also be able to engage learners in a number of hands-on activities that make use of mixed-media to maximize existing resources. And overall, lessons tackled in these guides encourage a two-way interaction between the teachers and students that will ultimately result to effective learning.

Lessons of these teaching guides address the content standards identified by the Department of Education (DepEd). Some teaching guides may include multiple learning competencies as that may be more efficiently achieved when tackled together. This guide approaches learning about DRRR by first understanding the hazards that may then potentially lead to disasters, as a common confusion arises from distinguishing the concepts of "hazard and "disaster". Each hazard type has its own precautionary measures and ideal responses to prevent disasters. Towards the end of the subject, learners will focus on applications to the community and the Philippine society.

Users of these guides should note that sciences and policies related to DRRR are ever evolving along with improvements and breakthroughs in data collection and technology; so it is expected that reference materials also change through time. It would be important for teachers of the subject to continually update any cited references in each guide to make sure that the lessons will also result to cutting-edge teaching.

As a big part of understanding disasters involves projecting future possibilities, the success of teaching the subject of Disaster Readiness and Risk Reduction may not be immediately measurable and definitely not something anyone is looking forward to test. But while the country is exposed to hazards that can alter the course of everyday life, bringing this subject to each classroom gives the people the power to take control of their lives and of nation-building in whatever the situation they may encounter in the future.

Parts of the Teaching Guide

This Teaching Guide is mapped and aligned to the DepEd SHS Curriculum, designed to be highly usable for teachers. It contains classroom activities and pedagogical notes, and is integrated with innovative pedagogies. All of these elements are presented in the following parts:

1. **Introduction**
   - Highlight key concepts and identify the essential questions
   - Show the big picture
   - Connect and/or review prerequisite knowledge
   - Clearly communicate learning competencies and objectives
   - Motivate through applications and connections to real-life
2. **Motivation**
   - Give local examples and applications
   - Engage in a game or movement activity
   - Provide a hands-on/laboratory activity
   - Connect to a real-life problem
3. **Instruction/Delivery**
   - Give a demonstration/lecture/simulation/hands-on activity
   - Show step-by-step solutions to sample problems
   - Give applications of the theory
   - Connect to a real-life problem if applicable
4. **Practice**
   - Discuss worked-out examples
   - Provide easy-medium-hard questions
   - Give time for hands-on unguided classroom work and discovery
   - Use formative assessment to give feedback
5. **Enrichment**
   - Provide additional examples and applications
   - Introduce extensions or generalisations of concepts
   - Engage in reflection questions
   - Encourage analysis through higher order thinking prompts
6. **Evaluation**
   - Supply a diverse question bank for written work and exercises
   - Provide alternative formats for student work: written homework, journal, portfolio, group/individual projects, student-directed research project

On DepEd Functional Skills and CHED College Readiness Standards

As Higher Education Institutions (HEIs) welcome the graduates of the Senior High School program, it is of paramount importance to align Functional Skills set by DepEd with the College Readiness Standards stated by CHED.

The DepEd articulated a set of 21st century skills that should be embedded in the SHS curriculum across various subjects and tracks. These skills are desired outcomes that K to 12 graduates should possess in order to proceed to either higher education, employment, entrepreneurship, or middle-level skills development.

On the other hand, the Commission declared the College Readiness Standards that consist of the combination of knowledge, skills, and reflective thinking necessary to participate and succeed - without remediation - in entry-level undergraduate courses in college.

The alignment of both standards, shown below, is also presented in this Teaching Guide - prepares Senior High School graduates to the revised college curriculum which will initially be implemented by AY 2018-2019.

College Readiness Standards Foundational Skills	DepEd Functional Skills
Produce all forms of texts (written, oral, visual, digital) based on: 1. Solid grounding on Philippine experience and culture; 2. An understanding of the self, community, and nation; 3. Application of critical and creative thinking and doing processes; 4. Competency in formulating ideas/arguments logically, scientifically, and creatively; and 5. Clear appreciation of one's responsibility as a citizen of a multicultural Philippines and a diverse world;	Visual and information literacies, media literacy, critical thinking and problem solving skills, creativity, initiative and self-direction
Systematically apply knowledge, understanding, theory, and skills for the development of the self, local, and global communities using prior learning, inquiry, and experimentation	Global awareness, scientific and economic literacy, curiosity, critical thinking and problem solving skills, risk taking, flexibility and adaptability, initiative and self-direction
Work comfortably with relevant technologies and develop adaptations and innovations for significant use in local and global communities	Global awareness, media literacy, technological literacy, creativity, flexibility and adaptability, productivity and accountability
Communicate with local and global communities with proficiency, orally, in writing, and through new technologies of communication	Global awareness, multicultural literacy, collaboration and interpersonal skills, social and cross-cultural skills, leadership and responsibility
Interact meaningfully in a social setting and contribute to the fulfilment of individual and shared goals, respecting the fundamental humanity of all persons and the diversity of groups and communities	Media literacy, multicultural literacy, global awareness, collaboration and interpersonal skills, social and cross-cultural skills, leadership and responsibility, ethical, moral, and spiritual values

Grade: 11/12
Subject Title: Disaster Readiness and Risk Reduction

No. of Hours/Semester: 80 hours/semester
Prerequisite (if needed): Grades 3-10 Science

Subject Description: This course focuses on the application of scientific knowledge and the solution of practical problems in a physical environment. It is designed to bridge the gap between theoretical science and daily living.

CONTENT	CONTENT STANDARD	PERFORMANCE STANDARD	LEARNING COMPETENCIES	CODE
Basic concept of disaster and disaster risk	*The learners demonstrate understanding of the…* 1. Concept of disaster 2. Concept of disaster risk 3. Nature of disasters 4. Effects of disasters	The learners relate the concept of disaster with daily life.	*The learners…* 1. Explain the meaning of disaster; 2. Differentiate the risk factors underlying disasters; 3. Describe the effects of disasters on one's life; 4. Explain how and when an event becomes a disaster; 5. Identify areas/locations exposed to hazards that may lead to disasters; and 6. Analyze disaster from the different perspectives (physical, psychological, socio-cultural, economic, political, and biological).	**DRR11/12-Ia-b-1** **DRR11/12-Ia-b-2** **DRR11/12-Ia-b-3** **DRR11/12-Ia-b-4** **DRR11/12-Ia-b-5** **DRR11/12-Ia-b-6**

CONTENT	CONTENT STANDARD	PERFORMANCE STANDARD	LEARNING COMPETENCIES	CODE
Exposure and Vulnerability	*The learners demonstrate understanding of…*	The learners conduct hazard hunts of exposed elements and propose corresponding corrective actions for one's preparedness.	*The learners…* 1. Enumerate elements exposed to hazards; 2. Explain the meaning of vulnerability; 3. Explain why certain sectors of society are more vulnerable to disaster than others; 4. Analyze why certain structures are more vulnerable to specific hazards than others;	**DRR11/12-Ic-7** **DRR11/12-Ic-8** **DRR11/12-Ic-9** **DRR11/12-Ic-10**
	Various elements that may be exposed to hazards: *1. Physical* *2. Social* *3. Economic* *4. Environmental* Vulnerability of each exposed element.		5. Determine the elements that are exposed to a particular hazard; 6. Recognize vulnerabilities of different elements exposed to specific hazards; and 7. Differentiate among hazards, exposure, and vulnerabilities and give examples from actual situations.	**DRR11/12-Id-11** **DRR11/12-Id-12** **DRR11/12-Id-13**
Basic concept of hazard	*The learners demonstrate understanding of the…* 1. Concept of hazard 2. Types of hazards 3. The impact of various hazards	The learners relate various types of hazard with a specific area for one's preparedness.	*The learners…* 1. Define hazards; 2. Give examples of the types of hazards; and 3. Explain the impact of various hazards on different exposed elements.	**DRR11/12-Ie-14** **DRR11/12-Ie-15** **DRR11/12-Ie-16**

CONTENT	CONTENT STANDARD	PERFORMANCE STANDARD	LEARNING COMPETENCIES	CODE
Earthquake Hazards	*The learners demonstrate understanding of…* Potential earthquake hazards: *1. Ground shaking* *2. Ground rupture* *3. Liquefaction* *4. Earthquake-induced ground subsidence* *5. Tsunami* *6. Earthquake-induced landslide*	The learners develop a family emergency preparedness plan to guide them on what to do before, during, and after an earthquake.	*The learners…* 1. Identify various potential earthquake hazards; 2. Recognize the natural signs of an impending tsunami; 3. Analyze the effects of the different earthquake hazards;	**DRR11/12-If-g-17** **DRR11/12-If-g-18** **DRR11/12-If-g-19**
			4. Interpret different earthquake hazard maps; and 5. Apply precautionary and safety measures before, during, and after an earthquake.	**DRR11/12-If-g-20** **DRR11/12-If-g-21**
Volcano Hazards	*The learners demonstrate understanding of…* Signs of impending volcanic eruptions Potential volcano-related hazards: *1. Lahar* *2. Ash fall* *3. Pyroclastic flow* *4. Ballistic projectile* *5. Volcanic gasses* 6. *Lava flow*	The learners develop a family emergency preparedness plan to guide them on what to do before, during, and after a volcanic eruption.	*The learners…* 1. Explain various volcano-related hazards; 2. Differentiate among different volcano hazards; 3. Recognize signs of an impending volcanic eruption;	**DRR11/12-Ih-i-22** **DRR11/12-Ih-i-23** **DRR11/12-Ih-i-24**
			4. Interpret different volcano hazard maps; and 5. Apply appropriate measures/interventions before, during, and after a volcanic eruption.	**DRR11/12-Ih-i-25** **DRR11/12-Ih-i-26**

CONTENT	CONTENT STANDARD	PERFORMANCE STANDARD	LEARNING COMPETENCIES	CODE
Other related geological hazards	*The learners demonstrate understanding of…* Related geological hazards *1. Rainfall-induced landslide* *2. Sinkhole*	The learners develop a family emergency preparedness plan to guide them on what to do before, during, and after the occurrence of events that cause geological hazards.	*The learners…* 1. Discuss the different geological hazards; 2. Analyze the causes of geological hazards; 3. Recognize signs of impending geological hazards;	**DRR11/12-IIa-b-27** **DRR11/12-IIa-b-28** **DRR11/12-IIa-b-29**
			4. Interpret geological maps; and 5. Apply mitigation strategies to prevent loss of lives and properties.	**DRR11/12-IIa-b-30** **DRR11/12-IIa-b-31**
Hydrometeorological hazards	*The learners demonstrate understanding of…* Potential hydrometeorological hazards: *1. Typhoon* *2. Thunderstorm* *3. Flashflood* *4. Flood* *5. Stormsurge* *6. El niño* *7. La niña*	The learners develop a family emergency preparedness plan to guide them on what to do before, during, and after the occurrence of events that cause hydrometeorological hazards. The learners develop proficiency in executing emergency response plans through safety drills.	*The learners…* 1. Distinguish and differentiate among and between different hydrometeorological hazards; 2. Recognize signs of impending hydrometeorological hazards;	**DRR11/12-IIc-d-32** **DRR11/12-IIc-d-33**
			3. Apply appropriate measures/interventions before, during, and after hydrometeorological hazards; 4. Interpret different hydrometeorological hazard maps; and 5. Use available tools for monitoring hydro-meteorological hazards.	**DRR11/12-IIc-d-34** **DRR11/12-IIc-d-35** **DRR11/12-IIc-d-36**

CONTENT	CONTENT STANDARD	PERFORMANCE STANDARD	LEARNING COMPETENCIES	CODE
Fire hazard	*The learners demonstrate understanding of…* Fire hazards and related concepts: *1. Fire triangle* *2. Causes of fires* *3. Phases of a fire emergency*	The learners develop a family emergency preparedness plan to guide them on what to do before, during, and after a fire incident.	*The learners…* 1. Recognize elements of the fire triangle in different situations; 2. Analyze the different causes of fires; 3. Observe precautionary measures and proper procedures in addressing a fire incident;	**DRR11/12-IIe-f-37** **DRR11/12-IIe-f-38** **DRR11/12-IIe-f-39**
			4. Apply basic response procedures during a fire incident; and 5. Follow fire emergency and evacuation plans;	**DRR11/12-IIe-f-40** **DRR11/12-IIe-f-41**
Concept of Disaster Risk Reduction (DRR) and Disaster Risk Reduction and Management (DRRM)	*The learners demonstrate understanding of…* Disaster risk reduction: 1. Concept of DRR 2. Importance of DRR 3. Key principles	The learners are able to develop a community emergency preparedness plan and community disaster preparedness plan to minimize vulnerability and disaster risk in the community and avoid or	*The learners…* 1. Discuss the key concepts, principles, and elements of DRR; 2. Recognize the importance of DRR on one's life;	**DRR11/12-IIg-h-42** **DRR11/12-IIg-h-43**

CONTENT	CONTENT STANDARD	PERFORMANCE STANDARD	LEARNING COMPETENCIES	CODE
	Community-based disaster risk reduction and management for preparedness *1. Emergency plan* *2. Monitoring and Evaluation* *3. Early Warning Systems* *4. Survival kits and materials*	limit adverse impacts of hazards. The learners practice and develop proficiency in executing emergency response protocols/procedures through safety drills.	3. Discuss different community-based practices for managing disaster risk to specific hazards; 4. Develop a community preparedness plan; and 5. Prepare survival kits and materials for one's family and for public information and advocacy.	**DRR11/12-IIg-h-44** **DRR11/12-IIg-h-45** **DRR11/12-IIg-h-46**
What to expect between the State and the citizens	*The learners demonstrate understanding of…* 1. Policies of DRRM -The Philippine DRRM Law RA 10121 and its Implementing Rules and Regulations 2. Information and resources from the Government (Projects and Programs)	The learners are able to develop a community disaster preparedness plan to minimize vulnerability and disaster risk in the community and avoid or limit adverse impacts of hazards.	*The learners…* 1. Explain DRR-related laws and policies; 2. Avail of existing DRR-related services programs and projects; and 3. Abide by public policies on DRRM.	**DRR11/12-IIi-j-47** **DRR11/12-IIi-j-48** **DRR11/12-IIi-j-49**

Code Book Legend

Sample: DRR11/12-Id-11

LEGEND		SAMPLE	
First Entry	Learning Area and Strand/ Subject or Specialization	Disaster Readiness and Risk Reduction	**DRR11/12**
	Grade Level	Grade 11/12	
			-
Roman Numeral **Zero if no specific quarter*	Quarter	First Quarter	**1**
Lowercase Letter/s **Put a hyphen (-) in between letters to indicate more than a specific week*	Week	Weeks four	**D**
			-
Arabic Number	Competency	Determine the elements that are exposed to a particular hazard;	**11**

180 MINS

Introduction to Different Types of Disasters

Content Standard
The learners demonstrate understanding of the concept, Types, and their impacts.

Performance Standard
The learners shall be able to:

- relate various types of hazard with a specific area for one's preparedness.

Learning Competencies
The learners are able to:

- define hazards **(DRR11/12-Ie-14)**
- give examples of the types of hazards **(DRR11/12-Ie-15)**
- explain the impact of various hazards on different exposed elements. **(DRR11/12-Ie-16)**

Specific Learning Outcomes
At the end of the lesson, the learners will be able to:

- explain what a hazard is;
- define the two main categories (Natural and Man-made) of hazards; and
- identify the impact of hazards common in their environment.

LESSON OUTLINE

Introduction	Review: Natural Processes	5
Motivation	Definition of Hazard	10
Practice 1	Activity 1: Classifying Phenomena	40
Practice 2	Activity 2: Identifying Impacts of Hazards	125
Enrichment	Hazards	

Materials
Activity notebook, manila paper or cartolina, visual aids for instruction and activities (see procedure)

Resources
(1) United Nations Office for Disaster Risk Reduction. (n.d.). *Terminlogy - unisdr*. Retrieved from https://www.unisdr.org/we/inform/terminology

(2) Rep. Act No. 10121 (2010), Available at http://www.ndrrmc.gov.ph/attachments/article/95/Implementing_Rules_and_Regulartion_RA_10121.pdf

(3) International Federation of Red Cross and Red Crescent Societies. (n.d.). *Types of disasters: Definition of hazard*. Retrieved from http://www.ifrc.org/en/what-we-do/disaster-management/about-disasters/definition-of-hazard/

INTRODUCTION (5 MINS)

Communicate Learning Objectives

1. Introduce the following learning objectives using any of the suggested protocols (Verbatim, Own Words, Read-aloud)

   "I will be able to:

   I. explain the term hazard

   II. define the two main categories (Natural and Man-made) of hazards; and

   III. identify the impact of hazards common in their environment."

Review: Natural Processes

2. Warm up the learners' knowledge on natural processes by asking them about processes that shape and change our environment.

   Possible answers:

   I. Plate tectonics – leading to mountain building, volcanism, ocean formation, etc.

   II. Atmospheric processes – formation of clouds, precipitation, wind, etc.

   III. Biological accumulation – reef building, colony formation, forestation, etc.

   IV. Human activities – urbanization, extracting resources, geoengineering, etc.

   V. Point out to the local environment any of the processes that have been mentioned.

Teacher Tip:
Help the learners recall lessons on natural processes. This subject on DRRR has a big emphasis on disasters arising from natural hazards, so it is important that the learners understand how natural hazards are part of the natural cycle.

MOTIVATION (10 MINS)

Definition of Hazard

1. Recall a recent or historical disastrous event. Ask the learners to tell the class what they know about it.
2. Emphasize how the Philippines is one of the most hazardous countries in the world, having more than 20 tropical cyclones in a year, earthquakes everyday, and more than 20 active volcanoes found all over the country.
3. Introduce the basic definition of Hazard and Disaster. Cold call learners to highlight the differences between the two terms:

Teacher Tip:
You can bring a newspaper article that describes a historical disastrous event if you anticipate that the learners might not be aware about disasters in the Philippines.

Teacher Tip:
HAZARD - UNISDR (2009) (adapted by Philippines DRR Law, 2010):
A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

Hazard - A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

Disaster - A serious disruption of the functioning of a community or a society involving widespread human, material, economic, or environmental losses and impacts which exceeds the ability of the affected community or society to cope using its own resources.

4. Have them define in their own words, English, Filipino, and local dialect (if applicable).
5. Emphasize learning outcome: the definition of hazard.

Teacher Tip:

Comment: The hazards of concern to disaster risk reduction as stated in footnote 3 of the Hyogo Framework are "… hazards of natural origin and related environmental and technological hazards and risks." Such hazards arise from a variety of geological, meteorological, hydrological, oceanic, biological, and technological sources, sometimes acting in combination. In technical settings, hazards are described quantitatively by the likely frequency of occurrence of different intensities for different areas, as determined from historical data or scientific analysis.

DISASTER - UNISDR (2009) (adapted by Philippines DRR Law, 2010):

A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources.

Comment: Disasters are often described as a result of the combination of: the exposure to a hazard; the conditions of vulnerability that are present; and insufficient capacity or measures to reduce or cope with the potential negative consequences. Disaster impacts may include loss of life, injury, disease and other negative effects on human physical, mental and social well-being, together with damage to property, destruction of assets, loss of services, social and economic disruption and environmental degradation.

PRACTICE 1 (40 MINS)

Activity 1: Classifying Phenomena according to Hazards (40 mins.)

Pre-Activity (5 mins.)

1. List down these hazards on the board. Explain anything that some learners might not recall.
   A. Ground shaking
   B. Tornado
   C. Landslide
   D. Flood
   E. Indoor fire
   F. Lava flow
   G. Industrial pollution
   H. Typhoon
   I. Forest fire
   J. Liquefaction
   K. Storm surge
   L. Tsunami
   M. Extreme rainfall

During Activity (5 mins.)

2. Ask the learners to classify the phenomena in a table. They can classify them in any way they want but they have to describe the basis of their classification. Make them write their answers in their activity notebook.
3. Ask the learners to pair up with their seatmate (if odd numbered class, one group can be three learners) and tell them that they have to come up with a final classification scheme written on a sheet of paper. They should discuss the differences and similarities, if any, and the basis for their classification with each other.

Post Activity (30 mins.)

4. Choose a volunteer to share with the class the classification that they made.
5. Allow the learners to compare their answers with the one written on the board. Use this as a jump off point to the discussion of the types of hazards listed below.

Teacher Tip:
Instead of just plain words, you may include pictures of the phenomena

Detailed discussions on the specific types of hazards will be given in later lectures. The goal here is to just give a brief explanation the connection of each hazard to the solid earth, atmospheric, and hydrologic processes, and man-made sources.

You may add more or change some of the hazards as long as they still fall within geological, hydrometeorological, or man-made hazard.

	NATURAL HAZARDS			MAN-MADE AND TECHNOLOGICAL HAZARDS
DEFINITION	Naturally-occurring physical phenomena caused either by rapid or slow onset events			A hazard originating from technological or industrial conditions, including accidents, dangerous procedures, infrastructure failures, or specific human activities.
	BIOLOGICAL HAZARD	**GEOLOGICAL HAZARD**	**HYDROMETEORO-LOGICAL HAZARD**	
GREEK ETYMOLOGY	("bios" - life)	("ge" - Earth)	("hydor" - water) ("meteoros" - sky)	
DEFINITION (2009 UNISDR Terminology on Disaster Risk Reduction)	Process or phenomenon of organic origin or conveyed by biological vectors/ agents, including exposure to pathogenic micro-organisms, toxins and bioactive substances	Geological process or phenomenon	Process or phenomenon of atmospheric, hydrological or oceanographic nature	
SAMPLE RESPONSES	Natural, usually from living sources	Natural process, originates from the solid earth-geosphere	Natural process, but involved with the atmosphere and/or hydrosphere	Man-made

Teacher Tip:

You may write this down on the board or prepare a poster (cartolina or Manila paper), revealing each level as the discussion flows. You may also choose to use simpler or local terms if the need arises.

There may be several other types of hazards identified by other references, but for this DRRR subject, the focus will be on Geological, hydrometeorological, and fire hazards.

Other definitions of hazards from International Federation of Red Cross (IFRC),:

Natural hazards are naturally occurring physical phenomena caused either by rapid or slow onset events which can be geophysical (earthquakes, landslides, tsunamis and volcanic activity), hydrological (avalanches and floods), climatological (extreme temperatures, drought and wildfires), meteorological (cyclones and storms/wave surges) or biological (disease epidemics and insect/animal plagues). Technological or man-made hazards (complex emergencies/conflicts, famine, displaced populations, industrial accidents and transport accidents) are events that are caused by humans and occur in or close to human settlements. This can include environmental degradation, pollution and accidents. Technological or man-made hazards (complex emergencies/conflicts, famine, displaced populations, industrial accidents and transport accidents)

EXAMPLE	Ebola Virus, flu virus, rabies	Ballistic projectiles (Rocks from an erupting volcano), ground shaking, landslide, lava flow, liquefaction, tsunami	Tornado, flood, typhoon, forest fire, tsunami	Oil and chemical spill, forest fire, industrial pollution

6. Emphasize to the learners that this subject will mostly focus on Geological, Hydrometeorological, and fire hazards.

Activity 2: Identifying Impacts of Hazards (125 mins.)

Role Play

1. This activity is meant for the learners to think independently and their quick analysis on the impacts of certain hazards according to specific locations.

Figure 1. Map of locations and suggested scenarios.

A: Family in concrete house near the highway far from river and mountain

B: Mountain climbers going up the slope

C: Exchange learners in a local family home in the *barrio* near the river

D: Friends in a beach resort

E: Fishermen out on the sea

F: Passengers in a jeep along a road with moderate traffic

Pre-activity (5 mins)

1. Divide the class into 6 groups. Explain to the class that this activity is meant to let them imagine the impacts of certain phenomena (the hazards) on specific settings. Then, assign each group a certain setting (based on the letters above) in the same locality that they must commit to for each hazard.

Additional Definitions:

Biological hazard

Comment: Examples of biological hazards include outbreaks of epidemic diseases, plant or animal contagion, insect or other animal plagues and infestations.

Geological hazard

Comment: Geological hazards include internal earth processes, such as earthquakes, volcanic activity and emissions, and related geophysical processes such as mass movements, landslides, rockslides, surface collapses, and debris or mudflows.

Hydrometeorological factors are important contributors to some of these processes. Tsunamis are difficult to categorize; although they are triggered by undersea earthquakes and other geological events, they are essentially an oceanic process that is manifested as a coastal water-related hazard.

Hydrometeorological hazard

Comment: Hydrometeorological hazards include tropical cyclones (also known as typhoons and hurricanes), thunderstorms, hailstorms, tornados, blizzards, heavy snowfall, avalanches, coastal storm surges, floods including flash floods, drought, heatwaves and cold spells.

Hydrometeorological conditions also can be a factor in other hazards such as landslides, wildland fires, locust plagues, epidemics, and in the transport and dispersal of toxic substances and volcanic eruption material.

2. Explain the guidelines (below) for the activity:
   A. There should be one reporter, who will explain what the group is representing
   B. The rest of the group, actors, will take on roles, whether of living or non-living things. But there should always be at least one human in every situation. For example, they can be all humans, or one human and the rest are either animals, plants, or inanimate objects.
   C. No member is needed to represent the hazard.
   D. The actors must represent what is happening to the living and/or non-living things caught in the given situation. The assumption is that they are unable to avoid the situation.
   E. 5-10 minutes to make a depiction.
   F. The grade will be based on the accuracy of the depiction of possible impacts, not on the acting.
   G. Each group should submit the list of roles to the teacher. This will be used as a guide for grading.
3. Assign the learners to one of the letters assigned above.

During the activity (100 mins)

4. Collect the role sheets of each group.
5. Tell each group to present to the class their role play and explanation in 5 minutes. Ask the scribe to submit to you in a piece of paper the roles that each one will depict.
6. Keep strict time observance.
7. Provide feedback after each, especially pointing out the good aspects, and mentioning aspects they missed. Use the tables below as a guide on most likely depictions.

Additional Definition:

Technological hazard

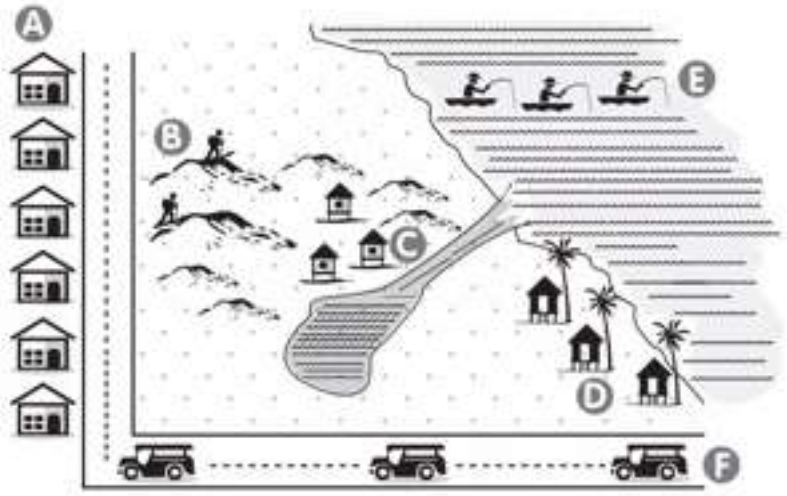
Comment: Examples of technological hazards include industrial pollution, nuclear radiation, toxic wastes, dam failures, transport accidents, factory explosions, fires, and chemical spills. Technological hazards also may arise directly as a result of the impacts of a natural hazard event.

Teacher Tip:

You may provide Figure 1 to the different groups or post it on the board.

You may choose other scenarios that may be more relatable to the learners. The important thing here is to allow the learners to portray the different impacts of common hazards if they experience them in certain locations.

You may have the guidelines prepared to be distributed to each group to save time.



Round 1 (60 mins) Choose one between the two:

A 60-minute class session might end here. Learners can prepare outside of class.

	Typhoon (strong winds and rain)	**Earthquake**
Family in concrete house near the highway far from river and mountain	Relatively safe, but could have a power interruption. If so, fires may arise from use of alternative light sources (e.g. candles).	Ground shaking can cause house to get cracks, falling objects can hurt people. Fire can start.
Mountain climbers going up the slope	Difficulty climbing up, possible landslide	Injuries, death if caught by landslide.
Exchange learners in a local family home in the *barrio* near the river	Flooded. Drowning of non-swimmers, drowning of animals, drowning of crops, destruction of property. Stranded individuals. Illness	Panic, injuries
Friends in an isolated beach	Big waves, cannot swim at beach, possible drowning.	Death from a tsunami may arise if the earthquake is submarine.
Fishermen on the open sea	Very rough sea, possible capsizing, man overboard	May experience very large waves.
Passengers in a jeep along a road with moderate traffic	Wet inside jeep, traffic due to impassable, flooded roads.	Panic, injuries

Round 2 (40 mins)

Following the same instructions as before. These can also be given impromptu. Allow the learners 10 minutes to prepare

	Landslide	**Faulty Electrical Wiring**
Family in concrete house near the highway far from river and mountain	No effect	Fire! Can be controlled
Mountain climbers going up the slope	trapped, caught in debris, death.	No effect
Exchange learners in a local family home in the *barrio* near the river	No effect	Fire! Severe effect if nipa hut.
Friends in an isolated beach	No effect	No to little effect.
Fishermen on the open sea	No effect	No effect
Passengers in a jeep along a road with moderate traffic	No to little effect.	No to little effect.

Note: Expect less time for explanation here. This will allow the learners to see that certain hazards will have no to little impact in certain situations.

Post activity (20 mins)

8. Cold call learners on what they learned from the activities. They may also write about it in their activity notebook.

Guide questions:

a. Are the impacts of each hazard the same?
b. What kinds of hazards affected everyone? What kind of hazards did not?
c. What would you do if you were caught in one of these hazards?

9. Summarize how the impact of certain hazards can differ based on what is exposed to the hazard and where.

ENRICHMENT

Hazards

1. Make the learners think of other specific hazards that would fall under Geological, hydrometeorological, or man-made/technological hazards.
2. Ask the learners which of the hazards are present or could happen in the local community, and which ones are less likely to happen and why.

EVALUATION

For "Act it Out"

ACT IT OUT	4	3	2	1
DEPICTION	All depictions appeared to be accurate and plausible.	Almost all depictions appeared to be accurate and plausible.	Most of the depictions appeared to be accurate and plausible.	Very little of the depictions appeared to be accurate and plausible.
REQUIRED ELEMENTS	Learner included more information than was required.	Learner included all information that was required.	Learner included most information that was required.	Learner included less information than was required.

300 MINS

Introduction to Disaster Concepts

Content Standard
The learners demonstrate understanding of the concept of disaster and disaster risk, and the nature and effects of disasters.

Performance Standard
The learners shall be able to:

- relate the concept of disaster with daily life

Learning Competencies
The learners are able to:

- explain the meaning of disaster (DRR11/12-Ia-b-1)
- differentiate the risk factors underlying disasters (DRR11/12-Ia-b-2)
- describe the effects of disasters on one's life (DRR11/12-Ia-b-3)
- explain how and when an event becomes a disaster (DRR11/12-Ia-b-4)
- analyze disaster from the different perspectives (physical, psychological, socio-cultural, economic, political, and biological) (DRR11/12-Ia-b-6)

Specific Learning Outcomes
At the end of the lesson, the learners will be able to:

- describe a disaster;
- examine events that have led to a disaster; and
- analyze the factors of disaster risk.

LESSON OUTLINE

Introduction	Communicating Learning Objectives	3
Instruction	Understanding Disaster Risk Factors	237
Practice	Simulation	50
Enrichment	Activities and Wrap-Up	10
Enrichment	Hazards	Opt

Materials
Individual: Activity notebook, writing materials

By Group: Manila paper, cartolina, colouring and writing materials, markers, masking tape or pins, World Atlas, map of Southeast Asia and Oceania with scale, a lot of building blocks, several colors but uniform sizes, human figurines or markers, ruler, flat disc about 3-inches in diameter

Resources

(1) United Nations Office for Disaster Risk Reduction. (n.d.). *Terminlogy - unisdr*. Retrieved from https://www.unisdr.org/we/inform/terminology
(2) Rep. Act No. 10121 (2010), Available at http://www.ndrrmc.gov.ph/attachments/article/95/Implementing_Rules_and_Regulartion_RA_10121.pdf
(3) Alliance Development Works. (n.d.). *Worldriskreport: Weltrisikobericht*. Retrieved from http://www.worldriskreport.org/
(4) Dillon, C. (2015). *Exposed: Why vanuatu is the world's most 'at-risk' country for natural hazards*. Retrieved from http://www.dw.com/en/exposed-why-vanuatu-is-the-worlds-most-at-risk-country-for-natural-hazards/a-18319825

Additional Resources at the End of this Lesson

INTRODUCTION (3 MINS)

Communicate Learning Objectives

1. Introduce the following Specific Learning Outcomes using any of the suggested protocols (Verbatim, Own Words, Read-aloud)
   I. I can explain what a disaster is.
   II. I can differentiate factors that put us at risk.
   III. I can explain when a disaster might happen.
2. Review the basic definition of Hazard and Disaster.

   Hazard - A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

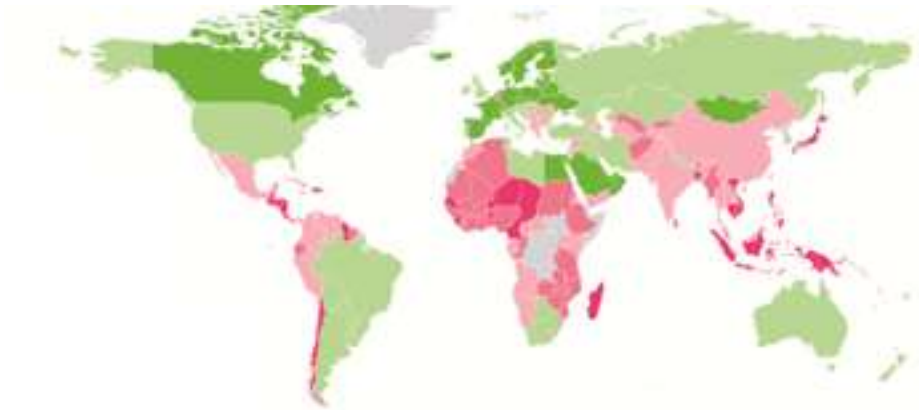
   Disaster - A serious disruption of the functioning of a community or a society involving widespread human, material, economic, or environmental losses and impacts which exceeds the ability of the affected community or society to cope using its own resources.

Teacher Tip:

Risk - the possibility that something bad or unpleasant (such as an injury or a loss) will happen (Merriam-Webster)

INSTRUCTION (237 MINS)

Activity: Understanding Disaster Risk Factors: Part 1 (Building background knowledge protocol)



World Risk Map (Hermes, 2014)

Pre-activity (7 mins)

1. Divide the class into groups of four to five.
2. Provide each group with a set of 4 different colored markers, a piece of chart paper, texts, loose leaf paper, and display a copy of the "mystery map"

During the activity (50 mins) *time is highly flexible here

1. Have participants write down what they think the map is about and draw a line after thoughts are jotted down. (5 mins)
2. Introduce the topic of DISASTER RISK. Ask participants to write what they know about the topic in their journals. (5 mins)
3. Ask participants, in their small groups, to share what they know about the topic. (10 mins)
4. Ask participants to create a web or visualization of their collective knowledge/understanding of the topic on a piece of chart paper using just one of the colored markers. (10 mins)
5. Provide an article or essay on the topic that is interesting, offers a solid introduction to the topic, and provides multiple perspectives. All participants read this article. (15 minutes)

   Suggested article:

   Exposed: Why Vanuatu is the world's most 'at-risk' country for natural hazards (http://www.dw.com/en/exposed-why-vanuatu-is-the-worlds-most-at-risk-country-for-natural-hazards/a-18319825)

6. Ask participants to text code the article with "N" for new information
7. Ask participants to add their new knowledge to their web using a different color of marker. (5 mins)

   Note: *A 60-minute class session will likely end here. The next part (reading) will resume in the next meeting.*

8. Distribute "expert texts": Hand out a different text on the topic to each member of the group. (20 mins)

Teacher Tip:

In showing the mystery map, you can have a large print out, display in the projector, or distribute copies for every individual or pair. Make sure to retrieve the copy at the end of the meeting.

While the learners are sharing, make sure to go around and check on how their discussions are going. Guide learners who seem to struggle with finding meaning behind the texts.

This is a very interactive activity and it aims to embrace the diversity of perspectives needed when understanding disaster risk.

If short on time, the readings can be assigned as homework.

Suggested articles:

(1) State failure as a risk factor – How natural events turn into disasters, World Risk report 2011, p44-47

(2) Environmental degradation as a risk factor (Welle, Beck, and Mucke), Work Risk Report 2012, p28-31

(3) Health and healthcare as risk factors (Michael Marx), World Risk Report 2013, p12-18

(4) Urbanization and risk – challenges and opportunities (Matthias Garschagen), World Risk Report 2014, p12-18

(5) How food insecurity influences disaster risk (Matthias Garschagen), World Risk Report 2015, p19-26

(6) Floods, storms and quakes uproot 22 million in 2013, numbers to rise http://uk.reuters.com/article/2014/09/16/uk-foundation-disasters-displaced-idUKKBN0HB2PC20140916

(7) Cities: Drivers of risk or resilience? http://ehs.unu.edu/blog/opinion/cities-drivers-of-risk-or-resilience.html

Note: *These five are key texts. The other two, and others that the teacher may find in the relevant time, can be added as supplements*

9. After everyone has read, each participant shares new knowledge with his/her group and captures key points on the chart paper using the fourth color. Again, ask participants to text-code for new information. (30 mins)
10. Return to the "mystery map". Re-display the initial map again.Ask participants to go back to where they had initially written about the "mystery map"; have participants note what they now think about the "mystery map". (10 mins)

Note: *A 60-minute class session will likely end here. The next part will resume in the next meeting.*

11. Debrief the experience. Ask the learners to post their charts on the board or wall. Give the learners time to observe everyone's work. (10 mins)

12. Ask for volunteers or cold call learners to share to the class any observations on everyone's output (10 minutes).

I. Guide questions:

A. Are there similarities between each group's work?

B. Are there differences?

C. What factors define disaster risk?

D. What the process was like to read successive, multi-perspective articles.

E. Did they know much about the topic before?

F. Had they been curious about the topic?

G. What inspired their curiosity?

13. Reveal to the learners the complete World Risk Index Map.

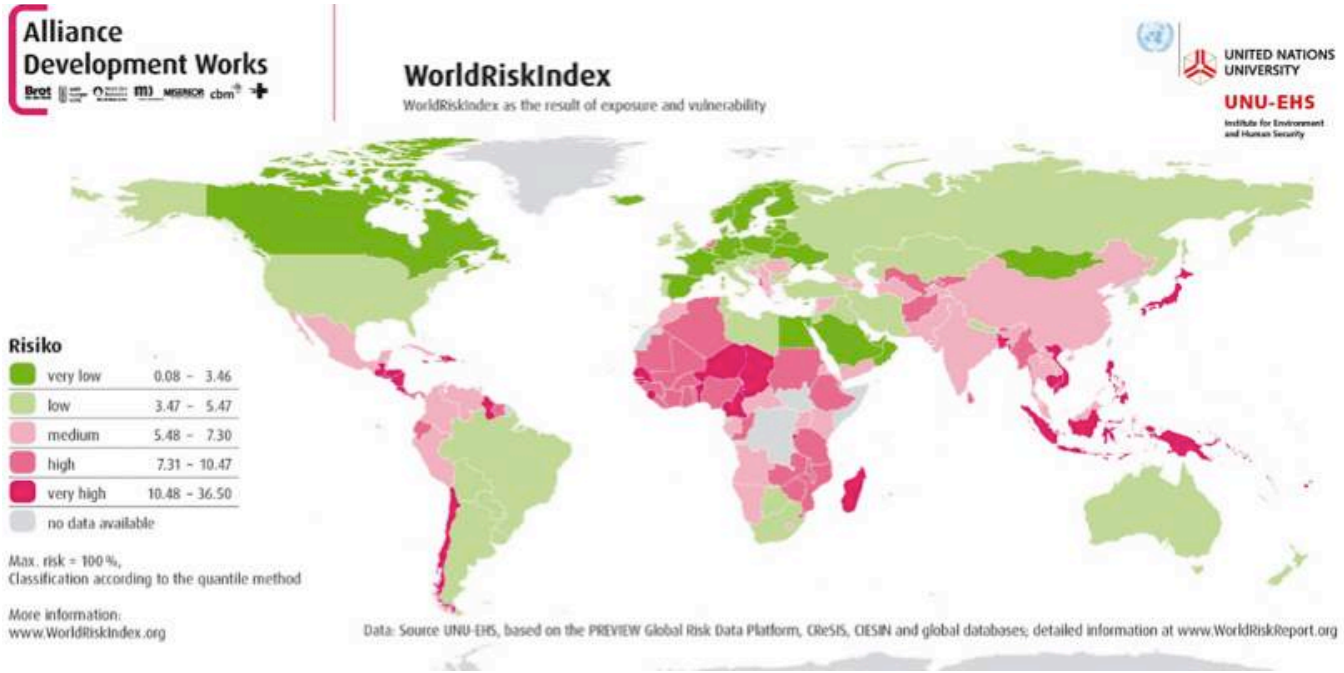


Figure 2: World Risk Map (Hermes, 2014)

Post-activity (40 mins)

1. Discuss the nature of Risk = $\frac{Exposure\ (to\ hazard)\ x\ Vulnerability}{Capacity\ to\ cope}$

When applied to disasters:

Disaster Risk = Exposure to natural or man-made hazards x vulnerability

Summarize with

"Disasters are often described as a result of the combination of:

I. The exposure to a hazard;

II. The conditions of vulnerability that are present, and;

III. Insufficient capacity or measures to reduce or cope with the potential negative consequences."

2. From the discussion, ask the learners to write an essay about how the risk factors concern them personally. They should try to identify

   I. Physical,
   II. Psychological,
   III. Socio-cultural,
   IV. Economic,
   V. Political, and
   VI. Biological risk factors that either affect or not affect them.

3. Assign a group of learners for each category of disaster risk factor.
4. In preparation for presentation for the next meeting, each group should come up with a summary of each category addressing the following key points:
   I. Definition for the category
   II. Examples that of factors that directly affect them and possible effects
   III. Examples of factors that might not necessarily affect them

Teacher Tip:

Numbers 4 and 5 may be done outside of class or as homework, and encourage learners to to research for points that they do not fully understand.

Disaster Risk factors are variables that either aggravate or mitigate the effects of hazards, affecting the degree or scope of a disaster.

(1) Physical factors would pertain to tangible objects or infrastructure, like the availability of fire exits, or the sturdiness of the building, or the presence or absence of objects that can harm you or help you, etc.
(2) Psychological factors include state of mental capacity and health (e.g. are we dealing with babies? Kids? Adults? People with special needs?), perception of self (e.g. self-assessment of capability to respond to disasters, fear), etc.
(3) Socio-cultural factors include religion, social status, traditions, perception by society, etc.
(4) Economic factors include assets and liabilities, income, economic class, etc.
(5) Political factors include government structure, diplomatic issues, etc.
(6) Biological factors include flora and fauna in environment, health, diseases, etc.

IV. Ways to address the factors to be ready for disasters

5. Each group's output should be ready for presentation to the class by putting it on manila paper or cartolina.

   Note: *A 60-minute class session will likely end here. The next part will resume in the next meeting*

6. Each group will present to class their output with a maximum time of 10 minutes each.
7. After presentation, ask the class to prepare materials for the next activity.

   Note: *A 60-minute class session will likely end here. The next part will resume in the next meeting*

PRACTICE (50 MINS)

Simulation: When does an event become a disaster?

Pre-Activity (5 mins.)

1. Materials needed:
   I. World atlas, or map of Southeast Asia and Oceania with scale
   II. A lot of building blocks (e.g. Lego), can be several colors but uniform sizes as much as possible
   III. Human figurines or markers
   IV. Ruler
   V. Flat disc about 3-inches in diameter (e.g. lid, carton cut-out)
   VI. Worksheet/workbook

Teacher Tip:
Numbers 4 and 5 may be done outside of class or as homework, and encourage learners to to research for points that they do not fully understand.

Disaster Risk factors are variables that either aggravate or mitigate the effects of hazards, affecting the degree or scope of a disaster.

(1) Physical factors would pertain to tangible objects or infrastructure, like the availability of fire exits, or the sturdiness of the building, or the presence or absence of objects that can harm you or help you, etc.
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(4) Economic factors include assets and liabilities, income, economic class, etc.
(5) Political factors include government structure, diplomatic issues, etc.
(6) Biological factors include flora and fauna in environment, health, diseases, etc.

RANK	1	2	3
COUNTRY	**VANUATU**	**TONGA**	**PHILIPPINES**
GEOGRAPHY	80+ island nation in the south Pacific Ocean	160+ island nation in the south Pacific Ocean	7,100+ island nation in the west Pacific Ocean
TOTAL AREA (LAND AND WATER)	12,189 sq km	747 sq km	300,000 sq km
POPULATION	272,264 urban population: 26.1%	106,501 urban population: 23.7%	100,998,376 urban population: 44.4%

Table 1: Top 3 Countries in terms of Disaster Risk (Bündnis Entwicklung Hilft, n.d.), Data on geography, area, and population (Central Intelligence Agency, n,d.)

2. Show facts about the countries with the highest risk to disasters:

   Top 3 countries in terms of Disaster Risk, from the World Risk Report 2015 published by BündnisEntwicklungHilft (Alliance Development Works) (http://www.worldriskreport.org/)

   Data on geography, area, and population from CIA The World Fact Book (https://www.cia.gov/library/publications/the-world-factbook/)

During Activity (27 mins.)

1. Ask each group to build a representation of Vanuatu, Tonga, and Philippines using the building blocks in very rough proportion to the given facts, meaning that a country with more islands should be represented by more blocks and the size and distribution by the actual layout of the blocks. The maximum size for the Philippines should fit an A4-sized sheet.Ask them to mark capital areas of each country with a single color block (e.g. red blocks for capital cities and urbanized areas). Allow them to use a world atlas as reference to the geography and size.
2. Let the learners take note of the total number of blocks used. (5 minutes)
3. The flat disk represents a typhoon. The learners will now simulate a scenario where a typhoon ravages each country. To do this, the learners will let the disc pass through each country slowly according to previous typhoons' tracks.

Teacher Tip:

Other items (e.g. rocks, sticks, candy) can be used in lieu of building blocks. The goal of this activity is for the learners to have a tactile appreciation of disaster risk

If creating a layout model for each country based on actual shape is challenging for the learners, you may opt to allow them to have a rectangular (or any regular polygon) layout instead, with the sizes proportional to the relative sizes of the country.

Alternatively, if resources are available, learners may use large drawings or print-outs of each country. The "typhoon" will just have to be larger as well. Computer simulations can also be used if technology is available.

Risk - interaction between exposure to natural hazards including the adverse effects of climate changes and the vulnerability of societies. (World Risk Report)

You may modify the questions to be answered.

A. Vanuatu – Typhoon Pam (2015)

   Global Disaster Alert and Coordination System. (n.d.). Overall red tropical cyclone alert for pam-15in vanuatu from 09 mar 2015 12:00 utcto 15 mar 2015 12:00 utc. Retrieved from http://www.gdacs.org/report.aspx?eventtype=TC&eventid=1000149

B. Tonga – Typhoon Ian (2014)

   European Commission. (n.d.). 13 January 2014: Tonga – Tropical cyclone ian. Retrieved from http://reliefweb.int/sites/reliefweb.int/files/resources/ECDM_20130113_Tonga_IAN.pdf

C. Philippines – Typhoon Yolanda (2013)

   Panahon TV. (n.d.). Fig 1.1 Actual track vs. Forecast track (2pm 07 nov 2013) of typhoon yolanda [Digital image]. Retrieved from http://www.panahon.tv/blog/wp-content/uploads/2014/11/actua_forecast_track.png

Post Activity (20 mins.)

1. Before and while doing the simulation, ask the learners to answer the following questions in their activity notebook:
   I. What are the assumptions made by doing this simulation compared to reality?
   II. What is exposure? After the simulated typhoon, how many percent of each country was impacted by the hazard?
   III. How would you compare the simulated effects of typhoons for each of the country models? What are the similarities? What are the differences?
   IV. How do these scenarios reflect actual disaster risk? What is vulnerability and are or are not included?

ENRICHMENT (10 MINS)

Wrap-Up

1. Cold call learners to explain the concept of disasters and disaster risk.

   Guide points:
   I. The equation for risk.
   II. The complexity of evaluating disaster risk
   III. Addressing issues one at a times vs all at the same time
   IV. The relevance of this subject

Activities

1. Instead of an essay at Instruction, you may have the learners get creative and make a sketch, artwork, a song, or other creative output.
2. From the results of the simulation, ask the learners to compare the impact measured from the impact of the actual events, based on the percent of the population affected. This comparison will allow the learners to identify factors (specifically vulnerability) that cannot be completely simulated in the building block set-up.
3. Aside from the building blocks, you may add human figurines or representations in the countries of services important in disaster response (doctors, government officials/decision makers, teachers, etc.). These can be used to indicate factors that improve the analysis of risk from a vulnerability stand point. For example, in countries with more doctors and not all of them are exposed to a hazard, the vulnerability is lessened as there is a better response to medical needs. To simulate this, the learners may put doctors in each urbanized area and see how the simulation will go.

EVALUATION

	4	3	2	1
COMPREHENSIVE-NESS OF THE CHART	The chart shows more than 10 key points and shows relationships between them.	The chart shows 5-10 key points and shows relationships between them.	The chart shows 1-5 key points only.	The learners were not able to identify key points.
PRESENTATION ON DISASTER RISK FACTORS	The group was able to discuss 5 disaster risk factors that either affect them or not and gave a clear definition.	The group was able to discuss 3-4 disaster risk factors with a clear definition.	The group was able to provide touch on only 1-2 examples of disaster risk factors but lacks a clear definition.	The group did not address the topic.
DISASTER SIMULATION	The learners made a complete model and typhoon track was accurate; simulation was well organized.	The learners made a complete model and typhoon track was accurate.	The learners made part of the model as instructed, but lacks consideration for aspects like scale and geography.	The learners were not able to create a model.
ANSWERS TO QUESTIONS	Learner answered questions and was able to define exposure and vulnerability and cite examples.	Learner answered questions and was able to define exposure and vulnerability.	Learner answered questions, but was not able to define factors of exposure and/or vulnerability.	Learner did not answer questions.

Additional Resources:

(1) Central Intelligence Agency. (n.d.). *The world factbook*. Retrieved from https://www.cia.gov/library/publications/the-world-factbook/

(2) Bündnis Entwicklung Hilft. (2011). State failure as a risk factor – How natural events turn into disasters. In Author, *Worldriskreport 2011*. Retrieved from http://www.worldriskreport.org/fileadmin/PDF/2011/WorldRiskReport-2011_online_EN.pdf

(3) Welle, T., Beck M. W., and Mucke P. (2012). Environmental degradation as a risk factor, in Alliance Development Works, *Worldriskreport 2012*. Retrieved from http://www.worldriskreport.org/fileadmin/PDF/2012/WRR_2012_en_online.pdf

(4) Marx, M. (2013). Health and healthcare as risk factors, in Alliance Development Works, *Worldriskreport 2013*. Retrieved from http://www.worldriskreport.org/fileadmin/PDF/2013/WorldRiskReport_2013_online.pdf

(5) Garschagen, M. (2014). Urbanization and risk – challenges and opportunities, in Alliance Development Works, *Worldriskreport 2014*. Retrieved from http://www.worldriskreport.org/fileadmin/PDF/2014/WorldRiskReport_2014_online.pdf

(6) Garschagen, M. (2015). How food insecurity influences disaster risk, in Bündnis Entwicklung Hilft, *Worldriskreport 2015*. Retrieved from http://www.worldriskreport.org/fileadmin/PDF/2015/WRR_2015_engl_online.pdf

(7) Onita, L. (2014). *Floods, storms and quakes uproot 22 million in 2013, numbers to rise*. Retrieved from http://uk.reuters.com/article/uk-foundation-disasters-displaced-idUKKBN0HB2PC20140916

(8) Garschagen, M. (2015). *Cities: Drivers of risk or resilience?* Retrieved from http://ehs.unu.edu/blog/opinion/cities-drivers-of-risk-or-resilience.html

(9) Global Disaster Alert and Coordination System. (n.d.). Overall red tropical cyclone alert for pam-15in vanuatu from 09 mar 2015 12:00 utcto 15 mar 2015 12:00 utc. Retrieved from http://www.gdacs.org/report.aspx?eventtype=TC&eventid=1000149

(10) European Commission. (n.d.). *13 January 2014: Tonga – Tropical cyclone ian*. Retrieved from http://reliefweb.int/sites/reliefweb.int/files/resources/ECDM_20130113_Tonga_IAN.pdf

(11) Panahon TV. (n.d.). *Fig 1.1 Actual track vs. Forecast track (2pm 07 nov 2013) of typhoon yolanda* [Digital image]. Retrieved from http://www.panahon.tv/blog/wp-content/uploads/2014/11/actua_forecast_track.png

(12) Bündnis Entwicklung Hilft. (2015). *Worldriskreport 2015*. Retrieved from http://www.worldriskreport.org/fileadmin/PDF/2015/WRR_2015_engl_online.pdf

(13) Merriam-Webster. (n.d.). *Risk*. Retrieved from

(14) http://www.merriam-webster.com/dictionary/risk

(15) Hermes, E. (2014). *World risk map* [Digital image].

120 MINS

Identifying Classroom Hazards that can Lead to Disasters

Content Standard
The learners demonstrate understanding of the concept of disaster and disaster risk, and the nature and effects of disasters.

Performance Standard
The learners shall be able to:

- relate the concept of disaster with daily life.

Learning Competencies
The learners are able to:

- describe the effects of disasters on one's life (DRR11/12-Ia-b-3)
- identify areas/locations exposed to hazards that may lead to disasters (DRR11/12-Ia-b-5)

Specific Learning Outcomes
At the end of the lesson, the learners will be able to:

- identify safe and dangerous areas in terms of disasters; and
- describe these potential disasters.

LESSON OUTLINE

Introduction	Communicating Learning Objectives	5
Practice	Classroom Hazard Mapping	105
Enrichment	Activities and Wrap-Up	10

Materials
Any existing hazard map (e.g. DENR-MGB Flood and Landslide Hazard Map)

Individual: Activity notebook or sheet of paper, writing materials

Br group: Manila paper or cartolina, colouring and writing materials, markers, masking tape or pins

Resources
(1) United Nations Office for Disaster Risk Reduction. (n.d.). *Terminlogy - UNISDR*. Retrieved from https://www.unisdr.org/we/inform/terminology

(2) Rep. Act No. 10121 (2010), Available at http://www.ndrrmc.gov.ph/attachments/article/95/Implementing_Rules_and_Regulartion_RA_10121.pdf

INTRODUCTION (5 MINS)

Communicate Learning Objectives

1. Introduce the following Specific Learning Outcomes using any of the suggested protocols (Verbatim, Own Words, Read-aloud):
   I. I will be able to Identify safe and dangerous areas in terms of disasters.
   II. I will be able to describe these potential disasters.

2. Review the basic definition of Hazard and Disaster.

   Hazard - A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

   Disaster - A serious disruption of the functioning of a community or a society involving widespread human, material, economic, or environmental losses and impacts which exceeds the ability of the affected community or society to cope using its own resources.

3. Have them define in their own words, English, Filipino, and local dialect (if applicable).

Definitions:

You can bring a newspaper article that describes a historical disastrous event if you anticipate that the learners might not be aware about disasters in the Philippines.

HAZARD

UNISDR (2009) (adapted by Philippines DRR Law, 2010):

A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

Comment: The hazards of concern to disaster risk reduction as stated in footnote 3 of the Hyogo Framework are "… hazards of natural origin and related environmental and technological hazards and risks." Such hazards arise from a variety of geological, meteorological, hydrological, oceanic, biological, and technological sources, sometimes acting in combination. In technical settings, hazards are described quantitatively by the likely frequency of occurrence of different intensities for different areas, as determined from historical data or scientific analysis.

DISASTER

UNISDR (2009) (adapted by Philippines DRR Law, 2010):
A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources.

PRACTICE (105 MINS)

Activity: Creating a Classroom Hazard Map

Overview: The learners will identify hazards in the classroom

Pre-Activity (15 mins)

1. Individually, ask the learners to get out a piece of paper or their assigned activity notebook for writing.
2. Ask the learners to list 10 hazards in the classroom. Their answers should be specific to certain locations in the classroom (e.g. the shelf at the corner near the door can fall on someone). (5 minutes)

Group Discussion (10 minutes)

1. Group the learners into teams of five to discuss their list of hazards.
2. One will act as group Facilitator to guide the discussion.
3. Two will report the group output to the class (the Reporters).
4. Two will take note of the discussions in the group and the reporting (the Scribes).
5. The groups should come up with a consensus of the hazards, and how it could lead to a disaster (the impact), that everyone has identified.

During the Activity (40 mins)

1. Each group should have:
   I. A sheet of manila paper or cartolina
   II. Coloring materials
2. Learners are to create a "Classroom Hazard Map" based on their discussion. The maps should be easy to follow and understand and still roughly to scale.
3. Potential hazards should be colored in red and labeled properly. Possible impacts of these hazards should be noted by the scribe and reporters.
4. Safe areas and paths should be colored blue.

Continuation (for Introduction)

Comment: Disasters are often described as a result of the combination of: the exposure to a hazard; the conditions of vulnerability that are present; and insufficient capacity or measures to reduce or cope with the potential negative consequences. Disaster impacts may include loss of life, injury, disease and other negative effects on human physical, mental and social well-being, together with damage to property, destruction of assets, loss of services, social and economic disruption and environmental degradation.

5. Works will be graded by the teacher based on this rubric:

	4	3	2	1
COMPREHENSIVE-NESS OF THE MAP	The map shows 5-7 potential hazards correctly and potential disasters were described. The map shows all safe spaces and the path going out of the room.	The map shows 5-7 potential hazards correctly and potential disasters were described. The map shows most safe spaces.	The map shows 1-4 hazards only. The map shows 1-2 safe spaces.	Map does not show hazards. Does not show safe spaces.
ROLES AND TEAMWORK	Not Applicable	All the members of the group accomplished their roles well and were active during discussion.	Members of the group know their roles but discussion was not very active.	Learners do not know their roles and has no cooperation.

Note: *A 60-minute class session will likely end here. The next part (reading) will resume in the next meeting.*

Teacher tips:

Learners should be able to use the definition of "hazard" when creating and discussing their list. To ensure this, make sure to go around each group and guide their discussion. Common answers would be falling books and furniture, glass breaking, collapsing structures, etc.

The number of hazards required to be identified in the classroom may be adjusted depending on the room. The rubric may then be adjusted proportionally. But in most cases, limiting the responses to 10 will allow the learners to have more unique answers than with their other classmates, allowing for livelier discussions.

Depending on the size and arrangement of the classroom, you may ask different groups of learners to go to other rooms (e.g. library, offices, canteen) or in the school grounds, or assign them to specific parts of the classroom.

Colors for potential hazards and safe areas may be different depending on availability of materials.

Post-activity (55 mins)

1. Each group will post their map in a designated area in the classroom using masking tape. Reporters must be by their map at all times.
2. The rest of the group will go around and listen to the reports of the other groups. They are encouraged to ask questions and make constructive reviews of their classmates' works.
3. The scribe of each group should take note of potential hazards they might have missed.
4. When everyone is done, debrief the activity.

Guide questions:

I. What will you do should an earthquake happen?

II. What can be done to prevent a disaster in the classroom?

ENRICHMENT (10 MINS)

Wrap-Up (5 mins.)

1. Ask: will a hazard always cause a disaster?

   Sample situation: There is a volcano in the middle of an uninhabited desert. What is the hazard? Will there be a human disaster if the volcano erupts?

Activities

1. The Classroom Hazard maps may be used by the class for the whole year. Learners can recreate their work using digital media, if possible.
2. You can introduce a long-term project where in the learners will identify hazards and create a hazard map of their home, their classroom, the school, or a place that they frequent. As the course continues, the learner may improve their map, and develop disaster mitigation plans.

120 MINS

Potential Earthquake Hazards and their Effects

Content Standard
The learners demonstrate understanding of potential earthquake hazards

Performance Standard
The learners shall be able to:

- develop a family emergency preparedness plan to guide them on what to do before, during, and after an earthquake

Learning Competencies
The learners are able to:

- identify various potential earthquake hazards (DRR11/12-If-g-17)
- analyze the effects of the different earthquake hazards (DRR11/12-If-g-19)

Specific Learning Outcome
At the end of the lesson, the learners will be able to:

- explain the different potential earthquake hazards

LESSON OUTLINE

Before the Lesson	Learner and Teacher Preparation	
Introduction	Communicating Learning Objectives	10
Motivation	Sharing of Stories	10
Practice	Activity	80
Enrichment	Reflection Questions	20

Materials
Jelly, large pan with sand and water and brick
Manila paper, markers, papers cut into metacards

Resources

(1) Philippine Institute of Volcanology and Seismology. (2008).
(2) PHIVOLCS Earthquake Monitoring. Retrieved from http://www.phivolcs.dost.gov.ph/index.php?option=com_content&view=article&id=38&Itemid=75
(3) Philippine Institute of Volcanology and Seismology. (2013). Bohol Earthquake 2013. http://www.phivolcs.dost.gov.ph/index.php?option=com_phocadownload&view=category&id=37:earthquake&Itemid=44
(4) Philippine Institute of Volcanology and Seismology. (2005). Ang Lindol at mga panganib na dulot nito [Flyer]. Retrieved from http://www.phivolcs.dost.gov.ph/images/IEC/lindol_panganib.pdf
(5) Philippine Institute of Volcanology and Seismology. (2006). Earthquake and Earthquake Hazards [Flyer]. Retrieved from http://www.phivolcs.dost.gov.ph/images/IEC/earthquake_hazards.pdf
(6) PHIVOLCS 200x. Earthquake hazards poster (link to be provided later)
(7) Incorporated Research Institutions for Seismology. (2014). Liquefaction during the 1906 San Francisco Earthquake. Retrieved from http://www.iris.edu/hq/inclass/animation/liquefaction_during_the_1906_san_francisco_earthquake
(8) Alexandra Kowalyk. (2009, November 24). Liquefaction [Video file]. Retrieved from https://www.youtube.com/watch?v=PwvvYxSZ7PI
(9) Philippine Institute of Volcanology and Seismology. (2011). Tsunami Preparedness [Flyer]. Retrieved from http://www.phivolcs.dost.gov.ph/index.php?option=com_phocadownload&view=category&id=17:tsunami-flyer&Itemid=44

BEFORE THE LESSON

Task for Learners:

1. As introduction/ preparation to this lesson, give out as assignment to learners at least a week before, any of the following, whichever is appropriate:
   I. (For areas where learners have internet access) Search the internet for any article/ material about a major earthquake occurrence. Better if the earthquake that occurred affected the local area. Submit a 1-page report describing this event (When, What happened, Effects to people and surroundings). Download photos of impacts/effects/damages and include in your report.
   II. (For areas with no access to internet). Interview your grandparents, parents, uncles/aunts, older brother/sister, neighbor who have experienced earthquake in the past. Ask the following questions: a. When did this earthquake occur (Month/Year if possible). b. Can you describe what you felt during the earthquake, what you did, and what were the effects that you saw after the earthquake. If no adult in the household ever personally experienced an earthquake, ask the adult if he/she can recall an earthquake event in other places. Submit a 1-page written report of their story/ narratives.

Task for Teacher:

1. Search the internet and download photographs of impacts/effects of earthquakes. Print some of these photos in page—size papers or bigger.

INTRODUCTION (10 MINS)

Communicate Learning Objectives (5 mins)

1. Identify the possible different effects from a major earthquake
2. Relate the different effects with associated earthquake hazards
3. Identify and explain the different earthquake-related hazards that can affect my home and community

Review (5 mins)

1. Ask the class what they think of when they hear the word earthquake. Write these on the board. Sample responses: *Shaking, damages- collapse of building, injuries, deaths,*

Teacher Tip.
This part is a review of JHS topics on earth science.

2. Define what an earthquake is.

   *Answer. An **earthquake** is a feeble shaking to violent trembling of the ground produced by the sudden displacement of rocks or rock materials below the earth's surface. There are two types of earthquakes: tectonic and volcanic earthquakes. **Tectonic earthquakes** are those generated by the sudden displacement along faults in the solid and rigid layer of the earth. Earthquakes induced by rising lava or magma beneath active volcanoes are called **volcanic earthquakes**.*
   This lesson will focus on tectonic earthquakes

3. Define what a fault is.

   *Answer. **Fault-** refers to a fracture, fissure or a zone of weakness where movement or displacement has occurred or may occur again; a fault is said to be "**active fault**" if it has historical and contemporary seismicity, has evidence of fault slip based on displaced rocks or soil units of known age and displaced landforms; an **active fault** is defined as a fault which has moved within the last 10,000 years*

4. Ask the class what is the meaning of hazard to them.

   Answer. A dangerous phenomenon (substance or human activity) that may cause loss of life, injury or other health impacts, property damage, loss of livelihood and services, social and economic disruption or environmental damage

MOTIVATION (10 MINS)

Sharing of Stories

1. Based on learners' answers on the assignment, ask the learners to name earthquake events that they were able to research on – whether by internet or interviews.
2. Write the answers on the board for reference of learners for later discussion.
3. Why are these earthquake events remembered? (Possible Answers: Because of its impacts, the damages, the deaths and injuries, it directly affected learner, affected relatives, etc)

Teacher Tip.
Answers will depend on location
Possible answers:

Local events: 16 July 1990 Luzon Earthquake, 1976 Moro Gulf Earthquake, 2013 Bohol Earthquake, 2012 Negros Earthquake, E Samar Earthquake, etc

International events: 2010 Chile Earthquake, 2011 March Eastern Japan Earthquake, 2004 Banda Aceh, Indonesia Earthquake, 2015 Nepal earthquake; Several China earthquakes (note need to search..)

PRACTICE (80 MINS)

Lecture Part

1. Post some photos of impacts of earthquake on the board.
2. Discuss the 5 different earthquake-related hazards using the photos.
3. Hazards are events or phenomena that may cause loss of life, injury or other health impacts, property damage, loss of livelihood and services, social and economic disruption or environmental damage. The following are the most common earthquake-related hazards: ground rupture, ground shaking, liquefaction, tsunami, and earthquake-induced landslides.

I. **Ground shaking**- disruptive up-down and sideways movement or motion experienced during an earthquake.

A. Strong ground shaking can cause objects to fall, break windows among others.

B. Strong ground shaking can also result to minor damages to buildings and worse, cause collapse of a structure. (e.g. collapse of Hyatt Hotel, Baguio City after the 16 July 1990 Luzon Earthquake).

C. Most part of the Philippines will experience shaking at different degrees depending on magnitude of earthquake, distance of one's location from the fault that moved, local below surface conditions, etc)

A. *Demonstrate ground shaking using jelly. You need to prepare the jelly the night before the activity so that it is fully set when learners begin the activity. Pour the jelly into eight 8½-inch square pans to be shared by 3 groups (divide jelly into 3) or in one large pan for the entire class to share*

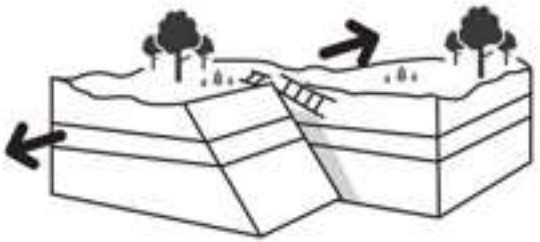
B. Ask the learners what they observe.

Note: *The discussion on ntensity will be linked later on the hazard maps topic.*

II. **Ground rupture-** displacement on the ground due to movement of fault .

A. This will be experienced by areas where fault passes through (note not all cracks on the ground that people see after a strong earthquake are faults, some may just be surficial cracks because of ground failure)

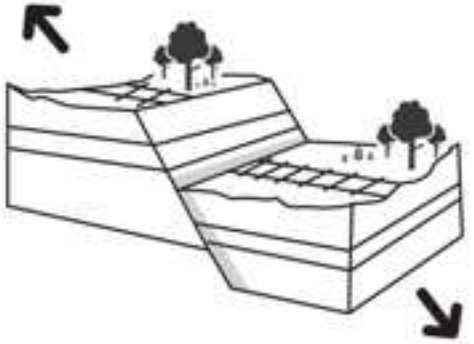
B. The movement may have vertical and horizontal component and may be as small as less than 0.5 meters (Masbate 1994 earthquake) to as big as 6 meters (16 July 1990 Earthquake).



III. **Tsunami-** sea waves resulting from the disturbance of ocean floor by an earthquake

A. This is a series of giant sea waves commonly generated by under-the-sea earthquakes and whose heights could be greater than 5 meters.

B. Examples of recent tsunami events in the Philippines are the August 1976 Moro Gulf Earthquake and Tsunami and the November 1994 Oriental Mindoro Earthquake and Tsunami, December 2004 Banda Aceh Earthquake (Indonesia), and March 2011 Eastern Japan http://www.phivolcs.dost.gov.ph/index.php?option=com_phocadownload&view=category&id=17:tsunami-flyer&Itemid=44 (Tsunami Flyer, English)28 August 2015

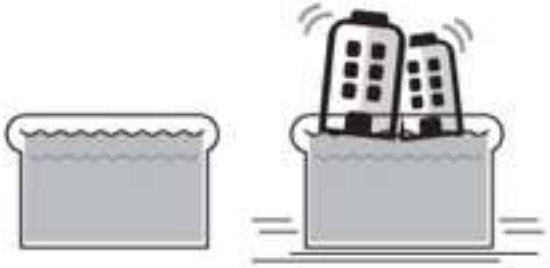


IV. **Liquefaction-** is a process that transforms the behavior of a body of sediments from that of a solid to that of a liquid when subjected to extremely intense shaking.

A. As a result, any heavy load on top of the sediment body will either sink or tilt as the sediment could no longer hold the load, such as what happened in Dagupan City during the 16 July 199 earthquake. (e.g. San Francisco 1906: http://www.iris.edu/hq/inclass/animation/liquefaction_during_the_1906_san_francisco_earthquake)

B. Demonstrate liquefaction using a pan, put sand to fill up to half the height of pan slowly pour water to into it half level of sand. Put a heavy object (brick, etc) on top. Shake the pan. The brick/ heavy object should tilt.

C. Ask the learners, what can you observe?



V. **Earthquake-induced landslide**- failures in steep or hilly slopes triggered by an earthquake

A. • loose thin soil covering on the slopes of steep mountains are prone to mass movement, especially when shaken during an earthquake.

B. • Many landslides occur as a result of strong ground shaking such as those observed on the mountainsides along the National Highway in Nueva Ecija and the road leading up to Baguio City during the 16 July 1990 earthquake.

4. Prepare this template on a large manila paper, put enough space for learners to put their metacards and provide for each group.

GROUP	GROUND RAPTURE	LIQUEFACTION	EARTHQUAKE-INDUCED LANDSLIDE	TSUNAMI
Name of Learner				
Name of Learner				
Name of Learner				

PART 2. Group Activity (40 mins)

Pre-Activity (5 mins)

1. Divide the class into 3 groups. For each group, learners should identify 1 **Facilitator** to lead the discussion, 1 person to act as **Secretary** to write the final answers, another person as **Reporter** to discuss the results of group discussion. All learners should write the identified impacts on the metacards. And there should be group discussion.

During Activity (15 mins)

1. Ask the learners to share their assignment about stories of past earthquake events with their group.
2. Let them write on metacards specific impacts or effects that they gathered based on descriptions from stories they downloaded or from descriptions of the adults that they interviewed. Ask them to write as many as they can identify (at least 10, can be more).
3. Ask the learners to classify these, can they identify under which of the 5 hazards do these impacts fall? (example: shelves and cabinets that toppled down, building collapse, building damage- are due to ground shaking; buildings that tilt/ experience some form of subsidence/ sinking after an earthquake is a result of liquefaction); Post answers under appropriate columns.

Post-Activity (20 mins)

1. Post the manila paper as accomplished by each group. Give learners 5 minutes per group to explain their answer. *(15 minutes)*
2. Discuss the answers, summarize for the learners *(5 minutes)*

ENRICHMENT (30 MINS)

Reflection Questions

1. Reinforce, reiterate where / in which environment each of the hazard is experienced or is more prominent.
2. Ask the learners, based on what they have learned so far, think of their home, what are the possible impacts/ effects of the 5 earthquake hazards to their home/s?
3. Ask the learners to write this checklist in their notebook:

What are the potential hazards that can affect me, my home and my community. How?

Will I be affected by (check all the will apply)

I. Ground Rupture (only if a fault passes through my home) (Note: This will be important for areas with known presence of faults)
II. Ground shaking: Yes
III. Liquefaction (Note, only for areas near rivers, coastal areas, underlain by soft sediments or water-saturated materials)
IV. Earthquake-induced landslide (if my home is near/ at the base or on the slope of a mountain side)
V. Tsunami (if my home is near the coast)

Those I have checked are the hazards I need to prepare for.

Note: *This part shall be linked with* ***DRR11/12-If-g-20****- Different earthquake hazards maps-activity will validate answers to this enrichment section.*

EVALUATION

	4	3	2	1
SUMMARY TABLE OF HAZARDS AND IMPACTS	The table shows 80-100% of impacts identified were correctly placed under associated hazard	The table shows 50-70% of impacts identified were correctly placed under associated hazard	The table shows 10-40% of impacts identified were correctly placed under associated hazard	The table does not show any of the impacts were correctly placed under the associated hazard
COOPERATION AMONG MEMBERS	The Facilitator was able to lead the discussion well, the Reporter was able to clearly present the summary of the group's output within the given time.	The Facilitator, Secretary, Reporter and the rest of the members were able to help each other and were able to come up with a comprehensive output.	The learners know their roles but were not actively portraying their responsibilities the entire time	The learners do not know their roles and the discussion was not properly facilitated among the learners

Disaster Readiness and Risk Reduction

60 MINS

Tsunami Signs

Content Standard
The learners demonstrate understanding of potential earthquake hazards.

Performance Standard
The learners shall be able to:

- develop a family emergency preparedness plan to guide them on what to do before, during, and after an earthquake

Learning CompetencY
The learners are able to:

- recognize the natural signs of an impending tsunami (**DRR11/12-If-g-18**)

Specific Learning Outcome
At the end of the lesson, the learners will be able to:

- explain the three (3) important natural signs of an impending tsunami

LESSON OUTLINE

Before the Lesson	Task for Learners and Teackers	
Introduction	Communicating Learning Objectives	5
Motivation	Sharing of Stories	5
Practice	Activity	40
Evaluation	Quiz and Reflection Questions	10

Materials
Manila paper, permanent markers

Resources

(1) 1976 Moro Gulf Earthquake (n.d.). Retrieved from http://202.90.128.66/1976MoroGulfEQ/index-moro.html

(2) Buck, P. S. (n.d.). *The big wave*. Retrieved from http://www.nplainfield.org/cms/lib5/NJ01000402/Centricity/Domain/873/bigwave%20entire%20text.pdf

(3) Caribbean Disaster Emergency Management Agency. (2010). *Tsunami smart teacher education resource kit.* Retrieved from http://www.uwiseismic.com/downloads/tchws_pae_teacherresourcekit_final.pdf

(4) International Tsunami Information Center. (2010). *Where the first wave arrives in minutes: Indonesians lessons on surviving tsunamis near their sources.* Retrieved from http://itic.ioc-unesco.org/images/docs/where_the_first_wave_arrives_in_minutes_sml.pdf

(5) International Tsunami Information Center. (2013). *Tsunami glossary.* Retrieved from http://itic.ioc-unesco.org/index.php?option=com_content&view=article&id=1328&Itemid=1142&lang=en

Additional Resources at the End of this Lesson

BEFORE THE LESSON

Task for Learners:

1. As introduction/ preparation to this lesson, give out as assignment to learners at least a week before, any of the following, whichever is appropriate:
    I. **Research Activity/Assignment.** Search the internet for any article/ material about a major earthquake worldwide and local. Better if the earthquake that occurred affected the local area. Submit a 1-page report describing this event (When, What happened, Effects to people and surroundings). Download photos of impacts/effects/damages and include in your report. Write and submit report.

Task for Teacher:

1. Search the internet and download resources.

INTRODUCTION (5 MINS)

Communicate Learning Objectives (5 mins)

1. Identify the 3 natural signs of an impending tsunami.
2. Discuss how one may prepare and protect oneself in case of a tsunami –generating earthquake.

Review (5 mins)

1. Ask the class what they remember about the major hazards related with earthquake event.
2. Define what a tsunami is (see Teacher Tip)

    *Answer. A **tsunami** is a series of giant sea waves commonly generated by under-the-sea earthquakes and whose heights could be greater than 5 meters.*

Teacher Tip:
This part is a review of previous meeting's lesson on earthquake hazards (DRR11/12-If-g-17 and 12-If-g-19)

MOTIVATION (10 MINS)

Sharing of Stories

1. Show a map of the Philippines with plots of historical tsunamis.
2. You may state:

    This is a map of the Philippines showing locations of most destructive tsunami events recorded in Philippine history. We had around 90 destructive earthquakes, around 40 tsunamis for past 400 years, and our coastal areas at eastern and western margins fronting major seas and inland seas have been affected by tsunamis.

3. Based on learners' answers on the assignment, ask the learners to share tsunami stories that they were able to research on.
4. Write the answers on the board for reference of learners for later discussion.

YEAR or DATE	LOCATION OF EVENT	MAJOR IMPACTS	LOCAL or INTERNATIONAL

Possible Answers
Local events: 1976 Moro Gulf Earthquake, 1994 Mindoro Earthquake and Tsunami

International events: 1960 Chile event 2010 Chile Earthquake, 2011 March Eastern Japan Earthquake, 2004 Banda Aceh, Indonesia Earthquake,

PRACTICE (80 MINS)

PART 1: Teacher to Discuss as Introduction (10 mins)

1. **Tsunami-** sea waves resulting from the disturbance of ocean floor by an earthquake; is a series of giant sea waves commonly generated by under-the-sea earthquakes and whose heights could be greater than 5 meters.

2. **Tsunami vs Storm surge**. A tsunami is a Japanese word meaning "*harbor waves*". A tsunami is commonly generated by disturbances associated with earthquakes occurring below or near the ocean floor. It occurs when the earthquake is shallow-seated and strong enough to displace parts of the seabed and disturb the mass of water over it. In addition, underwater volcanic eruptions and landslides can also generate a tsunami.

   Sometimes, tsunamis are erroneously called **"tidal waves"**. Remember that tsunamis are generated by earthquakes and tsunami waves are generated because of movement of fault under the sea. Tsunamis have nothing to do with high tide and low tide which is caused by the gravitational pull between the earth and moon. The increase in wave heights associated or during typhoons (when there are strong winds) or tropical cyclones are called "storm surges".

Storm surges (wind-generated waves on the surface of the sea) are not tsunamis (undersea earthquake-generated) (from PHIVOLCS, 2008, Training Module School Teachers' Seminar-Training on Natural Hazards Awareness and Preparedness Focus on Earthquakes and Volcanoes)

3. **Two kinds of Tsunami.** There are two types of tsunami generation: ***(1)*** *local tsunami* ***(2)*** *and far field or distant tsunami*. The coastal areas in the Philippines especially those facing the Pacific Ocean, South China Sea, Sulu Sea and Celebes Sea can be affected by tsunamis that may be generated by local earthquakes.

Local tsunamis are confined to coasts within a hundred kilometers of the source usually earthquakes and a landslide or a pyroclastic flow. It can reach the shoreline within 2 to 5 minutes.

Far field or distant tsunamis can travel from 1 to 24 hours before reaching the coast of the nearby countries. These tsunamis mainly coming from the countries bordering Pacific Ocean like Chile (1960 2010, 2015), Alaska in USA and Japan (2011). PTWC (Pacific Tsunami Warning Center) and NWPTAC (Northwest Pacific Tsunami Advisory Center) are the responsible agencies that closely monitor Pacific-wide tsunami event and send tsunami warning to the countries around the Pacific Ocean. (from PHIVOLCS, 2008, Training Module School Teachers' Seminar-Training on Natural Hazards Awareness and Preparedness Focus on Earthquakes and Volcanoes)

4. **Local tsunami**. Discuss Examples of recent tsunami events in the Philippines are the August 1976 Moro Gulf Earthquake and Tsunami and the November 1994 Oriental Mindoro Earthquake and Tsunami, December 2004 Banda Aceh Earthquake (Indonesia), and March 2011 Eastern Japan http://www.phivolcs.dost.gov.ph/index.php?option=com_phocadownload&view=category&id=17:tsunami-flyer&Itemid=44 (Tsunami Flyer, English) 28 August 2015, The natural signs of impending tsunami using the reading materials.

PART 2. GROUP LEARNING ACTIVITY: READING and DISCUSSION SESSION (30 MINS)

1. Divide the class into 3 groups . 1 answer sheet per group. Analyze reading materials to be discussed in class. (Distribute the 3 reading materials).
2. Give the learners 5 mins to read the assigned material, and another 5 minutes to discuss. The group should answer this question:

   Can you recognize what sign was observed by the main narrator of the story?

READING No. 1 ("Warnings of a Tsunami Underway" from "Where the First Wave Arrives in Minutes" (2010), UNESCO

1. Ask a volunteer learner from group 1 to read this first material.
2. From the reading ask learners to write what they think were the signs mentioned in the text.

   Answer: 1. Strong shaking, Earthquake

READING NO. 2 ("The Sea May Withdraw Shortly Before it Attacks" from Yulianto and Others, 2010. from "Where the First Waves Arrive in Minutes, UNESCO)

1. Ask another learner volunteer from group 2 to read this material.
2. According to the story, as soon as the strong shaking or earthquake stopped, what did the man observe?
   I. This reading highlights the sign that there might be observed changes in the sea level. This time it is more specific and states "the sea may withdraw before it attacks"
   II. Ask the learners to write in their answer sheet the 2nd sign
3. So, now, we have 2 signs:
   I. Strong earthquake and
   II. Sea will withdraw. Rapid lowering of sea level or noticeable rise and fall of coastal water

READING NO. 3. ("The Sea May Boom" from Yulianto (2010). Where the First Wave Arrives in Minutes)

1. Ask a volunteer from group 3 to read this last material. To those who grew up and lived by the sea, they know the normal sound of the sea.

2. According to the reading material, under a different situation such as a strong earthquake, and observance of changes in the behavior of the sea. What is the third observation that confirms incoming tsunami waves?

   Based on eyewitnesses, there is a distinct rumbling sound made by incoming waves- described as Distinct roaring sound, strange unusual strong sound (e.g. sucking sounds), rumblings of many trucks or jet-like or gush of strong rain. So, this is the 3rd natural sound.

3. In summary, Natural Signs of an Approaching Tsunami

   To mitigate the effect of the tsunami, the community should be aware of the natural signs that they might observe. The three natural signs of an approaching tsunami are:

   I. A strong felt earthquake,

   II. Unusual sea level change: sudden sea water retreat *(exposed sea beds – coral flats, fishes, etc..)* or rise, and

   III. Unusual rumbling sound of approaching waves (e.g. sound like that of a train)

4. Based on stories from eyewitnesses and survivors of past tsunamis, the following are the natural signs of an impending tsunami

   I. **Feel an earthquake.** If the ground shakes under your feet in a coastal region, a tsunami may have been caused by a strong undersea earthquake. However, you may not feel an earthquake if the event is far away.

   II. **See ocean water disappear from the beach, bay or river** Before a tsunami arrives, water may recede from the shoreline before returning as a fast-moving wall of water. If you notice the water is disappearing, tell your family and friends and prepare to move inland or to higher ground.

   III. **Hear an unusual roaring sound** If you hear a loud roar approaching (a bit like a passenger jet or a train), tell your family and friends. It could be a tsunami approaching.

EVALUATION (10 MINS)

Quiz - True or False?

1. Ask your learners to answer true or false to the following sentences.
   A. I should go to the shore to watch a tsunami. [FALSE]
   B. All undersea earthquakes cause tsunami. [FALSE]
   C. If I felt a strong earthquake while near the coast, I should wait to hear the rumbling sound before moving to high ground (FALSE)
   D. If a small tsunami is coming, I should get out of the water and wait until I hear it is safe to return. [TRUE]
   E. Is a big tsunami is coming, I should move as far inland as I can or to higher ground. [TRUE]
   F. If I am swimming when a small tsunami comes, I could get dragged out to sea by the strong rips and currents. [TRUE]
   G. A tsunami is most often caused by undersea earthquakes. [TRUE]

Reflection Questions

1. Ask the learners, based on what they have learned so far, what are the areas (in their city, municipality or province) that can possibly be affected by tsunami ?
   A. If my home is near the coast, will I be affected by Tsunami? (depends if their area is fronting a known offshore/ under the sea earthquake generator)
   B. How do I prepare for tsunami? (How far is your home/ school from the coast? To elevated area?)
2. Learners write their responses in their notebooks.

Note: This part shall be linked with **DRR11/12-If-g-20**-

Different earthquake hazards maps- activity will validate answers to this Evaluation Section.

	4	3	2	1
SUMMARY TABLE: TSUNAMI EVENTS AND THEIR IMPACTS	The list is complete and has the 3 natural signs.	The list shows 2 of identified natural signs	The list mentions 1 of the natural signs	The list from each group does not show any of the expected answers (3 natural signs)
COOPERATION AMONG MEMBERS	The Facilitator was able to lead the discussion well, the Reporter was able to clearly present the summary of the group's output within the given time.	The Facilitator, Secretary, Reporter and the rest of the members were able to help each other and were able to come up with a comprehensive output.	The learners know their roles but were not actively portraying their responsibilities the entire time.	The learners do not know their roles and the discussion was not properly facilitated among the learners

Additional Resources:

1. International Tsunami Information Center. (2014). *Surviving a tsunami: Lessons from Chile, Hawaii, and Japan*. Retrieved from http://itic.ioc-unesco.org/images/stories/awareness_and_education/surviving_a_tsunami/Surviving_v2014_sm_Eng_20150109.pdf
2. Martinez-Villegas, M. L. (2015). Filipinos in japan: Narratives of experience from the march 11, 2011 great east japan earthquake and tsunami. *Journal of Disaster Research*, 10(1), 135-144.
3. Philippine Institute of Volcanology and Seismology. (1994). The 15 november 1994 mindoro earthquake. Retrieved from http://earthweb.ess.washington.edu/tsunami/specialized/events/mindoro/report.html
4. Philippine Institute of Volcanology and Seismology. (2006). *Tsunami* [Flyer]. Retrieved from http://www.phivolcs.dost.gov.ph/index.php?option=com_phocadownload&view=category&id=17:tsunami-flyer&Itemid=44
5. Philippine Institute of Volcanology and Seismology. (2008). *Phivolcs earthquake monitoring*. Retrieved from http://www.phivolcs.dost.gov.ph/index.php?option=com_content&view=article&id=38&Itemid=75
6. Philippine Institute of Volcanology and Seismology. (2013). *The great east japan earthquake and tsunami 11 march 2011: Ang huling sayonara* [Comics]. Retrieved from http://satreps.phivolcs.dost.gov.ph/images/jica_materials/comics_no2_lornaKikuta_anghulingsayonara.pdf
7. Philippine Institute of Volcanology and Seismology. (2013). *The great east japan earthquake and tsunami 11 march 2011: Bagong pag-asa* [Comics]. Retrieved from http://satreps.phivolcs.dost.gov.ph/images/jica_materials/comics_no4_bagong_pag_asa.pdf

8. Philippine Institute of Volcanology and Seismology. (2013). *The great east japan earthquake and tsunami 11 march 2011: Daang mapanganib* [Comics]. Retrieved from http://satreps.phivolcs.dost.gov.ph/images/jica_materials/comics_no1_imeldasuzuki_daangmapanganib.pdf
9. Philippine Institute of Volcanology and Seismology. (2013). *The great east japan earthquake and tsunami 11 march 2011: Oras ng peligro* [Comics]. Retrieved from http://satreps.phivolcs.dost.gov.ph/images/jica_materials/comics_no3_oras_ng_peligro.pdf
10. Philippine Institute of Volcanology and Seismology. (2014). *Philippine tsunami and seiches (1589-2012).* Retrieved from http://www.phivolcs.dost.gov.ph/index.php?option=com_content&view=article&id=3547&Itemid=500038
11. ProVention Consortium. (2008, August 5). *Tales of disasters 3. Tsunami (English)* [Video file]. Retrieved from https://www.youtube.com/watch?v=aiBR45Ntk_0
12. Short amateur video on 2004 December Banda Aceh Tsunami and 2011 March Japan Tsunami
13. U.S. Geological Survey. (1999). Surviving a tsunami: Lessons from chile, hawaii, and japan. Retrieved from http://pubs.usgs.gov/circ/c1187/

60 MINS

Earthquake Hazard Maps

Content Standard
The learners interpret different earthquake hazard maps

Performance Standard
The learners shall be able to:

- develop a family emergency preparedness plan to guide them on what to do before, during, and after an earthquake

Learning Competency
The learners are able to:

- Interpret different earthquake hazard maps (**DRR11/12-If-g-20**)

Specific Learning Outcome
At the end of the lesson, the learners will be able to:

- use the different earthquake hazard maps and integrate this information into the class disaster preparedness plan

LESSON OUTLINE

Introduction	Communicating Learning Objectives	10
Practice	Hazard Maps	30
Practice	Take-home activity	20

Materials:
Hazard Maps, Bond paper, Tracing Paper, Pens

Suggested Resources

(1) U.S. Geological Survey. (2015). Earthquake Hazards 101 - the Basics. Retrieved from http://earthquake.usgs.gov/hazards/about/basics.php
(2) U.S. Geological Survey. (2014). Earthquake Hazards 201 - Technical Q&A. Retrieved from http://earthquake.usgs.gov/hazards/about/technical.php#use
(3) Udono, T. and Sah, A. K. (2002, August 7). Hazard Mapping and Vulnerability Assessment. Paper presented in Regional Workshop on Total Disaster Risk Management, Asian Disaster Reduction Center. Kobe, Japan: Asian Disaster Reduction Center
(4) Hazard map. (n.d.). Retrieved DATE from Wikipedia: https://en.wikipedia.org/wiki/Hazard_map
(5) Philippine Institute of Volcanology and Seismology. (2010). Philippine Fault Zone Maps. Retrieved from http://www.phivolcs.dost.gov.ph/index.php?option=com_content&view=article&id=379&Itemid=500023
(6) Philippine Institute of Volcanology and Seismology. (n.d.). VFS Atlas. Retrieved from http://www.phivolcs.dost.gov.ph/index.php?option=com_wrapper&view=wrapper&Itemid=500043
(7) Earthquake brochure –PHIVOLCS (no date) Philippine Institute of Volcanology and Seismology. (n.d.). PHIVOLCS Earthquake Intensity Scale (PEIS). Retrieved from http://www.phivolcs.dost.gov.ph/index.php?option=com_phocadownload&view=category&id=13:peis&Itemid=44
(8) Philippine Institute of Volcanology and Seismology. (n.d.). Philippine Institute of Volcanology and Seismology. Retrieved from http://www.phivolcs.dost.gov.ph/

INTRODUCTION (10 MINS)

Communicate Learning Objectives (5 mins)

1. Interpret different earthquake hazard maps.

Review (5 mins)

1. Ask the class what they remember about the major hazards related with earthquake event.

Teacher Tip

This part is a review of previous meeting's lesson on earthquake hazards **DR R11/12-If-g-17 and 12-If-g-19**

PRACTICE (30 MINS)

Hazard Maps

1. Briefly discuss the following:
2. You may state:

   This is a map of the Philippines showing locations of most destructive tsunami events recorded in Philippine history. We had around 90 destructive earthquakes, around 40 tsunamis for past 400 years, and our coastal areas at eastern and western margins fronting major seas and inland seas have been affected by tsunamis.
3. Based on learners' answers on the assignment, ask the learners to share tsunami stories that they were able to research on.
4. Write the answers on the board for reference of learners for later discussion.

PHIVOLCS Earthquake Intensity Scale here For reference, see PHIVOLCS Earthquake Intensity Scale (n.d.).

An alternative is if the learners are not from QC or the school is in a place outside NCR, then Teacher can choose to

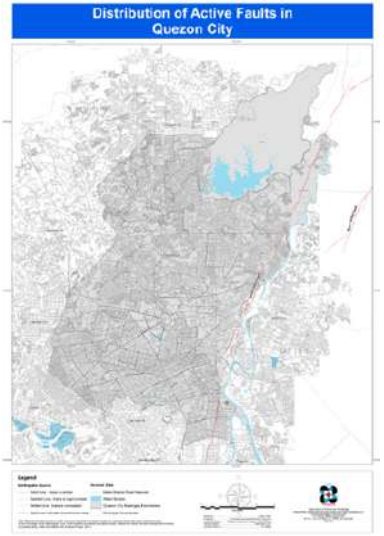
(1) provide specific location for learners to use
(2) download earthquake hazard maps available using this link: http://www.phivolcs.dost.gov.ph/ go to HAZARD MAPS to use other hazard maps available

I. Concepts of Magnitude and Intensity
   A. **Magnitude** of an earthquake refers to the amount of energy released, measured by the amount of ground displacement or shaking. It is calculated based on record of the earthquake (seismograph). It is represented by Arabic numbers (ex. 4.8, 9.0)
   B. **Intensity** is the strength of an earthquake as perceived and felt by people in a certain locality. It is a numerical rating based on relative effects to people, objects, environment and structures in the surroundings. The intensity is generally higher near the epicenter. It is represented by Roman Numerals (ex. II, IV, IX) .

II. **Hazard Maps** - People and properties are affected by earthquake due to any or a combination of the following: unsafe location, poor construction, people don't believe or know that they be affected, people don't know how they can be affected, people don't know what to do, and there is lack of timely and proper response.

Scientists have for so long studied earthquake occurrences and the hazards associated with them by looking at impacts from major earthquakes. Based on studies, given a specific earthquake scenario (magnitude) maps showing areas likely to be affected by a certain specific hazard and the degree of expected impact are generated. The purpose is to be able to use these maps.

A. As we learned in earlier modules, for earthquakes, there are at least 5 earthquake-related hazards that one needs to consider: ***ground rupture***, ***ground shaking***, ***liquefaction***, ***earthquake-induced landslides*** and ***tsunami***.
B. **Hazard Maps** are maps that show different hazards that may affect a certain area. For earthquakes, a ***ground shaking hazard map*** shows the distribution of earthquake shaking levels that have a certain probability of occurring. A ***ground rupture hazard map*** shows areas wherein faults cut across. There are hazard maps for ***liquefactio***n, ***earthquake-induced landslide*** and ***tsunami***.



MAP A: DISTRIBUTION OF ACTIVE FAULTS IN QUEZON CITY

III. These maps were generated to provide the most accurate and detailed information possible to assist engineers in designing buildings, bridges, highways, and utilities that will withstand shaking from earthquakes in an area. These maps are used by local governments to help establish zoning, construction requirements necessary to preserve public safety and for purposes of general planning for disaster risk reduction and mitigation.

Before using the map, be sure that you understand the basic parts-

A. Map Title (tells you what the map is all about);
B. Legend (details of what each symbols mean)
C. Scale (refer to the bar scale as this helps determine distances, etc)

MAP B: QUEZON CITY GROUND SHAKING HAZARD MAP

5. **Hands-on Activity using the maps**
    A. An example of hazard map for ground rupture. Below (A) is the map of Quezon City showing areas where the fault known as the Valley Fault System (VFS) passess through.
    B. Map B is the Ground shaking hazard map for Quezon City. As discussed earlier, if the scenario is a Magnitude 7.2 earthquake, the map which is now color-coded shows areas that will experience various Intensities from 6-9. (refer to the legend)
6. Using the map A, locate where your community is. Find where the red line is, this significies where the VFS is located. How far is your community from the fault.
7. Using map B, what is the likely intensity that your community will experience during a Magnited 7.2 earthquake.

PRACTICE (40 MINS)

Take-Home Activity - Learners submit a report a week after

PART I.

1. Learners to search the internet, go to PHIVOLCS site, refer to hazard maps to identify the different hazards likely to affect their community. Use the following table to assess the community's exposure to hazard.

PART II. Elements at risk

1. Using the provided Active Faults Map of your barangay, study the map carefully and its legend.
2. Can you identify where the trace of the VFS is?
3. Identify major streets that you can recognize. Write the street name on the map.
4. Identify and mark the following on the map:
    I. Barangay Hall
    II. Village Clubhouse
    III. Schools, DayCare Center
    IV. Hospitals, Clinics,
    V. Groceries, Markets
    VI. Important infrastructures (bridges, gymnasium/ open or covered courts, etc)

VII. Water tanks; deep wells, Using the ruler or string, determine the distance of some of these elements from the trace of the VFS nearest some elements at risk.

5. Take note if any of these identified elements on your map fall within any of the identified hazard zones (groundshaking, liquefaction and earthquake induced landslide).
6. Are any of the identified elements at risk transected by the VFS? Take note of these.

HAZARD	INTENSITY			REMARKS
GROUND SHAKING	High	Moderate	Low	
EARTHQUAKE INDUCED LANDSLIDE (Circle)	High	Moderete	Low	
LIQUEFACTION (Circle)	High	Moderete	Low	
ACTIVE FAULT (Circle)	TRANSCECTED		NOT TRANSECTED	

PART III. Open spaces and evacuation routes.

1. Identify open spaces that are available within your barangay or nearby. List as many as you can identify. Show location on the map.

HAZARDS	4	3	2	1
EVALUATION OF ASSIGNMENT	High Report answers 90-100% of guide questions in the take home activity	Moderate Report answers 70-89% of the guide questions in the take home activity	Report answers 50-69% of the guide questions in the take home activity	Report does not answer most of the guide questions in the take home activity

60 MINS

Precautionary Measures for Earthquakes

Content Standard
The learners apply precautionary measures for earthquakes.

Performance Standard
The learners shall be able to:

- develop a family emergency preparedness plan to guide them on what to do before, during, and after an earthquake.

Learning Competency
The learners are able to:

- apply precautionary and safety measures before, during and after an earthquake (**DRR11/12-If-g-21**)

Specific Learning Outcomes
At the end of the lesson, the learners will be able to:

- explain how to prepare before, during and after an earthquake;
- identify what are the proper actions to do during an earthquake; and
- design a promotional material that tackles preparedness before, during and after an earthquake

LESSON OUTLINE

Before the Lesson	Tasks for Learners and Teachers	
Introduction	Communicating Learning Objectives	5
Motivation	Photographs	10
Practice	Group Discussion	35
Evaluation	True or False?	5
Enrichment	Inquiry	5

Materials:
Manila paper from previous lesson, list of earthquake hazard and impacts, cartolina

Suggested Resources

(1) Philippine Institute of Volcanology and Seismology. (2011). *Earthquake preparedness guide* [Flyer]. Retrieved from http://www.phivolcs.dost.gov.ph/index.php?option=com_phocadownload&view=file&id=41:earthquake-preparedness-guide-pocketsize&Itemid=44

(2) Philippine Institute of Volcanology and Seismology. (2013). *Earthquake!!! Are you prepared?* [Poster]. Retrieved from http://www.phivolcs.dost.gov.ph/index.php?option=com_phocadownload&view=file&id=71:earthquake-are-you-prepared&Itemid=44

BEFORE THE LESSON

For Learners

1. Learners present their posters in a display.
   "Paano mo matutulungan ang iyong pamilya na maghanda bago, habang at pagkatapos ng lindol?" "How can you help your family to prepare before, during and after an earthquake?"

For Teachers

1. Teachers prepare a cartolina with this written "" Earthquakes alone don't injure or kill people. It is our practices at home, in school, in the workplace or outside that could hurt or injure us and others."

INTRODUCTION (5 MINS)

Communicate Learning Objectives

1. Explain and give examples on how to prepare before, during and after an earthquake
2. Discuss how one may prepare and protect oneself in case of an earthquake

Review

1. Ask the class what they remember about the major hazards related with earthquake event.

Teacher Tip:
This part is a review of previous meeting's lesson on earthquake hazards **DRR11/12-If-g-17 and 12-If-g-19**

MOTIVATION (10 MINS)

Photographs

1. Show these photos of impacts of a major earthquake.

A school building in Cabanatuan City collapsed after intense ground shaking, trapping hundreds of students. 16 July 1990 Luzon Earthquake (Source: PHIVOLCS)


Kobe, Japan. 1995 earthquake. Source: Creative Commons, Wikimedia


Nepal. 2015 earthquake. Source: Creative Commons, SIM Central

2. Ask: *How can we avoid this from happening?*
3. Post the cartolina you prepared with this – " Earthquakes alone don't injure or kill people. It is our practices at home, in school, in the workplace or outside that could hurt or injure us and others." *W5 is this so?*

PRACTICE (35 MINS)

Part 1: Group Discussion Session to be Facilitated by Teacher (20 mins)

1. Divide the class into 3 groups. Identify a leader to lead the discussion, a secretary to write down answers in the Manila paper and a speaker to present the group outputs.
2. Provide manila paper and pens per group. Ask the learners to discuss the assigned topics / tasks for discussion:
    I. Group 1. List the ways by which we can prepare before an earthquake.
    II. Group 2. List actions that one must do during an earthquake.
    III. Group 3. List possible actions that one must do after an earthquake.

Teacher Tip:
Source: PHIVOLCS flyer EARTHQUAKE PREPARENDESS GUIDE

http://www.phivolcs.dost.gov.ph/index.php?option=com_phocadownload&view=category&id=12:earthquake-what-to-do-before-during-and-after-an-earthquake&Itemid=44

Discussion Guide to Teacher

1. What to do BEFORE an earthquake

I. The key to effective disaster prevention is planning.
    A. Know the earthquake hazards in your area
    B. Follow structural design and engineering practices when constructing a house or a building
    C. Evaluate structural soundness of the buildings and houses; strengthen or retrofit if necessary

II. Prepare your homes, workplace or schools:
    A. Strap or bolt heavy furniture, cabinets to the walls
    B. Check the stability of hanging objects like ceiling fans and chandeliers
    C. Breakable items, harmful chemicals and flammable materials should be stored properly in the lowermost secured shelves

III. Familiarize yourself with the exit routes.

IV. Know where fire extinguishers, first aid kits, alarms and communication facilities are located. Learn how to use them beforehand.

A. Prepare a handy emergency supply kit with first aid kit, canned food and can opener, water, clothing, blanket, battery-operated radio, flashlights and extra batteries

V. Conduct and participate in regular earthquake drills

2. What to do DURING an earthquake.

I. When you are INSIDE a structurally sound building or home…STAY there! Do the "Duck, Cover and Hold on"

A. If possible, quickly open the door for exit.

B. Duck under a sturdy desk or table, and hold on to it, or protect your head with your arms

C. Stay away from glass windows, shelves and other heavy objects

D. Beware of falling objects. Be alert and keep your eyes open.

II. If you're OUTSIDE.. move to an open area!

A. Stay away from trees, power lines, posts and concrete structures

B. Move away from steep slopes which may be affected by landslides

C. If you're near the shore and feel an earthquake especially if it's too strong, MOVE QUICKLY TO HIGHER GROUNDS. **Tsunamis** might follow.

III. If you're in a moving vehicle, STOP and get out! Do not attempt to cross bridges, overpasses or flyovers which may have been damaged.

3. What to do AFTER an earthquake.

I. Be prepared for aftershocks. Once the shaking stops, take the fastest and safest way out of the building.

II. DON'T…

A. …use elevators

B. …enter damaged buildings

C. …use telephone unless necessary

D. …PANIC

III. CHECK…
   A. …yourself and others for injuries
   B. ..water and electrical lines for damages
   C. …for spills of chemical, toxic and flammable materials
   D. …and control fires which may spread

IV. If you need to evacuate your residence, leave a message stating where you are going and bring your emergency supply kit

V. Keep updated on disaster prevention instructions form battery-operated radios.

Teacher Tip:
Take note of additional, useful answers that learners might come up with.

Part 2: Group Discussion Session to be Facilitated by Teacher (15 mins)

1. Each group is given 5 minutes to present their work
2. Let the learners have time to explain and discuss the answers.

ASSESSMENT (5 MINUTES)

Quiz - True or False?

1. When the shaking starts, I should run immediately and leave the room to get out of the building as fast as I could.
2. During an earthquake and I am outside, it is best to take shelter under trees, power lines, posts and concrete structures.
3. If near the shore and a very strong earthquake is felt, one must move quickly to higher ground even if there is no immediate information of the possible source and location of the earthquake.
4. During an earthquake, to make it faster to get out of the building, use the elevator.
5. In the chemistry lab, breakable items, harmful chemicals and flammable materials are be stored properly in the uppermost secured shelves.
6. After a very strong earthquake, employees of an office located on the 10th floor of the building should immediately evacuate by going down the building and finding the designated open space for temporary evacuation area.

Answer Key:

1. False
2. False
3. True
4. False
5. False
6. True

ENRICHMENT (5 MINUTES)

Inquiry

1. Going back to the earlier question posed by Teacher to the class:

   " Earthquakes alone don't injure or kill people. It is our practices at home, in school, in the workplace or outside that could hurt or injure us and others." Why is this so?

   Sample Response: *Because we did not prepare ourselves and our surroundings. We have to be conscious of the various ways by which we can prepare ourselves, our school and the community.*

2. Ask the learners to answer this question:

   How can I help spread the right information about earthquake preparedness?

   Possible answers: *Discuss at home. Discuss with friend. Help in the organization of earthquake drills. Seriously participate in the earthquake preparedness activities of the school*

Assignment

1. Design a poster in a cartolina, showing at least one important action on earthquake preparedness as discussed in class.
2. This poster will be displayed in class in the next scheduled meeting.

Teacher Tip:
Another alternative project or culminating activity for this Chapter on Earthquake is to ask the learners to come up with their own emergency bag, basic content: first aid kit, canned food and can opener, bottle of water, clothing, blanket, battery-operated radio, flashlights and extra batteries, medicine, hygiene kit for women.

	4	3	2	1
SUMMARY TABLE TSUNAMI EVENTS AND THEIR IMPACTS	The list is complete.	The list of answers from the learners has 60%-90% of expected items as mentioned in the teacher's guide	The list of answers from the learners has 25%-60% of expected items as mentioned in the teacher's guide	The list of answers from the learners does not show any of expected items as mentioned in the teacher's guide
COOPERATION AMONG MEMBERS	The Leader was able to facilitate the discussion well, the Reporter was able to clearly present the summary of the group's output within the given time.	The Leader, Secretary, Reporter and the rest of the members were able to help each other and were able to come up with a comprehensive output.	The learners know their roles but were not actively portraying their responsibilities the entire time	The learners do not know their roles and the discussion was not properly facilitated among the learners

120 MINS

Different Types of Volcanic Hazards

Content Standards
The learners demonstrate understanding of volcano-related hazards

Performance Standards
The learners shall be able to:

- develop a family emergency preparedness plan to guide them on what to do before, during, and after a volcanic eruption

Learning Competencies
The learners are able to:

- explain various volcano-related hazards **(DRR11/12-Ih-i-22)**
- differentiate among different volcano hazards **(DRR11/12-Ih-i-23)**

Specific Learning Outcomes
At the end of the lesson, the learners will be able to:

- identify the most common volcano-related hazards in the Philippines; and
- explain the differences of the various volcano-related hazards

LESSON OUTLINE

Before the Lesson	Pre-Activity	
Introduction	Communicating Learning Objectives	10
Instruction	Volcanic Phenomena	30
Practice	Learner Activity and Presentations	30
Evaluation	True or False?	10
Enrichment	Inquiry	20

Materials:
Manila paper, permanent pens, masking tape

Suggested Resources

(1) Fisher, R. V. (1997). *Hazardous volcanic events.* Retrieved from http://volcanology.geol.ucsb.edu/hazards.htm

(2) Geography Video 4 the UC. (2010, December 31). *Dome collapse and pyroclastic flow at unzen volcano* [Video file]. Retrieved from https://www.youtube.com/watch?v=Cvjwt9nnwXY

(3) GNS Science, Te Pü Ao. (2010). *Volcanic hazards.* Retrieved from http://gns.cri.nz/Home/Learning/Science-Topics/Volcanoes/Volcanic-Hazards

Additional Resources at the End of this Lesson

BEFORE THE LESSON

For Learners

1. Ask the learners to research about the following volcanoes: Pinatubo, Taal, Mayon, Bulusan, Kanlaon, and Hibok-hibok
2. Ask them to research on the following topics: Location, provinces around the volcano, history of eruptions, last recorded eruption, and kinds of hazards present.
3. Bring researched materials to class.

INTRODUCTION (5 MINS)

Communicate Learning Objectives

1. Identify the most common volcano-related hazards in the Philippines
2. Explain the differences of the various volcano-related hazards

Teacher Tip:
This portion is just a review of JHS topic on volcanoes

Review

1. Ask the class to name several volcanoes they know of (aside from the assigned list)

   Expected answers: (Pinatubo, Taal,Mayon, Bulusan, Kanlaon, Hibok-hibok)

   Possible answers: local; Makiling, Banahaw, Iriga, Isarog, Matutum, Parker- see list

   Possible answers: international- Kraratau, Mt Unzen, Mt St Helens, etc

2. What do they know about major volcanic eruptions in the Philippines?

   Possible Answers:

   I. Pinatubo June 1991 ashfall reached Manila, devastated provinces of Pampanga, Zambales and Tarlac.

   II. Mayon 1984, 1993, 2000-2001, 2009 eruptions. Lahar events that occurred after major eruptions such as during Typhoon Luming and Dinang in 1981, Typhoon Reming in 2006. The 1814 euption of Mayon buried the famous church of Cagsawa.

   III. Taal Volcano 1911, 1965 eruptions killed many people in Taal Volcano Island and the lke coastal communities.

3. What are the negative impacts during an eruption?

   Possible Answer: Destruction of properties, deaths and injuries, displacement of people.

MOTIVATION (10 MINS)

Photographs

1. Show these photos of impacts of volcanic eruptions.
2. What do we have here? (2 kinds of eruption, one violent or explosive and one effusive or quiet)

Mayon Volcano eruption, 1984. An example of pyroclastic flow event. *Photo from PHIVOLCS.*

Mayon Volcano eruption, 1984. An example of lava flow event *Photo from PHIVOLCS.*

Teacher Tip:
There are several kinds of events caused from volcanic action that can be harmful to life and property. These include lava flows, lahars, ash falls, debris avalanches, and pyroclastic density currents (pyroclastic flows and surges) –RV Fisher http://volcanology.geol.ucsb.edu/hazards.htm

INSTRUCTION (30 MINS)

1. Discuss: **Volcanic hazards** are phenomena arising from volcanic activity that pose potential threat to persons or property in a given area within a given period of time. Below is a list of volcanic hazards common in Philippine active volcanoes.

VOLCANIC PHENOMENA	NEGATIVE IMPACTS / WHY IT IS HAZARDOUS
Lava Flows are stream-like flows of incandescent molten rock erupted from a crater or fissure. When lava is degassed and/or very viscous, it tends to extrude extremely slowly, forming lava domes.	Lava flows rarely threaten human life because lava usually moves slowly -- a few centimeters per hour for silicic flows to several km/hour for basaltic flows. Most characterize this as quiet effusion of lava. Major hazards of lava flows -- burying, crushing, covering, burning everything in their path.

Teacher Tip:
Different sources (USGS, GNS, etc) will have varying list of identified volcanic hazards, and this all depends on location of the volcano and type of volcano.
What are listed on the discussion guide are volcanic hazards common for Philippine volcanoes.

VOLCANIC PHENOMENA	NEGATIVE IMPACTS / WHY IT IS HAZARDOUS
Lava Flows  *Lava flow can bury large area and render it useless for years. Lava flow from the 2000 eruption of Mayon Volcano Photo from PHIVOLCS*	***Lavas can burn.*** The intense heat of lavas melt and burn. As lava flows are hot and incandescent, areas it covers are burned (forest, built up areas, houses). ***Lavas can bury.*** Lavas can bury homes and agricultural areas under meters of hardened rock. Areas affected by lava flows once solidified are also rendered useless and will not be useful anymore (for agriculture, etc) for years due to the solid nature of the lava deposit. Lavas can also block bridges and highways, affecting mobility and accessibility of people and communities. Collapsing viscous lava domes **can trigger dangerous pyroclastic flows.**
Ashfall or tephra fall are showers of airborne fine- to coarse-grained volcanic particles that fallout from the plumes of a volcanic eruption; ashfall distribution/ dispersal is dependent on prevailing wind direction	Ashfall endanger life and property by During peak of eruption with excessive ash, ***can cause poor or low visibility*** (driving, slippery roads) Loss of agricultural lands if **burial by ashfall** is greater than 10 cm depth, Producing suspensions of fine-grained particles in air and water which clogs filters and vents of motors, human lungs, industrial machines, and nuclear power plants.

Teacher Tip:
An exceptionally fast flow (extremely rare) at Mt. Nyiragongo, Zaire (30-100 km/hour), overwhelmed about 300 people. Sometimes lava melts ice and snow to cause floods and lahars. Lava flows can dam rivers to form lakes that might overflow and break their dams causing floods. Methods for controlling paths of lava flows: (1) construct barriers and diversion channels, (2) cool advancing front with water, (3) disruption of source or advancing front of lava flow by explosives (Fisher, http://volcanology.geol.ucsb.edu/hazards.htm)

VOLCANIC PHENOMENA	NEGATIVE IMPACTS / WHY IT IS HAZARDOUS
Ashfall or Tephra Fall  *Ash fall from Mt. Pinatubo, 1991, Creative Commons, Wikimedia*	Ash suspended in air is also **dangerous for aircrafts** as the abrasive ash can cause the engines to fail if the suspended ash is encountered by the airplane Carrying of harmful (even poisonous, unpleasant) gases, acids, salts, and, close to the vent, heat. Burial by tephra can collapse roofs of buildings, break power and communication lines and damage or kill vegetation. Even thin (<2 cm) falls of ash can damage such critical facilities as hospitals, electric-generating plants, pumping stations, storm sewers and surface-drainage systems and sewage treatment plants, and short circuit electric-transmission facilities, telephone lines, radio and television transmitters.
Pyroclastic flows and surges (Pyroclastic density current) are turbulent mass of ejected fragmented volcanic materials (ash and rocks), mixed with hot gases (200°C to 700°C to as hot as 900°C) that flow downslope at very high speeds (>60kph). Surges are the more dilute, more mobile derivatives or pyroclastic flows.	Pyroclastic flows and surges are potentially highly destructive owing to their mass, high temperature, high velocity and great mobility. Pyroclastic flows can • Destroy anything on its path by direct impact • Burn sites with hot rocks debris • Burn forests, farmlands, destroy crops and buildings

Teacher Tip:
Many people and the cities of Pompeii and Herculaneum were destroyed in 79 AD from an eruption of Mount Vesuvius; 29,000 people were destroyed by pyroclastic surges at St. Pierre, Martinique in 1902; >2000 died at Chichónal Volcano in southern Mexico in 1982 from pyroclastic surges.

VOLCANIC PHENOMENA	NEGATIVE IMPACTS / WHY IT IS HAZARDOUS
Pyroclastic Flows and surges (Pyroclastic Density Current  *Pyroclastic flow from Pinatubo Volcano eruption, June 1991 Photo from PHIVOLCS*	Deadly effects include asphyxiation (inhalation of hot ash and gases), burial, incineration (burns) and crushing from impacts. The only effective method of risk mitigation is evacuation prior to such eruptions from areas likely to be affected by pyroclastic density currents
Lahars are rapidly flowing thick mixture of volcanic sediments (from the pyroclastic materials) and water, usually triggered by intense rainfall during typhoons, monsoons and thunderstorms. Lahar can occur immediately after an eruption or can become long-term problem if there is voluminous pyroclastic materials erupted such as the case of 1991 Pinatubo eruption. Lahars can also occur long after an eruption has taken place such as the lahars at Mayon Volcano after the 1984 eruption .	Lahars have destroyed many villages and lives living on Pinatubo and Mayon Volcano because most people live in valleys where lahars flow. • Lahars can destroy by direct impact (bridges, roads, houses) • Lahars can block tributary stream and form a lake. This can submerged villages within the valley of the tributary that was blocked, there is also the danger of the dammed lake breaching or lake breakout and if this happens, this puts to danger the lives of people in communities downstream • Lahars can bury valleys and communities with debris

Teacher Tip:
Nevado del Ruiz, Colombia
A special case of lahar event occurred during the eruption of Nevado del Ruiz, Colombia in 1985. The 21,000 lives lost at Armero, Colombia, was from a lahar that formed during the eruption of Nevado del Ruiz in 1985. It was generated by meltwater from the interaction of pyroclastic surges with snow and ice, from a very small eruption. (http://hvo.wr.usgs.gov/volcanowatch/archive/2009/09_10_29.html)

Lahars at Mayon Volcano
http://www.typhoon2000.ph/stormstats/lahars.htm

VOLCANIC PHENOMENA	NEGATIVE IMPACTS / WHY IT IS HAZARDOUS
Lahars	• Lahars can lead to increased deposition of sediments along affected rivers and result to long-term flooding problems in the low-lying downstream communities.
Volcanic gases- gases and aerosols released into the atmosphere, which include water vapor, hydrogen sulfide, sulfur dioxide, carbon monoxide, hydrogen chloride, hydrogen fluoride	Sulfur dioxide (SO_2), carbon dioxide (CO_2), and hydrogen flouride (HF) are some volcanic gases that pose hazard to people, animals, agriculture and property. SO_2 can lead to acid rain. High concentrations of CO_2 which is colorless and odorless can be lethal to people, animals and vegetation. Fluorine compounds can deform and kill animals that grazed on vegetation covered with volcanic ash.
Debris avalanche or volcanic landslide- massive collapse of a volcano, usually triggered by an earthquake or volcanic eruption. An example of recent debris avalanche event occurred during the 1980 eruption of Mt. St Helens. Based on present morphology of volcanoes, Iriga Volcano in Camarines Sur, Banahaw Volcano and Quezon Province and Kanlaon Volcano had pre-historic debris avalanche events.	When a huge portion of the side of a volcano collapses due to slope failure. This results to massive destruction similar to what happened in Mt. St. Helens in the USA in 1980. The huge volcanic debris avalanche typically leaves an amphitheater-like feature and at the base of volcanoes with debris avalanche event, a hummocky topography (small hills all over).
Ballistic projectiles are Volcanic materials directly ejected from the volcano's vent with force and trajectory	Ballistic projectiles endanger life and property by the force of impact of falling fragments, but this occurs only close to an eruption vent.

Teacher Tip:
Additional references

Volcanic Gases and their effects
http://pubs.usgs.gov/of/1997/of97-262/of97-262.html

Impact of volcanic gases on climate, the environment and people
http://pubs.usgs.gov/of/1997/of97-262/of97-262.html

Debris avalanche
https://www.google.com.ph/search?q=debris+avalanche&biw=1280&bih=705&tbm=isch&tbo=u&source=univ&sa=X&sqi=2&ved=0CEMQsARqFQoTCJW6nIXy9cgCFQLzYwod4rYGfg#imgrc=_0VK13baG73Z9M%3A

https://www.google.com.ph/search?q=volcanic+debris+avalanche&biw=1280&bih=705&tbm=isch&tbo=u&source=univ&sa=X&ved=0CDQQsARqFQoTCKC9uNzs98gCFYGLlAod-BkL8A#imgrc=TVABvwuJdokw7M%3A

VOLCANIC PHENOMENA	NEGATIVE IMPACTS / WHY IT IS HAZARDOUS
Tsunami- sea waves or wave trains that are generated by sudden displacement of water (could be generated during undersea eruptions or debris avalanches)	An eruption that occurs near a body of water may generate tsunamis if the pyroclastic materials enter the body of water and cause it to be disturbed and displaced, forming huge waves.

PART 2. Learner ACTIVITY and PRESENTATIONS (30 minutes)

1. Attributing impacts to specific hazards as discussed.
2. Based on the researched materials brought by learners, ask learners to identify which type of volcanic hazards are present in the 6 most active volcanoes of the Philippines
3. Each group is given 5 minutes to present their work
4. Let the learners have time to explain and discuss the answers.
5. Prepare this template on a large manila paper, put enough space for learners to put their metacards) and provide for each group

GROUP	DESCRIBE IMPACTS BASED ON MATERIALS RESEARCHED	VOLCANIC HAZARDS
Pinatubo		
Taal		
Mayon		
Bulusan		
Kanlaon		
Hibok-hibok		

Note: *Keep this Manila paper as this will be used and referred to for the succeeding sessions.*

For information about eruption history:

Pinatubo Volcano
http://www.phivolcs.dost.gov.ph/html/update_VMEPD/Volcano/VolcanoList/pinatubo.htm

Taal Volcano
http://www.phivolcs.dost.gov.ph/html/update_VMEPD/Volcano/VolcanoList/taal.htm

Mayon Volcano
http://www.phivolcs.dost.gov.ph/html/update_VMEPD/Volcano/VolcanoList/mayon.htm

Bulusan Volcano
http://www.phivolcs.dost.gov.ph/html/update_VMEPD/Volcano/VolcanoList/bulusan.htm

Kanlaon Volcano
http://www.phivolcs.dost.gov.ph/html/update_VMEPD/Volcano/VolcanoList/kanlaon.htm

Hibok hibok
http://www.phivolcs.dost.gov.ph/html/update_VMEPD/Volcano/VolcanoList/hibok.htm

EXPECTED POSSIBLE ANSWERS

GROUP	DESCRIBE IMPACTS BASED ON MATERIALS RESEARCHED	VOLCANIC HAZARDS
Pinatubo	• 1991 eruption • The volcano slope turned into gray desert, vegetation was covered and destroyed, the Aetas were displaced • Roof of houses collapsed, killing people in Zambales • Flights cancelled • During the rainy season weeks or months after June eruption, houses were buried, bridges destroyed	• Pyroclastic flow • Ashfall • Lahars (lahar occurrences continued to be a problem for the succeeding 5 years after the 1991 eruption)
Taal	• 1754, 1911, 1965 eruption • Ash covered the communities on the island as well as those nearby • Whole island was devastated	• Ashfall/ tephra fall • Pyroclastic flow • Lava flow (1968-1969)
Mayon	• 1814,1984, 1993, 2000-2001, • 2014-sudden phreatic explosion killed some tourists/hikers • 1993- about 70 people mostly tending their vegetable farms were killed • 1984- a Typhoon brought heavy rains that caused lahars to be generated and buried communities near a river • Areas covered by molten lava flows have been rendered useless and could not be used for farming anymore	• Ballistic projectiles • Ashfall • Pyroclastic flows • Lahars • Lava flow
Bulusan	• Small eruptions caused ashfall	• Ashfall

Teacher Tip:
Learners can download news articles photographs of impacts. The purpose is for learners to be able to relate the impact with type of hazard.

GROUP	DESCRIBE IMPACTS BASED ON MATERIALS RESEARCHED	VOLCANIC HAZARDS
Kanlaon	• 1993- phreatic event killed a tourist/hiker	• Ashfall
Hibok-hibok	• 1951- about 500 casualties from the town of Mambajao when pyroclastic flows swept the area	• Pyroclastic flows

EVALUATION (10 MINUTES)

Quiz - True or False?

1. Pyroclastic flows and surges are potentially highly destructive owing to their mass, high temperature, high velocity and great mobility.
2. Lahars are rapidly flowing thick mixture of volcanic sediments (from the pyroclastic materials) and water, usually triggered by intense rainfall during typhoons, monsoons and thunderstorms. Lahars can occur immediately after an eruption or can become long-term problem for as long as there are excess sediments on the volcano's slope and water to remobilize these.
3. Lava flows are considered the most dangerous type of hazard from a volcano and is always a big threat to human lives.
4. During eruption, excessive ashfall is dangerous as it can cause poor or low visibility.
5. Ash from volcanoes are also abrasive, because of this, ash suspended in air is also dangerous for airplanes as this can cause the engines to fail if the suspended ash is encountered by the airplane.
6. High concentrations of CO_2 which is colorless and odorless can be lethal to people, animals and vegetation.

Answer Key:

1. True
2. True
3. False
4. True
5. True
6. True

ENRICHMENT (20 MINUTES)

Inquiry

1. Reinforce, reiterate where / in which environment each of the hazard is experienced or is more prominent.
2. Ask the learners, based on what they have learned so far, think of their home (if near volcano), or think of areas such as Taal and Mayon, what are the possible impacts/ effects of the volcanic hazards to the home/s around these volcanoes?
3. Ask the learners to write this checklist in their notebook:

OPTION 1. (IF IN AREAS with nearby volcano)

What are the potential volcanic hazards that can affect me, my home and my community. How?

Will I be affected by (check all the will apply)

- Lava flows
- Ashfall
- Pyroclastic flows
- Lahars
- Volcanic gases
- Debris avalanche
- Ballistic projectiles
- Tsunami

Those I have checked are the hazards I need to prepare for.

OPTION 2. (IF IN AREAS far from a volcano)

What is the nearest volcano near my place?

It is very unlikely that I will be directly affected by an eruption coming from this volcano. But, indirectly, what can possibly be the effect of a major eruption to us?

For example:

1. Travel and accessibility- Lahars from Pinatubo greatly affected major highways (North Luzon Express Way and Highways going to the north) due to destroyed bridges by the lahars
2. Supply chain will be affected as trucks carrying supplies will not be able to pass by major road networks
3. Kanlaon is known as the vegetable basket of the Visayas, if an eruption occurs, the source of vegetables will be very affected. There will be shortage of supplies and this will in turn affect other businesses
4. Ash suspended in air from major eruptions can also disrupt air travel- flight may be delayed and cancelled.

Note: This part shall be linked with **DRR11/12-lh-i-26**- Different volcano hazards maps- activity will validate answers to this ENRICHMENT SECTION

EVALUATION

	4	3	2	1
SUMMARY TABLE VOLCANO EVENTS AND THEIR IMPACTS	The list is complete.	The list of answers from the learners has 60%-90% of expected items as mentioned in the teacher's guide	The list of answers from the learners has 25%-60% of expected items as mentioned in the teacher's guide	The list of answers from the learners does not show any of expected items as mentioned in the teacher's guide
COOPERATION AMONG MEMBERS	The Leader was able to facilitate the discussion well, the Reporter was able to clearly present the summary of the group's output within the given time.	The Leader, Secretary, Reporter and the rest of the members were able to help each other and were able to come up with a comprehensive output.	The learners know their roles but were not actively portraying their responsibilities the entire time	The learners do not know their roles and the discussion was not properly facilitated among the learners

Additional Resources:

1. International Association of Volcanology and Chemistry of the Earth's Interior. (n.d.). *Understanding volcanic hazards* [Video file]. Retrieved from http://www.iavcei.org/IAVCEI_publications/videos_IAVCEI.htm
2. Martinez-Villegas, M. L. (2001). Proceedings from PHIVOLCS '01: An introduction to volcanic hazards in the philippines, in learning to expect the unexpected. Quezon City, Philippines: Author.
3. Philippine Institute of Volcanology and Seismology. (2008). School teachers' seminar-training on natural hazards awareness and preparedness: Focus on earthquakes and volcanoes. Quezon City, Philippines: Author.
4. Philippine Institute of Volcanology and Seismology. (2008). *Volcanic hazards* [Flyer]. Retrieved from http://www.phivolcs.dost.gov.ph/index.php?option=com_phocadownload&view=category&id=25:volcanoes-and-volcanic-hazards&Itemid=44
5. Philippine Institute of Volcanology and Seismology. (2008). *Volcano monitoring*. Retrieved from http://www.phivolcs.dost.gov.ph/index.php?option=com_content&view=article&id=50&Itemid=86
6. Philippine Institute of Volcanology and Seismology. (2010). *Ang mga sensyales kon maglupok ang bulkan kanla-on* [Poster]. Retrieved from http://www.phivolcs.dost.gov.ph//images/attachments/article/757/EULogo_Poster_KANLAON_TRANSLATED_Precursor_ilonggo.jpg
7. Philippine Institute of Volcanology and Seismology. (2010). *Mga sensyales aron mahibaw-an nga mobuto ang bulkang kanla-on* [Poster]. Retrieved from http://www.phivolcs.dost.gov.ph//images/attachments/article/757/EULogo_Poster_KANLAON_TRANSLATED_Precursor_Cebuano.jpg
8. Tilling, R. I. (1989). Volcanic hazards and their mitigation: progress and problems. *Reviews of Geophysics*, 27(2), 237-269.
9. U. S. Geological Survey. (2008). *What are volcano hazards?, Fact sheet 002-97*. Retrieved from http://pubs.usgs.gov/fs/fs002-97/
10. U. S. Geological Survey. (n.d.). *Preparing for volcanic emergencies*. Retrieved from http://volcanoes.usgs.gov/vhp/preparedness.htmlhttp://volcanoes.usgs.gov/hazards/planning.php
11. Philippine Institute of Volcanology and Seismology. (1984). Mayon volcano eruption: An example of pyroclastic flow event [Photograph].
12. Philippine Institute of Volcanology and Seismology. (1984). *Mayon volcano eruption: An example of lava flow event* [Photograph].
13. U. S. Geological Survey. (n.d.). Lava flow can burn forest and farm areas along its path [Photograph]. Retrieved from http://volcanoes.usgs.gov/Imgs/Jpg/Kilauea/30210600-045_large.jpg
14. Philippine Institute of Volcanology and Seismology. (2000). [Untitled photograph of lava flow from mayon volcano eruption].
15. Impact of heavy ashfall during the 1991 Pinatubo Eruption, Clark Airbase. (1991).
16. Philippine Institute of Volcanology and Seismology. (1993). [Untitled photograph of pyroclastic flow from mayon volcano eruption].
17. Philippine Institute of Volcanology and Seismology. (2000). [Untitled photograph of pyroclastic flow from pinatubo volcano eruption].
18. Garcia, A. (1991). [Untitled photograph of a truck in front of the pinatubo volcano eruption]. Retrieved from https://www.google.com.ph/search?q=Pinatubo+Volcano+eruption

+impacts&biw=1280&bih=705&tbm=isch&tbo=u&source=univ&sa=X&ved=0CDUQsARqFQoTCNqdlcLDqsgCFcUUlAod170LWA#imgrc=ijVzHDr1ETbT6M%3

19. Philippine Institute of Volcanology and Seismology. (1991). [Untitled photograph showing how after a series of lahar events, a house located along the river was eventually buried].
20. U. S. Geological Survey. (2009). *Lessons learned from the armero, colombia tragedy.* Retrieved from http://hvo.wr.usgs.gov/volcanowatch/archive/2009/09_10_29.html
21. Alojado, D. (2008). *Lahars at mayon volcano, albay, philippines.* Retrived from http://www.typhoon2000.ph/stormstats/lahars.htm
22. McGee, K. A., Doukas, M. P., Kessler, R., Gerlach, T. M. (1997). *Impacts of volcanic gases on climate, the environment, and people.* Retrieved from http://pubs.usgs.gov/of/1997/of97-262/of97-262.html
23. U. S. Geological Survey. (n.d.). Debris avalanche or volcanic landslide [Digital image]. Retrieved from http://volcanoes.usgs.gov/Imgs/Jpg/Photoglossary/30210600-078_large.jpg
24. U. S. Geological Survey. (n.d.). [Untitled photograph of the hummocky terrain of the debris avalanche north of mount shasta]. Retrieved from http://volcanoes.usgs.gov/vsc/images/image_mngr/200-299/img265_350w_235h.jpg
25. Philippine Institute of Volcanology and Seismology. (n.d.). *Pinatubo volcano.* Retrieved from http://www.phivolcs.dost.gov.ph/html/update_VMEPD/Volcano/VolcanoList/pinatubo.htm
26. Philippine Institute of Volcanology and Seismology. (n.d.). *Taal volcano.* Retrieved from http://www.phivolcs.dost.gov.ph/html/update_VMEPD/Volcano/VolcanoList/taal.htm
27. Philippine Institute of Volcanology and Seismology. (n.d.). *Mayon volcano.* Retrieved from http://www.phivolcs.dost.gov.ph/html/update_VMEPD/Volcano/VolcanoList/mayon.htm
28. Philippine Institute of Volcanology and Seismology. (n.d.). *Bulusan volcano.* Retrieved from http://www.phivolcs.dost.gov.ph/html/update_VMEPD/Volcano/VolcanoList/bulusan.htm
29. Philippine Institute of Volcanology and Seismology. (n.d.). *Kanlaon volcano.* Retrieved from http://www.phivolcs.dost.gov.ph/html/update_VMEPD/Volcano/VolcanoList/kanlaon.htm
30. Philippine Institute of Volcanology and Seismology. (n.d.). *Hibok hibok volcano.* Retrieved from http://www.phivolcs.dost.gov.ph/html/update_VMEPD/Volcano/VolcanoList/hibok.htm

Disaster Readiness and Risk Reduction

60 MINS

Signs of Volcanic Eruptions

Content Standard
The learners demonstrate understanding of volcano-related hazards

Performance Standard
The learners shall be able to:

- develop a family emergency preparedness plan to guide them on what to do before, during, and after a volcanic eruption

Learning Competency
The learners are able to:

- recognize signs of an impending volcanic eruption **(DRR11/12-Ih-i-24)**

Specific Learning Outcomes
At the end of the lesson, the learners will be able to:

- identify the different parameters used to monitor volcanoes; and
- explain the common signs of an impending volcanic eruption

LESSON OUTLINE

Before the Lesson	Learner Task (Assigned 2 weeks before this lesson)	
Introduction	Communicating Learning Objectives	5
Motivation	Photographs	10
Instruction	Gallery Walk	35
Evaluation	Quiz	5
Enrichment	Inquiry	5

Materials:
Manila paper, permanent pens, masking tape

Suggested Resources

(1) Earth Observatory. (n.d.). *Sensing remote volcanoes: Feature articles.* Retrieved from http://earthobservatory.nasa.gov/Features/monvoc/monvoc2.php

(2) Lastog561. (2007, June 9). *Mt. Pinatubo explosion at clark air base, philippines part 1* [Video file]. Retrieved from https://www.youtube.com/watch?v=SMe0VPQftsc&list=PLvK95S7LA5_LGKDQQDZJ3EorompbMWhOO

(3) Oregon State University. (n.d.). *What are the signs that a volcano is about to erupt?* Retrieved from http://volcano.oregonstate.edu/what-are-signs-volcano-about-erupt

(4) Philippine Institute of Volcanology and Seismology. (2008). *Phivolcs volcano monitoring*. Retrieved from http://www.phivolcs.dost.gov.ph/index.php?option=com_content&view=article&id=50&Itemid=86

(5) Philippine Institute of Volcanology and Seismology. (2010). *Ang mga sensyales kon maglupok ang bulkan kanla-on* [Poster]. Retrieved from http://www.phivolcs.dost.gov.ph//images/attachments/article/757/EULogo_Poster_KANLAON_TRANSLATED_Precursor_ilonggo.jpg

Additional Resources at the End of this Lesson

BEFORE THE LESSON

This work must be assigned 2 weeks before actual day of lesson

1. Divide class into 5 groups, assign the 1 topic per group to research on
   I. **Ground deformation** (geodetic measurements-) as used in monitoring volcanoes
   II. **Geochemistry**: Gas emissions from volcanoes (what types of gases are measured/monitored? What kinds of instruments are used?- getting samples from vents, fumaroles and analyzing in the laboratory, remote and direct measurement)
   III. **Seismic activity** (a seismometer is installed on the volcano to detect volcanic earthquakes,
   IV. Monitoring signs of impending eruption by **remote sensing** (what are some tools used? Advantages and disadvantages of using remote sensing)
   V. **Sensory observations** (visual, auditory, olfactory, tactile). Expect - will some learners mention unusual animal behavior?
2. Prepare a group poster presentation on the assigned group topic
   I. Size: whole illustration board, or 2 cartolinas
   II. Content of poster: Include brief explanation of different monitoring parameters and equipment/ instrument; include pictures or illustrations
3. Bring the poster to class on assigned date.

Teacher Tip:

Precursors of an Impending Volcanic Eruption

The following are commonly observed signs that a volcano is about to erupt. These precursors may vary from volcano to volcano.

1. Increase in the frequency of volcanic quakes with rumbling sounds; occurrence of volcanic tremors
2. Increased steaming activity; change in color of steam emission from white to gray due to entrained ash
3. Crater glow due to presence of magma at or near the crater
4. Ground swells (or inflation), ground tilt and ground fissuring due to magma intrusion
5. Localized landslides, rockfalls and landslides from the summit area not attributable to heavy rains
6. Noticeable increase in the extent of drying up of vegetation around the volcano's upper slopes
7. Increase in the temperature of hot springs, wells (e.g. Bulusan and Canlaon) and crater lake (e.g. Taal) near the volcano
8. Noticeable variation in the chemical content of springs, crater lakes within the vicinity of the volcano
9. Drying up of springs/wells around the volcano
10. Development of new thermal areas and/or reactivation of old ones;appearance of solfataras

From:
http://www.phivolcs.dost.gov.ph/index.php?option=com_content&view=article&id=50&Itemid=86

INTRODUCTION (5 MINS)

Communicate Learning Objectives

1. Identify the different parameters used to monitor volcanoes
2. Explain the common signs of an impending volcanic eruption

Teacher Tip:
This portion is just a review of JHS topic on volcanoes.

MOTIVATION (10 MINS)

Photographs

1. Show these photos of impacts of volcanic eruptions.
2. What do we have here? (2 kinds of eruption, one violent or explosive and one effusive or quiet)

Teacher Tip:
There are several kinds of events caused from volcanic action that can be harmful to life and property. These include lava flows, lahars, ash falls, debris avalanches, and pyroclastic density currents (pyroclastic flows and surges) –by RV Fisher http://volcanology.geol.ucsb.edu/hazards.htm

Mayon Volcano eruption, 1984. An example of pyroclastic flow event. *Photo from PHIVOLCS.*

Mayon Volcano eruption, 1984. An example of lava flow event *Photo from PHIVOLCS.*

INSTRUCTION (35 MINS)

Gallery Walk

1. Each group is given 7 minutes to present their work to the whole class
2. Let the learners have time to explain and discuss their poster.
3. Reiterate important points within the topic

Discussion

1. Discuss:

   Most volcanoes provide various types of warnings before eruptions begin. Some volcanoes, especially those that have not erupted for a long time (hundreds of years) might display obvious precursors of reactivation months to weeks before a major eruption (ex. Pinatubo in 1991).

   Some volcanoes might **explode without warning if the type of eruption is what is known as phreatic. Also known as** steam-blast eruptions, these events could occur with little or no warning as superheated water flashes to steam similar to what happened at Mayon volcano in 2013 and Ontake Volcano, Japan (2014) https://www.youtube.com/watch?v=aQtkoLxqUNQ and https://www.youtube.com/watch?v=3ObsOj9Q2Do

   It is important to be able to observe warning signs of volcanic unrest so that people can evacuate in time, to minimize injuries and casualties. It is therefore important to be able to monitor a volcano's activity, and this is normally done with the aid of different tools or instruments to monitor the different parameters.

   The assessment of a volcano's status (if it is quiet or in normal state, in state of unrest, expected to erupt, erupting) is based on the different parameters that can be observed. Volcanologists often use a combination of as many data available from the different parameters used for evaluation. For example the number of earthquakes as recorded by the seismograph may increase from background levels of 0-5 per week and may escalate into 100s in a day.

   This is further confirmed and supported by increasing number of earthquakes felt by the local people. In addition other parameters such as gas measurements and water acidity may also show signs of increasing trend.

PARAMETERS	EQUIPMENT / INSTRUMENT / TOOLS	WHAT TO OBSERVE
Ground deformation	• Precise engineering methods of surveying using the instrument Electronic Distance Meter (EDM) to measure accurately to millimeter changes on ground (if the slope for the volcano swells • Swelling of the ground surface can be detected by using precision instruments and techniques that measure minute changes in slope, distance, or elevation at the ground surface. • Deformation on ground is also measured using data of repeated measurements from permanent Global Positioning System (GPS) installed around the volcano. • Use of Remote sensing images also help compare before and afer features.	• Some subtle (in millimeters) ground movements may be detected only by sensitive instruments/ equipment

PARAMETERS	EQUIPMENT / INSTRUMENT / TOOLS	WHAT TO OBSERVE
Geochemistry (Gas, Water, temperature)	• Direct measurement of temperature and chemistry ground water, spring water or lakes (using a thermometer /thermocouple, pH meter)	• Changes in temperature • Water becomes more acidic
Geochemistry (Gas, Water, temperature)	• Gas being emitted by volcanic can be measured directly by gas monitoring equipment • Collect gas and water samples from vents and fumaroles and analyze in the laboratory (X-Ray Flourescence XRF) • Remote monitoring Gas monitoring equipment (COSPEC- correlation spectrometer for FlySPEC/ ScanDOAS for SO_2; and CO_2 flux meter for CO_2)	• Some gas, for example SO_2 from base levels of 100 tons/day jump to 4,000 tons/day s can be an indication of unrest
Seismic activity/ Seismicity/ volcanic earthquakes	• Seismometer is the equipment used to detect occurrence of volcanic earthquakes	• Increase in number of volcanic earthquakes recorded
People living near volcanoes may observe premonitory events before an eruption		
Visual, observations		• Intensified steaming activity • What used to be white steam slowly or drastically change to gray to dark (suggests increasing presence of ash) • Drying up of vegetation, drying up of streams, water wells • Crater glow at the summit area • Increasing frequency of rolling rocks from the summit; localized landslides not related to heavy rains • Summit area appears to glow or becomes incandescent at night

People living near volcanoes may observe premonitory events before an eruption	
Auditory observations	• Hear rumbling sound
Olfactory	• Smell of sulfur (rotten eggs)
Feel (Tactile)	• Ground movement/ volcanic earthquake increasingly become felt

SOME DEFINITIONS

Ground deformation- Ground deformation refers to surface changes on a volcano, such as subsidence (sinking), tilting, or bulge formation, due to the movement of magma below the surface. Deformation changes at a volcano, such as those related to magnitude or location, may indicate that an eruption is about to occur. (http://earthobservatory.nasa.gov/Features/monvoc/monvoc2.php)

Use of **remote sensing technology** or techniques as applied to volcano monitoring. Monitoring surface changes on a volcano from afar- using available tools such as satellite images; advantage: less exposure on the ground for volcanologists, safer; but sometimes interpretation needs field verification.

Seismic activity—from earthquakes to swarms of earthquakes. Most unrest in volcanoes start with volcanic earthquakes. Volcanoes and earthquakes go hand in hand. The challenge is to determine which patterns of seismic waves precede an eruption. When magma makes its way up to the surface it breaks the rocks along the way, and in so doing, earthquakes are generated.

Gases—types and rate of emission. Gases rise through vents called fumaroles (from the Latin for "smoke") and other cracks. Sometimes the concentrations are high enough to create acid rain that kills vegetation—the trees at the Long Valley, California, caldera, for example. That's one very visible sign of activity, but scientists have several ways to measure the rate of emissions more precisely. They can collect samples from vents directly, but it is safer to use remote sensing instruments. Scientists mount/ install infrared and correlation spectrometers from airplanes, for example, and fly through a plume of gas. These instruments read energy signatures—thermal output or electromagnetic frequencies—to identify and quantify the gases. (source: http://www.planetseed.com/relatedarticle/major-warning-signs)

ASSESSMENT (5 MINS)

Quiz - True or False?

1. In order to assess and forecast a volcano's activity, volcanologists need only to use one parameter.
2. Aside from instrumental monitoring, people living near volcanoes on their own, may observe premonitory events before an eruption such as intensified steaming activity.
3. As the volcano unrest progresses into an eruption, volcanic earthquakes not only increase in number but the number of earthquakes felt by many people become more and more frequent.
4. Measuring the amount of gases being emitted by volcanoes is also an important aspect of volcano monitoring.
5. The development and use of remote sensing technology in monitoring volcanoes has greatly contributed to the safety of scientists.
6. In visual observation, it is not only the increase in volume of steam that is observed but the color of steam, which might drastically change from "white" to "dark gray".

Answer Key:

1. FALSE
2. TRUE
3. TRUE
4. TRUE
5. TRUE
6. TRUE

ENRICHMENT (5 MINS)

1. Go back to the earlier question posed. "Why it is important to monitor a volcano's status?"

	4	3	2	1
GROUP POSTER PRESENTATION (FORMAT, LAYOUT, CONTENT, FIGURES)	Group members demonstrate full grasp of topic, presents complete and accurate information Poster has excellent design and layout. Neat and easy to understand the content Pictures and graphics are clear and relevant	Group members at ease with topic and presents accurate information Poster has nice design and layout. It is neat and easy to read Most pictures and graphics are clear and relevant	Group members uncomfortable with information, leaves out important details and/or presents inaccurate information The poster needs improvement in design , layout or neatness Few of the pictures and graphics are clear and relevant	Group members do not have grasp of information , many statements are incorrect and unsupported The poster needs significant improvement in design, layout or neatness The learner's pictures are not clear and relevant
COOPERATION AMONG MEMBERS	The Leader was able to facilitate the discussion well, the Reporter was able to clearly present the summary of the group's output within the given time.	The Leader, Secretary, Reporter and the rest of the members were able to help each other and were able to come up with a comprehensive output.	The learners know their roles but were not actively portraying their responsibilities the entire time.	The learners do not know their roles and the discussion was not properly facilitated among the learners.

Additional Resources:

(1) Philippine Institute of Volcanology and Seismology. (2010). *Mga sensyales aron mahibaw-an nga mobuto ang bulkang kanla-on* [Poster]. Retrieved from http://www.phivolcs.dost.gov.ph//images/attachments/article/757/EULogo_Poster_KANLAON_TRANSLATED_Precursor_Cebuano.jpg

(2) The Major Warning Signs. (n.d.). Retrieved from http://www.planetseed.com/relatedarticle/major-warning-signs

(3) U.S. Geological Survey. (n.d.). *Monitoring and studying volcanoes faqs.* Retrieved from http://www.usgs.gov/faq/categories/9818/3783

(4) Philippine Institute of Volcanology and Seismology. (1984). Mayon volcano eruption: An example of pyroclastic flow event [Photograph]. Philippine Institute of Volcanology and Seismology. (1984). *Mayon volcano eruption: An example of lava flow event* [Photograph].

(5) Fisher, R. V. (1997). *Hazardous volcanic events.* Retrieved from http://volcanology.geol.ucsb.edu/hazards.htm

(6) robertsc1. (2014, Septermber 27). Japan's mount ontake volcano erupted/eruption, killing 34 people, report BBC (corrected aspect) [Video file]. Retrieved from https://www.youtube.com/watch?v=3ObsOj9Q2Do

(7) BBC News. (2014, September 29). *Video: Japan volcano shoots rock & ash on mount ontake - Bbc news* [Video file]. Retrieved from https://www.youtube.com/watch?v=aQtkoLxqUNQ

60 MINS

Volcano Hazard Maps

Content Standard
The learners demonstrate understanding of volcano-related hazards.

Performance Standard
The learners shall be able to:

- develop a family emergency preparedness plan to guide them on what to do before, during, and after a volcanic eruption

Learning Competency
The learners are able to:

- Interpret different volcano hazard maps **(DRR11/12-lh-i-25)**

Specific Learning Outcomes
At the end of the lesson, the learners will be able to:

- identify the different types of volcano hazard maps;
- demonstrate how to use the different volcano hazard maps for evacuation planning; and
- explain what Volcano Alert Levels mean

LESSON OUTLINE

Before the Lesson	Prerequisite Learner Knowledge and Competencies	
Introduction	Communicating Learning Objectives	15
Instruction and Practice	Activity	35
Enrichment	Group Work	15

Materials:
Manila paper, permanent pens, masking tape

Suggested Resources

(1) GNS Science, Te Pü Ao. (n.d.). Hazard Maps. Retrieved from http://gns.cri.nz/Home/Learning/Science-Topics/Volcanoes/Eruption-What-to-do/Hazard-maps
(2) Philippine Institute of Volcanology and Seismology. (2011). Taal Volcano Alert Level. Retrieved from http://www.phivolcs.dost.gov.ph/index.php?option=com_content&view=article&id=815&Itemid=500044
(3) Philippine Institute of Volcanology and Seismology. (2015). Mayon Volcano Alert Level. Retrieved from http://www.phivolcs.dost.gov.ph/index.php?option=com_content&view=article&id=816&Itemid=500045
(4) Philippine Institute of Volcanology and Seismology. (n.d.). Mayon Volcano Hazard Maps. Retrieved from http://www.phivolcs.dost.gov.ph/html/update_VMEPD/vmepd/vmepd/mayonhazmaps.htm
(5) Philippine Institute of Volcanology and Seismology. (n.d.). Taal Volcano Hazard Maps. Retrieved from http://www.phivolcs.dost.gov.ph/html/update_VMEPD/Volcano/VolcanoList/taal.htm

Additional Resources at the Back

BEFORE THE LESSON

Prerequisite Knowledge and Competencies

1. This module will require more than one hour of seriously studying the maps- to know what they mean and how to use them.
2. It is also assumed that the learners already have background knowledge on map reading.
3. The in-class activity is meant to introduce the learners to the concepts. As the time is limited, it is suggested to focus on the most dangerous of hazards from volcanoes, which is the pyroclastic flows or surges.

INTRODUCTION (10 MINS)

Communicate learning objectives (5 mins)

After the end of the lesson, the learners will be able to

1. Identify the different types of volcano hazard maps
2. Demonstrate how to use the different volcano hazard maps for evacuation planning
3. Explain what Volcano Alert Levels

Teacher Tip:
This portion is just a review of JHS topic on volcanoes.

Review (5 mins)

1. Ask the class what they remember about the major hazards related with volcano eruption event

INSTRUCTION AND PRACTICE (35 MINS)

Introduction of the Topic (15 mins)

1. Discuss:

   Volcano Alert Levels. In the Philippines, we use a system of Volcano Alert Signals to define the current status of each volcano. The alert levels range from 0 to 5. The alert levels are used to guide any appropriate response from the Local Government Units (LGUs). Examples of Volcano Alert Levels for the 6 most active volcanoes in the Philippines can be found in this link: http://www.phivolcs.dost.gov.ph/index.php?option=com_content&view=article&id=50&Itemid=86

Teacher Tip:
For more information about Taal Volcano, see this link: http://www.phivolcs.dost.gov.ph/html/update_VMEPD/Volcano/VolcanoList/taal.htm

For more information about Mayon Volcano see this link: http://www.phivolcs.dost.gov.ph/html/update_VMEPD/Volcano/VolcanoList/mayon.htm

For each of the **Alert Level**, there should be a corresponding action coming from authorities. For example, take a look at Mayon Volcano Alert Levels, if Alert Level 1 is declared, it is advised the people should not venture into the 6-kilometer radius **Permanent Danger Zone**.

The **Permanent Danger Zone (PDZ)** for volcanoes is an delineated and identified where no permanent habitation is recommended due to the possible impact of various hazards at any time. For Mayon Volcano, the area covered within 6-kilometer radius from the summit is delineated as the PDZ. As soon as Alert Level is raised from 0 to 1, it is recommended that people should not venture within this area at any time. This is already part of the precautionary action taken by the Province of Albay when Alert 1 is declared.

Geologists gain better understanding of likely future hazards by studying the geology of the volcano, observing eruptions and monitoring background levels of activity. These are then shown in **hazard maps**.

Hazard maps illustrate potential for ground-based volcanic impacts—lava flows, pyroclastic flows, ashfall, volcanic gases, and more far-reaching hazards (such as lahars) in valleys that drain the volcano (USGS, http://volcanoes.usgs.gov/observatories/cvo/hazards.html). To help understand the areas that may be affected by specific volcanic eruption phenomena, hazard maps are used. These maps show areas that can be affected and areas that are safe (http://gns.cri.nz/Home/Learning/Science-Topics/Volcanoes/Eruption-What-to-do/Hazard-maps). Hazard maps are generated for various uses and are most useful in determining risks of living in identified potentially hazardous areas. Hazard maps can also help people to become aware of specific dangers (lava flow , pyroclastic flows, ashfall, lahars, etc) they might face in the event that a volcano reactivates.

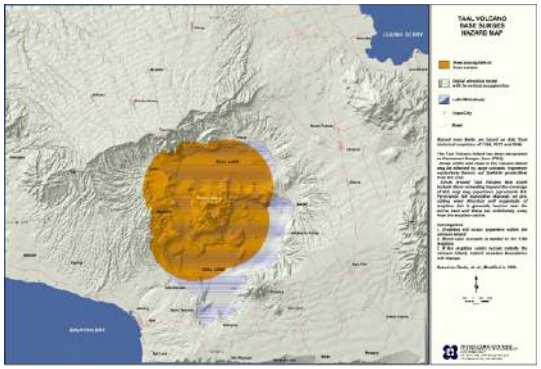
Resource:
Pyroclastic flow from Pinatubo Volcano eruption, June 1991
Photo from PHIVOLCS

Hands-On: Case Studies - Taal Volcano and Mayon Volcano (20 mins)

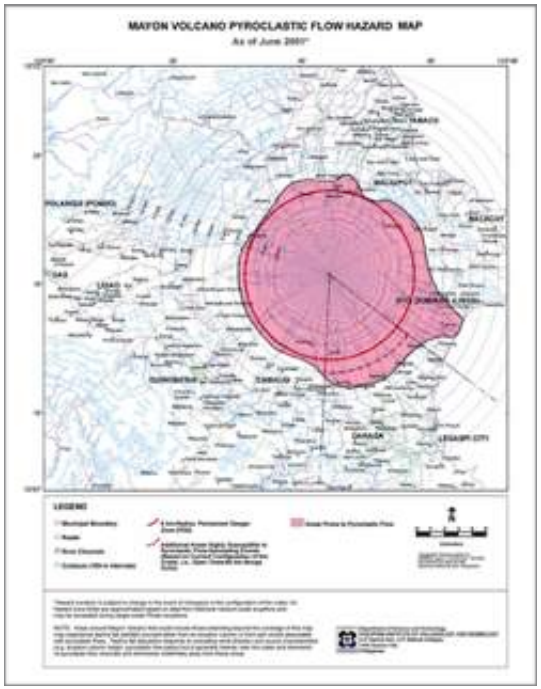
1. Divide the class into 4 groups. Groups 1 and 2 will use the Taal Volcano Base Surge Hazard Map while Groups 3 and 4 will use the Mayon Volcano Pyroclastic flow Hazard Map.
2. Remember our previous lesson about volcanoes- there are several hazards associated with erupting volcanoes: **lava flows, ash fall, pyroclastic flows/ surges, lahars, volcanic gases** among others.
3. For today we will focus on one of the most dangerous hazards from a volcano**. Pyroclastic flows and surges (Pyroclastic density current)-** turbulent mass of ejected fragmented volcanic materials (ash and rocks), mixed with hot gases (200°C to 700°C to as hot as 900°C) that flow downslope at very high speeds (>60kph). Surges are the more dilute, more mobile derivatives or pyroclastic flows.
4. Pyroclastic flows and surges are potentially highly destructive owing to their mass, high temperature, high velocity and great mobility. Pyroclastic flows can:
   I. Destroy anything on its path by direct impact
   II. Burn sites with hot rocks debris
   III. Burn forests, farmlands, destroy crops and buildings
5. Deadly effects include asphyxiation (inhalation of hot ash and gases), burial, incineration (burns) and crushing from impacts.
6. The only **effective method of risk mitigation is evacuation** prior to such eruptions from areas likely to be affected by pyroclastic density currents

7. For today, examine the **Taal Volcano Base Surge Hazard Map,** or the **Mayon Volcano Pyroclastic Flow Hazard Map**. Again, as we have learned, for any map, before using the map, be sure that you understand the basic parts-
   I. Map Title (tells you what the map is all about);
   II. Legend (details of what each symbols/ colors mean)
   III. Scale (refer to the bar scale as this helps determine distances, etc)

8. Based on the hand, For Mayon Volcano, which municipalities have communities on the slope of Mayon? Write these on the Table provided.
9. Using the map, Fill in **Table 1** and **Table 2** Present in Class.



Resource:
Taal Volcano Base Surges Hazard Map



Resource:
Mayon Volcano Pyroclastic Flow Hazard Map

Group Report

Name of Volcano: _____

1. For Taal Volcano, based on the hazard map identify the municipalities/Cities that are likely to be affected by the pyroclastic flows or surges .
2. For Mayon Volcano, for each municipality, identify barangays that are within 6-kilometer PDZ. Which barangays are within 6-7 km? 7-8 km?

Table 1.

PUT SPECIFIC NAME	BARANGAYS WITHIN 6 KM	BARANGAYS WITHIN 6-7 KM	BARANGAYS WITHIN 7-8 KM
Municipality 1			
Municipality 2			
Municipality 3			
Municipality 4			
Municipality 5			

3. Part of what disaster officers need to do prior to any event, as part of a disaster plan is to identify areas for evacuation. If you are to identify sites for evacuation, where will you put this? Take note, it is important to be sensitive to the needs of the people living in affected communities. An evacuation area should be outside the identified hazard zone, accessible, least inconvenience for the evacuees.

Table 2.

BARANGAY TO BE EVACUATED	RECOMMENDED AREAS FOR EVACUATION	DISTANCE OF EVACUATION AREA FROM BARANGAY LOCATION

4. Fill out Table 2. For each of the Barangay you listed in Table 2, select a temporary evacuation area based on parameters mentioned in #3. Which areas will you suggest/ recommend for temporary evacuation? Why did you suggest this?

ENRICHMENT (15 MINS)

1. Each group should present the results of their work. **(3 minutes/ group = total of 12 minutes)**
2. Teacher to ask the class for questions or comments about the work of each group.
3. Teacher to give her final comments **(3 minutes)**

	4	3	2	1
SUMMARY TABLE	The list is complete.	The list of answers from the learners has 60%- 90% of expected items as mentioned in the teacher's guide.	The list of answers from the learners has 25%-60% of expected items as mentioned in the teacher's guide.	The list of answers from the learners does not show any of expected items as mentioned in the teacher's guide.
COOPERATION AMONG MEMBERS	The Leader was able to facilitate the discussion well, the Reporter was able to clearly present the summary of the group's output within the given time.	The Leader, Secretary, Reporter and the rest of the members were able to help each other and were able to come up with a comprehensive output.	The learners know their roles but were not actively portraying their responsibilities the entire time.	The learners do not know their roles and the discussion was not properly facilitated among the learners.

Additional Resources:

(1) Philippine Institute of Volcanology and Seismology. (n.d.). Taal Volcano. Retrieved from
(2) http://www.phivolcs.dost.gov.ph/html/update_VMEPD/Volcano/VolcanoList/taal.htm
(3) Philippine Institute of Volcanology and Seismology. (n.d.). Mayon Volcano. Retrieved from
(4) http://www.phivolcs.dost.gov.ph/html/update_VMEPD/Volcano/VolcanoList/mayon.htm
(5) U.S. Geological Survey. (2014). Volcano Hazards in the Cascade Range. Retrieved from http://volcanoes.usgs.gov/observatories/cvo/hazards.html
(6) Philippine Institute of Volcanology and Seismology. (2008). PHIVOLCS Volcano Monitoring. Retrieved from http://www.phivolcs.dost.gov.ph/index.php?option=com_content&view=article&id=50&Itemid=86
(7) Garcia, A. (1991). [Untitled photograph of a truck in front of the pinatubo volcano eruption]. Retrieved from https://www.google.com.ph/search?q=Pinatubo+Volcano+eruption+impacts&biw=1280&bih=705&tbm=isch&tbo=u&source=univ&sa=X&ved=0CDUQsARqFQoTCNqdlcLDqsgCFcUUlAod170LWA#imgrc=ijVzHDr1ETbT6M%3

60 MINS

Precautionary Safety Measures for Volcanic Eruptions

Content Standards
The learners demonstrate understanding of volcano-related hazards.

Performance Standards
The learners shall be able to:

- develop a family emergency preparedness plan to guide them on what to do before, during, and after a volcanic eruption.

Learning Competencies
The learners are able to:

- identify appropriate measures or interventions before, during and after a volcanic eruption **(DRR11/12-lh-i-26)**

Specific Learning Outcomes
At the end of the lesson, the learners will be able to:

- identify the different measures/interventions before a volcanic eruption
- identify the different measures to take during a volcanic eruption
- identify the different measures to take after a volcanic eruption

LESSON OUTLINE

Introduction	Communicating Learning Objectives	3
Motivation	Pose a Question	5
Instruction and Practice	Role Playing and Discussion	45
Evaluation	True or False	5

Materials:
Manila paper, permanent pens, masking tape

Suggested Resources
Precautionary Measures

(1) Centers for Disease Control and Prevention. (2014). *Key Facts About Protecting Yourself During a Volcanic Eruption*. Retrieved from http://emergency.cdc.gov/disasters/volcanoes/during.asp
(2) Daskeo, F. (n.d.). Precautionary Measures Before, During, and After Volcanic Eruptions. Retrieved from https://science1.knoji.com/precautionary-measures-before-during-and-after-volcanic-eruptions/
(3) GNS Science, Te Pü Ao. (2010). Be Prepared: Volcanic Ash Fall. Retrieved from http://www.gns.cri.nz/Home/Learning/Science-Topics/Volcanoes/Eruption-What-to-do/Be-Prepared-Volcanic-Ash-Fall
(4) Ideas for Action : Save, Recycle and Do Not Pollute. (1992). Retrieved from http://collections.infocollections.org/ukedu/en/d/Jii25ie/5.9.html#Jii25ie.5.9
(5) Lastog561. (2007, June 9). Mt. Pinatubo Explosion At Clark Air Base, Philippines Part 1 [Video file]. Retrieved from https://www.youtube.com/watch?v=SMe0VPQftsc

Additional Resources at the End of this Lesson

INTRODUCTION (10 MINS)

Communicate learning objectives (5 mins)

After the end of the lesson, the learners will be able to

1. Identify the different measures/interventions before a volcanic eruption
2. Identify the different measures to take during a volcanic eruption
3. Identify the different measures to take after a volcanic eruption

Teacher Tip:
This portion is just a review of JHS topic on volcanoes.

MOTIVATION (5 MINS)

Pose a Question

1. From previous lesson, we learned about the dangers from erupting volcanoes. Below are some photos showing impacts of volcanic eruptions.
2. How can we protect ourselves?
3. How can we avoid or minimize the negative impacts of volcanic eruptions?

Teacher Tip:
There are several kinds of events caused from volcanic action that can be harmful to life and property. These include lava flows, lahars, ash falls, debris avalanches, and pyroclastic density currents (pyroclastic flows and surges) –RV Fisher http://volcanology.geol.ucsb.edu/hazards.htm

> ***Note:*** *This portion must be assigned after the discussion on volcano hazards* ***(DRR11/12-Th-i22 and DRR11/12-Ih-I 23)*** *before actual class for the learners to have time to prepare.*

INSTRUCTION AND PRACTICE (45 MINS)

Role Playing: Demonstrate What to do before, during and after (30 minutes)

1. You have divided the class into 3 groups during the previous meeting (based on **DRR 11/12-Ih-i22** and **DRR 11/12-Ih-i-23**) .
   I. Group 1 what to do BEFORE a volcano eruption
   II. Group 2, what to do DURING a volcano eruption
   III. Group 3. What to do AFTER a volcano eruption
2. Each group is given 10 minutes to present their chosen situation on how to best represent as many "what to dos"

Discussion (15 mins)

3. After the role-playing, to emphasize important details, teacher will discuss in the class the following:

   VOLCANIC ERUPTION PREPAREDNESS. Teacher may opt to check out from the list what have been demonstrated in the role play.

   Active volcanoes are being monitored for possible unrest so that major eruptions can be forecast and predicted. An eruption can affect the surrounding environment, destroy structures and cause deaths and injuries to man.

   Although volcanoes are dangerous when in eruptive stage, there are still also many benefits that man derive from a volcano when it is quiet. As volcanoes do not erupt frequently, during its long periods of quiescence, the rich fertile soil derived from the volcanoes provide land for agriculture and livestock , such that economic activities and communities have flourished in the shadow of volcanoes. **There are many ways by which man can prepare and protect himself from volcanic eruptions.**

Volcanic Eruption Preparedness

Before

1. For longer-term development planning, consult available volcano hazard maps that indicate areas declared as permanent danger zones (PDZs) and areas likely to be affected by different volcanic hazards so that these areas are avoided when choosing sites for developing new residential areas, commercial/ business areas, siting for critical facilities etc.
2. Be aware of the kinds of volcanic hazards present in your area. Determine the distance of your residence, workplace and livelihood (farms, etc) from the volcano. Know if you are within what kilometer radius from the volcano summit your location is.
3. Be aware of the meanings of Alert Levels, and recommended actions. Make sure your family emergency plan has taken this into consideration.
4. Be aware of community efforts such as identified evacuation areas as well as designated pick up points . Make sure that the whole family knows about this. If you do not plan to stay in evacuation area, and has other alternatives (another house, relatives in another town), make sure that the whole family is aware of this.

Teacher Tip:

Each volcano will have different characteristics of eruption depending on type (composition which can be learned from the rocks from the volcano). As such, **Alert Level** descriptions will vary.

Examples of Alert Level Scheme can be found in the following links:

- Taal Volcano - http://www.phivolcs.dost.gov.ph/index.php?option=com_content&view=article&id=815&Itemid=500044
- Mayon Volcano - http://www.phivolcs.dost.gov.ph/index.php?option=com_content&view=article&id=816&Itemid=500045
- Bulusan Volcano - http://www.phivolcs.dost.gov.ph/index.php?option=com_content&view=article&id=817&Itemid=500046
- Hibok hibok Volcano - http://www.phivolcs.dost.gov.ph/index.php?option=com_content&view=article&id=1237&Itemid=500047
- Pinatubo Volcano - http://www.phivolcs.dost.gov.ph/index.php?option=com_content&view=article&id=1236&Itemid=500048
- Kanlaon Volcano - http://www.phivolcs.dost.gov.ph/index.php?option=com_content&view=article&id=1238&Itemid=500049

5. Stock enough non-perishable off and potable water. Cooking fuel, emergency light,/ flashlight, whistle, battery operated radio, medicines, first-aid kit, dust mask, should be made part of your emergency kit.
6. Consider provisions for pet animals, etc.
7. Always listen to the radio's latest **PHIVOLCS Alerts** (***See Teacher Tip #1***) and information. Heed the advise of community leaders or LGUs about evacuation procedures.

During

1. Stay inside the house or evacuation area. Do not go sightseeing.
2. Listen to the radio for advise and information.
3. If you are outside and very near the volcano, leave the area immediately. If caught in ashfall or **tephra*** fall, seek shelter immediately. Sometimes, pieces of rocks may be hot, seek care for burns right away.
4. Do not drive. If you must drive, keep the ca windows up and do not operate the air conditioning system as this will bring in ash from outside. Drive slowly as ashfall will reduce visibility. Ash on road surface can cause the roads to become slippery.
5. Check that your pet or livestock have enough food.
6. Do not try to clean or shovel the ashfall during eruptions.
7. Protect yourself from ashfall.
   I. Close windows and doors to stop the ash from entering the house.
   II. Turn off all electric fans and airconditioning units.
   III. Wear dust-mask or cover your face with clean wet towel or cloth to prevent ash from irritating the eyes and entering the respiratory track.
   IV. Better to use bottled water. If you must use tap water, always boil water first before using.

After

1. Listen to the latest update about **Alert Levels,** other information from the radio.
2. Cook food thoroughly.
3. If the family has evacuated during the eruption, only the adult members of the family should be allowed to go home to inspect the house condition.

Teacher Tip:

Tephra- is fragmental material produced by a volcanic eruption regardless of composition, fragment size or emplacement mechanism. Volcanologists also refer to airborne fragments as pyroclasts. Once clasts have fallen to the ground they remain as **tephra**

Size ranges > 64 mm volcanic bombs/blocks
2- 64 mm lapilli
< 2 mm ash

4. Only when local authorities- the LGUs have declared that it is safe to go home that the family should return.
5. How to clean up an ashfall
   I. As soon as the ashfall has stopped, remove the ash immediately.
   II. Wear dust mask before you start cleaning.
   III. The recommended method to clean the ash is to lightly damp the ash so that it does not billow when swept.
   IV. Clean house roofs first, to prevent damage to gutters and down-pipes.
   V. Do not dump ash in sewage systems.
   VI. Inside the house, use damp cloth to remove ash. Avoid vigorous rubbing as ash particles are very abrasive.
   VII. To remove ash from your car, wash with plenty of water.

EVALUATION (5 MINS)

Quiz - True or False?

1. Be aware of community efforts such as identified evacuation areas as well as designated pick up points.
2. At the peak or height of eruption, one can go out and do sightseeing as eruptions are a sight to see.
3. Heavy ashfall can severely reduce visibility, that is why people are advised not to drive.
4. During and after heavy ashfall, if you must use tap water, always boil water first before using.
5. To remove ash inside the house, use damp cloth and vigorously rub off the surface covered with ash.
6. Wear dust-mask or cover your face with clean dry towel or cloth to prevent ash from irritating the eyes and entering the respiratory track.

Answer Key:

1. True
2. False
3. True
4. True
5. False
6. False

Assignment:

1. Bring bond paper and pencil for the next meeting.

	4	3	2	1
ROLE PLAY	• 6 or more measures were demonstrated in the role play • Always willing and focused during group work and presentation • Convincing communication of character's feelings, situation and motives • Purpose is clearly established and effectively sustained • Impressive variety of non-verbal cues are used in an exemplary way • Choices demonstrate insightful and powerfully enhanced role play	• There are 4-5 measures included in the presentation • Usually willing and focused during group work and presentation • Competent communication of character's feelings, situations and motives • Purpose is clearly established and generally sustained • Good variety of non-verbal cues (voice, gestures, eye contact, props, costumes) are used in a competent way • Choices demonstrate thoughtfulness and completely enhance role play	• Able to incorporate 2-3 measures as listed • Adequate communication of character's feelings, situation and motives • Purpose id established but may not be sustained • Satisfactory variety of non-verbal cues (voice, gestures, eye contact, props, costumes) used in an acceptable way • Choices demonstrate awareness and developing acceptably enhance role play	• Only 0-1 of preparedness measures as listed was demonstrated • Group members rarely willing and focused during group work and presentation • Limited communication of character's feelings, situation and motives • Purpose is vaguely established and may not be sustained • Limited variety of non-verbal cues (voice, gestures, eye contact, props, costumes) • Choices demonstrate little awareness and do little to enhance role play.

Additional Resources:

1. Philippine Institute of Volcanology and Seismology. (2010). *Ang mga sensyales kon maglupok ang bulkan kanla-on* [Poster]. Retrieved from http://www.phivolcs.dost.gov.ph//images/attachments/article/757/EULogo_Poster_KANLAON_TRANSLATED_Precursor_ilonggo.jpg
2. Philippine Institute of Volcanology and Seismology. (2010). *Mga sensyales aron mahibaw-an nga mobuto ang bulkang kanla-on* [Poster]. Retrieved from http://www.phivolcs.dost.gov.ph//images/attachments/article/757/EULogo_Poster_KANLAON_TRANSLATED_Precursor_Cebuano.jpg
3. ProVention Consortium. (2008, August 7). Tales of Disasters 4. Volcano (English) [Video file]. Retrieved from https://www.youtube.com/watch?v=6bPdmvLPo_0
4. U.S. Geological Survey. (2014). . Retrieved from https://volcanoes.usgs.gov/ash/ashfall.html
5. U.S. Geological Survey. (2015). Volcanic Ash Impacts and Mitigation. Retrieved from
6. https://volcanoes.usgs.gov/volcanic_ash/
7. Fisher, R. V. (1997). Hazardous volcanic events. Retrieved
8. from http://volcanology.geol.ucsb.edu/hazards.htm
9. Impact of heavy ashfall during the 1991 Pinatubo Eruption, Clark Airbase. (1991). Retrieved from [insert URL here]
10. Philippine Institute of Volcanology and Seismology. (2011). *Taal Volcano Alert Signal.* Retrieved from http://www.phivolcs.dost.gov.ph/index.php?option=com_content&view=article&id=815&Itemid=500044
11. Philippine Institute of Volcanology and Seismology. (2015). *Mayon Volcano Alert Levels.* Retrieved from http://www.phivolcs.dost.gov.ph/index.php?option=com_content&view=article&id=816&Itemid=500045
12. Philippine Institute of Volcanology and Seismology. (2011). *Bulusan Volcano Alert Signals.* Retrieved from http://www.phivolcs.dost.gov.ph/index.php?option=com_content&view=article&id=817&Itemid=500046
13. Philippine Institute of Volcanology and Seismology. (2011). *Hibok-hibok Volcano Alert Signals.* Retrieved from http://www.phivolcs.dost.gov.ph/index.php?option=com_content&view=article&id=1237&Itemid=500047
14. Philippine Institute of Volcanology and Seismology. (2011). *Pinatubo Volcano Alert Signals.* Retrieved from http://www.phivolcs.dost.gov.ph/index.php?option=com_content&view=article&id=1236&Itemid=500048
15. Philippine Institute of Volcanology and Seismology. (2015). *Kanlaon Volcano Alert Level Scheme.* Retrieved from http://www.phivolcs.dost.gov.ph/index.php?option=com_content&view=article&id=1238&Itemid=500049

60 MINS

Landslides and Sinkholes

Content Standard
The learners demonstrate understand of related geological hazards including: rainfall-induced landslides and sinkholes.

Performance Standard
The learners shall be able to:

- develop a family emergency preparedness plan to guide them on what to do before, during and after the occurrence of events that *are caused by* geological hazards.

Learning Competency
The learners are able to:

- interpret geological maps **(DRR11/12 IIa-b-30)**

Specific Learning Outcomes
At the end of the lesson, the learners will be able to:

1. identify the different elements of a geohazard map;
2. interpret geohazard maps provided by the Mines and Geosciences Bureau to identify areas prone to landslide and flooding;
3. be aware of how geologically dynamic is the area in which they live in;
4. be aware of the potential geohazards they are exposed to in their *barangay;* and
5. identify possible safe evacatuion routes in case of landslides and floods.

LESSON OUTLINE

Introduction	Communicating Learning Objectives	3
Motivation	Video clips	7
Instruction and Practice	Interpretation of Geohazard Map	40
Evaluation	Quiz	10
Enrichment	Research on Historical Landslide Disasters	

Materials:
Computer and access to internet; Ruler which can be used for measuring distances.
Optional: Handheld GPS Receiver

Suggested Resources

(1) Center for Environmental Geomatics - Manila Observatory. (2005). Mapping Philippine Vulnerability to Environmental Disasters. Retrieved from http://vm.observatory.ph/
(2) Department of Environment and Natural Resources. (n.d.). Retrieved from http://www.denr.gov.ph/
(3) Environmental Science for Social Change. (n.d.). Retrieved from http://essc.org.ph/content/
(4) Geological Map Reading. CEDD, 2008.
(5) Hong Kong Slope Safety Website of Geotechnical Engineering Office. (2009). Surveying the Landscape - Introduction to Geological Mapping. Retrieved from http://hkss.cedd.gov.hk/hkss/eng/education/GS/eng/hkg/chapter3.htm
(6) Mines and Geosciences Bureau. (n.d.). Retrieved from http://www.mgb.gov.ph
(7) Philippine Information Agency. (n.d.). Retrieved from http://news.pia.gov.ph/
(8) ANC videos. (2011, October 21). ANC Future Perfect: Philippine Geohazard Map 1/3 [Video file]. Retrieved from https://www.youtube.com/watch?v=X5F1_o_h40A&feature=youtu.be
(9) untvweb. (2014, April 22). Completing the Geohazard Map of the Philippines [Video file]. Retrieved from https://www.youtube.com/watch?v=0ysL_W9b7rE&feature=youtu.be
(10) untvweb. (2014, April 14). Mas detalyadong geohazard map ng MGB, 80% complete na (APR142014) [Video file]. Retrieved from https://www.youtube.com/watch?v=qG0R9Q1yjWU&feature=youtu.be

INTRODUCTION (3 MINS)

Communicate learning objectives (5 mins)

1. Explain that the class will learn how to use geohazard maps to identify hazardous places and safe places.
2. Write the specific learning outcomes for the lesson on the board and ask learners to read them.
    I. I can identify the different elements of a geohazard map.
    II. I can interpret geohazard maps provided by the Mines and Geosciences Bureau to identify areas prone to landslide and flooding.
    III. I can be aware of how geologically dynamic is the area in which they live in.
    IV. I can be aware of the potential geohazards they are exposed to in their *barangay*.
    V. I can identify possible safe evacatuion routes in case of landslides and floods.

MOTIVATION (7 MINS)

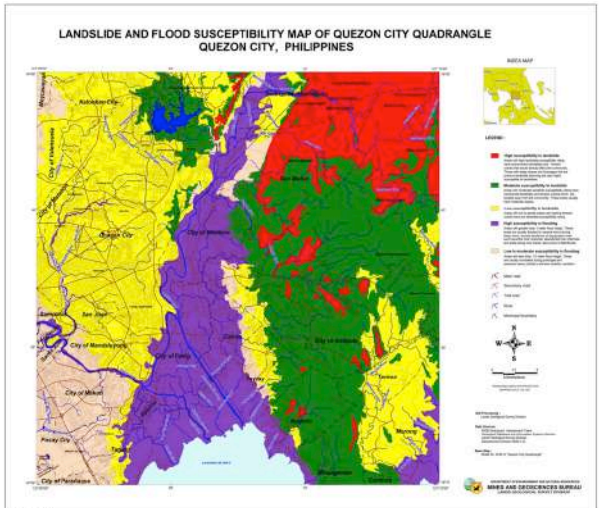
Video Clips

1. Post one of following videos on geohazard maps:
    I. https://youtu.be/X5F1_o_h40A
    II. https://youtu.be/0ysL_W9b7rE
    III. https://youtu.be/qG0R9Q1yjWU
2. After watching the video, ask the following questions:
    I. What are the different colors of areas prone to rain-induced landslides and what action should be taken corresponding to each of these colors?
    II. What are the different colors of areas prone to flooding and what actions should be taken corresponding to each of these colors?

INSTRUCTION AND PRACTICE (40 MINS)

Interpretation of Geohazard Maps

1. Show the map below.
2. Together with the class, identify the following parts of the map:
   I. Title
   II. Legend
   III. Orientation Compass
   IV. Map Ruler /Bar Scale
   V. Coordinates
3. Give the class two minutes to study the hazard map below, after which ask the class the following questions:
   I. What are the different colors used to distinguish different areas in the map?
   II. What does each color mean regarding the susceptibility of an area for a specific hazard? (see comments to the right).
   III. For each hazard and level of susceptibility, what actions should someone in a particular area take during periods of intense rain?



Landslide and Flood Susceptibility Map of QC Quadrangle

Additional Notes:

FOR RAIN-INDUCED LANDSLIDE PRONE AREAS, THERE ARE THREE COLORS:

Yellow: low susceptibility-less likely to be experience landslide; Be prepared.

Green: moderately susceptible; be cautiouns.

Red: highly susceptible; Be alert and ready to evacuate.

FOR FLOOD-PRONE AREAS:

Pink: Low to moderately susceptible. Be cautions.

Violet: Highly susceptible; be alert and ready to evacuate.

4. Show class how to download geohazard maps from one of the four sources above. For MGB website, you should show the following steps:
   I. Go to http://www.mgb.gov.ph
   II. Click on the icon on the top left hand-side of the MGB webpage for GEOHAZARD MAPS. This will bring you to http://gdis.denr.gov.ph/mgbpublic/ which will show a map of the Philippines with squares superimposed on top.
   III. Click on the square containing the city or municipality where the school is located in. This action will download the map in jpeg format.
5. Class views the downloaded map.
6. Again, make sure that the learners can identify the different elements of the map:
   I. Title
   II. Orientation compass
   III. Legend
   IV. Map ruler
   V. Coordinates.
7. Ask learners to identify the main and secondary roads and locate the school relative to these roads.
8. If handheld GPS is available, show the coordinates of the school and asks learners to look for the school on the map using the GPS coordinates. If no GPS is available, mark the approximate location of the school with a dot.
9. Ask learners to measure the distance of the school to the different main and secondary roads using a ruler and the map ruler or bar scale.

   Bonus: *Ask a learner to study the map and determine what the scale of the map is. (Maps are generally 1:50,000. See note on teaching map scale).*
10. Then, ask the following questions:
   I. Where are the areas of high susceptibility to landslides? What can you conclude regarding the topography of such areas? (These areas are normally mountainous areas with steep slopes with little vegetative cover and high levels of human development).
   II. Where are the areas of moderate susceptibility to landslides?
   III. Where are the areas of low susceptibility to landslides?
   IV. Where are the areas of high susceptibility to flooding? What can you conclude regarding the

Teacher Tip:
Ideally maps should have a scale of at least 1:10,000 if not larger (lower 2nd number)

topography of such areas? (These are normally low lying areas adjacent to rivers and lakes as well as areas in valleys).

V. Where are the areas of moderate to low susceptibility to flooding?

VI. What areas are considered generally safe during period of strong rain (areas with low susceptibility to both flooding and landslide)?

VII. Is the school located in an area that is susceptible to rain-induced landslides?

VIII. Is the school located in an area that is susceptible to floods?

EVALUATION (10 MINS)

Quiz

1. Provide each learner with a copy of the geohazard map where the learner's house is located.
2. Ask the learners to do the following:
   I. Obtain the approximate location of his/her house in terms of coordinates?
   II. The approximate distance of his/her house to the closest major road
   III. Is his/her house located in an area susceptible to rain-induced landslides?
3. Is his/her house located in an area susceptible to flooding?

ENHANCEMENT: (OUT OF CLASS ACTIVITY)

1. Have learners choose from among the following activities.
2. Have learners research historical landslide disasters, including:
   I. Cherry Hill Subdivision, Antipolo, Rizal – August 1999
   II. Barangay Guinsaugon, St. Bernard, Southern Leyte – February 2006
   III. Little Kibungan, Barangay Puguis, La Trinidad, Benguet – October 2009
3. Have learner locate this in the geohazard maps which can be download from the sources given above. Based on the maps, what is the susceptibility to landslides and floods? Are there any safe areas within the area?
4. Have learners check the PHIVOLCS website (www.phivolcs.dost.gov.ph) for hazard maps for earthquake induced hazards (earthquake induced landslides, ground rupture, ground shaking, liquefaction, or tsunami). Maps are available at the National scale, and in some cases at the Provincial scale.

I. If a map is available for the Province in which the learner's home or school is located, have the learner download the corresponding map(s), and identify the high risk areas within the province. For all earthquake-induced hazards for which there is an available hazard map, have the learner determine if the barangay in which he/she lives is a high, medium or low risk area. For cases in which the barangay is identified as high risk with regards to a specific hazard, have learner interview people in the barangay who have live there for a long time about their experiences regarding the hazard at which the barangay is exposed to. Also ask them to suggest based on their experiences what are the safe areas within the barangay.

II. If there is no available hazard map for the province in which the learner is from, have the learner download the hazard maps for liquefaction susceptibility and earthquake-induced landslides for the Philippines. Have the learner identify what areas have a high risk with respect to liquefaction and earthquake-induced landslides. Have the learner list down what are the common characteristics of these areas. Ask the learner if these characteristics are common to the area in which he/she lives in.

EVALUATION	**4**	**3**	**2**	**1**
Learner is able to identify the different elements of a geohazard map.	Learner is able to identify the title, legend, orientation compass, map ruler and coordinates. Learner is able to determine the scale of the map. Learner is able to measure distances using the map ruler. Learner is able specify the location of point on the map using its coordinates.	Learner is able to identify the title, legend, orientation compass, map ruler and coordinates.	Learner is only able to identify the title and legend.	Learner is unable to identify any of the main elements of a geohazard map.
Learner is able to interpret geohazard maps provided by the Mines and Geosciences Bureau to identify areas prone to landslide and flooding.	Learner is able to distinguish between the different zones in the map. Learner is able to locate a given point on the map and is able to determine if the area is susceptible to rain induced landslides and/or flooding. Learner is able to identify all susceptible areas as well as areas that are safe.	Learner is able to distinguish between the different zones in the map. Learner is able to locate a given point on the map and is able to determine if the area is susceptible to rain induced landslides and/or flooding.	Learner is able to distinguish between the different zones in the map. Learner is able to locate a given point on the map, but is unable to determine if the area is susceptible to rain induced landslides and/or flooding.	Learner is unable to distinguish between the different zones in the map.

120 MINS

Impending Signs of Landslides and Sinkholes

Content Standard
The learners demonstrate understand of related geological hazards including: rainfall-induced landslides and sinkholes.

Performance Standard
The learners shall be able to:

- develop a family emergency preparedness plan to guide them on what to do before, during and after the occurrence of events that *are caused by* geological hazards.

Learning Competencies
The learners are able to:

- Discuss the different geologic hazards **(DRR11/12 IIa-b-27)**
- Analyze the causes of geologic hazards **(DRR11/12 IIa-b-28)**

Specific Learning Outcomes
At the end of the lesson, the learners will be able to:

- explain in his/her own words the definition of a landslide;
- explain the different types of landslides;
- explain the causes of landslides;
- explain in his/her own words the definition of a sinkholes;
- explain in her/her own words the different types of sinkholes; and
- explain the causes of sinkholes.

LESSON OUTLINE - DAY 1

Introduction	Communicating Learning Objectives	2
Motivation	Definition of Terms	3
Instruction	Group Activity	30
Practice	Film Viewing	20
Evaluation	Definition of Landslide	5

Suggested Resources

(1) Burns, S.F., Harden, T.M., and Andrew, C.J. (n.d.). Homeowner's Guide to Landslides. Retrieved from http://www.oregongeology.org/sub/landslide/homeowners-landslide-guide.pdf
(2) Byrd, D. (2013). What causes sinkholes? Retrieved from http://earthsky.org/earth/what-causes-sinkholes
(3) CBS Evening News. (2014, April 19). Wyoming landslide splits home in two, creeps towards resort town [Video file]. Retrieved from https://www.youtube.com/watch?v=_zcjbF6omWI&feature=youtu.be
(4) Cruden, D.M., Varnes, D.J., 1996. Landslide Types and Processes: Chapter 3 in Turner, A.K, and Schuster, R.L., (Editors) 1996: Landslides - Investigation and mitigation. Special Report 247, Transportation Research Board, National Research Council. National Academy Press Washington D. C, 1996, pp 36–75.
(5) GabeHashTV. (2013, April 19). EPIC LANDSLIDE CAPTURED ON VIDEO IN FRENCH ALPS APRIL 19, 2013 [Video file]. Retrieved from https://www.youtube.com/watch?v=SlGTirtRP4c&feature=youtu.be
(6) globalnational. (2012, July 13). EPIC mudslide caught on camera (Raw Video) [Video file]. Retrieved from https://www.youtube.com/watch?v=n1cCs-S5EKc&feature=youtu.be

Additional Resources at the End of this Lesson

INTRODUCTION (2 MINS)

Communicate learning objectives (5 mins)

After the end of the lesson, the learners will be able to

1. explain in his/her own words the definition of a landslide
2. explain the different types of landslides.
3. explain the causes of landslides.

Teacher Tip:

Before the class session, learner can watch the following documentary videos on landslides to be able to get more information and have more time to understand the material.

https://youtu.be/p01ioGURkwE
https://youtu.be/G7qpzPQM2uM
https://youtu.be/sQjbBOKtah0

MOTIVATION (3 MINS)

Definition of Terms

1. Ask 2 to 3 learners to describe how they would define what a landslide is. Teacher can also ask the class if anyone has seen or experienced a landslide, and ask them to share their experiences.
2. Suspend judgement on whether learners answers are right or wrong, but instead states that they will be able to determine if their answers are correct after the lesson.

Teacher Tip:

Another alternative would be to interview on video a victim of a landslide disaster.

INSTRUCTION (30 MINS)

Group Activity

1. Divide the class into groups, and asks each group to appoint a scribe who documents the answers of the group.
2. Learners watch the following videos:
   I. USGS (2013)
   II. News Direct (2013)
   III. BBC Earth Unplugged (2013)
3. Learner read the following resource materials:
   I. Homeowners Guide to Landslides
   II. Varne's Classification of Landslides (Classifies landslides according to material and type of movement)
   III. A review of the Classification of Landslides of the Flow type (explains the velocity scale).
4. Learners answer the following questions:

Teacher Tip:

This exercise is based on an exercise contained in resource (1) above but modified to specifically relate to rainfall-induced landslide hazards even though the term landslides can be used to describe many different types of motion of sand, soil, mud, rocks, and other earth structures.

Landslides occur in response to a variety of both natural and manmade triggering events, such as earthquakes, heavy rainfall, volcanic activity, or road and building construction.

5. What are landslides? Try paraphrasing the definition in your own words.
   I. What are the different types of landslides?
   II. What are the causes of landslides?
   III. After 10 minutes, learners share their answers with the class.

Teacher Tip:
There are more variations in landslide mechanisms and triggering events than can be covered in an introductory course.

Therefore, the most important outcome of any lesson on landslides is that learners develop the curiosity and willingness to critically evaluate what their surroundings can tell them about landslides.

PRACTICE (20 MINS)

Film Viewing

1. Teachers shows each of the following videos (ranging in time from 2 to 3 minutes). After showing each video, teacher asks learners to identify the type of movement, slope material and velocity of flow.
2. After showing the videos, learner exchange papers and check each other's papers based on the following solution key.

	MOVEMENT	MATERIAL	VELOCITY
PINOY NEWS BLOGGER (2015) https://youtu.be/yZjebZGLUEg	Slump	Soil	Rapid to very rapid
POJCDK (2007) https://youtu.be/51C7vEAVbxk?list=PLD585D2210775E1CD.	Debris slide	Rocks, soil, water	Extremely rapid
GABEHASHTV (2013) https://youtu.be/SlGTirtRP4c	Rock fall	Rocks and dry soil	Extremely rapid
CBS EVENING NEWS (2014) https://youtu.be/_zcjbF6omWI	Creep	Soil	Very slow to slow
BBC NEWS (2015) https://youtu.be/eeKb0fv85Ik	Mudslide	Soil	Extremely rapid

Teacher Tip:
The number of videos can be increased or replaced with other available videos. It is suggested that videos of well known recent landslides be used.

EVALUATION (5 MINS)

Definition of Landslide

1. Explain in your own words what a landslide is.
2. Describe the different types of landslides according to the Varnes classification system.
3. Explain some of the causes of landslides.
4. Suggest some other causes of landslide not discussed in the lecture materials.

Sample Answer:

Landslides are a downward movement of geological materials such as soil and rock. Landslides occur when the sum of downward driving forces (gravity, seepage, earthquake forces, etc) is greater than the sum of the resisting forces (strength of the material, lateral confining forces due to a retaining wall).

The general types of landslides are slumps, rockfall and topples, mudslides, debris slides and flow, creep. Creep are generaly slow, involve soil, and travel short distances; Slumps can involve both soil and rock, travel short distances and vary from slow to very rapid. Rockfall and topples involve rocks, are very to extremely rapid and can travel great distances; When debris from rockfalls and slumps mix with water, they can transform into debris slides that can travel great distances. Mudslides generally involve saturated soils moving at very to extremely rapid velocities and travel great distances.

Landslides can be triggered by saturation of slope by extreme rainfall, or by vibration caused by earthquakes by human activity.

120 MINS

Impending Signs of Landslides and Sinkholes

Content Standard
The learners demonstrate understand of related geological hazards including: rainfall-induced landslides and sinkholes.

Performance Standard
The learners shall be able to:

- develop a family emergency preparedness plan to guide them on what to do before, during and after the occurrence of events that *are caused by* geological hazards.

Learning Competencies
The learners are able to:

- Discuss the different geologic hazards **(DRR11/12 IIa-b-27)**
- Analyze the causes of geologic hazards **(DRR11/12 IIa-b-28)**

Specific Learning Outcomes
At the end of the lesson, the learners will be able to:

- explain in his/her own words the definition of a landslide;
- explain the different types of landslides;
- explain the causes of landslides;
- explain in his/her own words the definition of a sinkholes;
- explain in her/her own words the different types of sinkholes; and
- explain the causes of sinkholes.

INTRODUCTION (2 MINS)

Communicate learning objectives (5 mins)
After the end of the lesson, the learners will be able to

1. explain in his/her own words the definition of a sinkholes
2. explain in her/her own words the different types of sinkholes.
3. explain the causes of sinkholes.

Teacher Tip:
Before the class session, learner can watch the documentary (https://youtu.be/wVGFJeIxOsA) on sinkholes to be able to get more information and provide more time to understand the material.

MOTIVATION (3 MINS)

Definition of Terms

1. Ask 2 to 3 learners to describe how they would define what a sinkhole is. Teacher can also ask the class if anyone has seen or experienced a landslide, and ask them to share their experiences.
2. Suspend judgement on whether learners answers are right or wrong, but instead states that they will be able to determine if their answers are correct after the lesson.

Teacher Tip:
Another alternative would be to interview on video a victim of a landslide disaster.

INSTRUCTION (50 MINS)

Group Activity

1. Divide the class into groups, and asks each group to appoint a scribe who documents the answers of the group.
2. If online resources and equipment are available, learners watch the following videos:
   I. USGS (2013)
   II. News Direct (2013)
   III. BBC Earth Unplugged (2013)
3. If online resources and/or equipment is not available, teacher downloads the following materials and prints out enough copies for learners to read in lieu of watching the above videos.
   I. USGS Water Science School. (http://water.usgs.gov/edu/sinkholes.html)
   II. Sinkhole.org (http://www.sinkhole.org/facts4.php)

Definition:
Sinkholes are depressions or openings in the ground surface. They are generally formed as the result of a collapse in the ceiling of an underground cavity or cavern. Sinkholes typically develop slowly, but can also form suddenly when a collapse occurs.

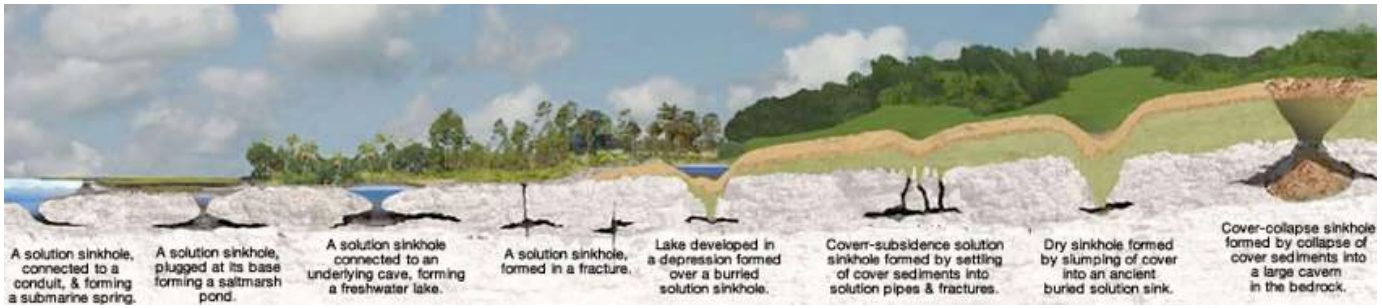
Sinkholes naturally occur in areas underlain by soluable carbonate or evaporite rocks like limestone, dolomite, gypsum, and salt.

The three types of sinkholes are: Dissolution sinkholes; Cover-subsidence sinkholes; and Cover-collapse sinkholes.

4. Learners answer the following questions.
   I. What are sinkholes? Try paraphrasing in your own words?
   II. In what type of geologic conditions do sinkholes occur? What is Karst?
   III. What are the different types of sinkholes and what are the major differences regarding the rate they can occur.
   IV. What are some man made causes of sink holes?
5. After 10 minutes, learners share their answers with the class.

Discussion

1. Show the picture to help learners differentiate between the different types of sinkholes.



http://www.saveoursuwannee.org/wp-content/uploads/2012/07/sinkhole-types.jpg

2. Show the next set of pictures and asks learner to identify what type of sinkhole it is.

Cover - Subsidence

Dissolution sinkhole

Cover collapse

Definition:

Dissolution sinkholes occur where there is little soil or vegetation over the soluble rock. Aggressive disssolution occurs where flow is focused in pre-existing openings in the rock , such as along joints, fractures, and bedding planes, or in the zone of water – table fluctuations where the ground water is in contact with the atmosphere. They typically develop gradually.

Cover-subsidence sinkholes tend to develop gradually where the covering sediments are permeable and contain sand.

Cover-collapse sinkholes tend to develop abruptly and cause catastrophic damages. They occur where the coverning sediments contain significant amounts of clay.

Karst terrain is a type of topography that is formed by dissolution of bedrock in areas underlain by limestone, **dolostone** or, as in some western states, **gypsum**. Such terrain has underground drainage systems that are reflected on the surface as sinkholes, springs, disappearing streams or even caves.

EVALUATION (5 MINS)

Definition of Sinkhole

1. Explain in your own words what a sinkhole is.
2. Explain the different types three different types of sinkholes.
3. Explain some of the causes of sinks holes.
4. Suggest some other causes of sinkholes not discussed in the lecture materials.

ENRICHMENT

Alternative Activities

1. Do an internet search of recent or well-documented landslides that have occurred in the past.
2. Perform a do-it-yourself landslide experiment as shown in the following videos:
   I. Saferworldcomm (2013) (https://youtu.be/6tSnA9I6uL4)
   II. Luke Pajer (2014) (https://youtu.be/mb4O7YDX7N8)
3. Perform the following a simulation-experiment for a sinkhole.

	4	3	2	1
EXPLAIN IN HIS/HER OWN WORDS THE DEFINITION OF A LANDSLIDE AND SINKHOLES	Learner is able to explain the hazard. Learner is able to explain all of the types of landslides/ sinkholes and is able to distinguish between the different types.	Learner is able to explain the hazard. Learner is able to explain all of the types of landslides/ sinkholes and occasionally is able to distinguish between the different types.	Learner is able to explain the hazard. Learner is able to explain some (1 to 2) of the types of landslides/sinkholes but is unable to distinguish between the different types.	Learner is unable to explain the hazard. Learner is unable to explain any of the types of landslides/sinkholes
EXPLAIN IN HIS/HER OWN WORDS THE CAUSES OF LANDSLIDES AND SINKHOLES	Learner is able to explain causes of the causes of landslides/sinkholes and is able to suggest other valid causes not discussed in the lecture materials.	Learner is able to explain all of the common causes of landslides/sinkholes.	Learner is able to explain some of the causes of landslides/sinkholes.	Learner is unable to explain any of the causes of landslides/sinkholes.

Additional Resources:

(1) ScienceTube. (2015, January 5). Naked Science - Landslides (Full Documentary) [Video file]. Retrieved from https://www.youtube.com/watch?v=G7qpzPQM2uM&feature=youtu.be

(2) Silverman, J. (2008). How Sinkholes Work. Retrieved from http://science.howstuffworks.com/nature/natural-disasters/sinkhole.htm

(3) Storm. (2013, May 14). Amazing Footage of Ui Landslide [Video file]. Retrieved from https://www.youtube.com/watch?v=gNokmNrUzL8&feature=youtu.be

(4) Top Documentary Films Channel. (2015, March 6). Killer Landslides [Video file]. Retrieved from https://www.youtube.com/watch?v=sQjbBOKtah0&feature=youtu.be

(5) Top Documentary Films Channel. (2015, March 8). Documentary | Sinkholes [Video file]. Retrieved from https://www.youtube.com/watch?v=wVGFJeIxOsA&feature=youtu.be

(6) U.S. Geological Survey. (2015). Sinkholes. Retrieved from http://water.usgs.gov/edu/sinkholes.html

(7) USGS. (2012, June 11). Landslide Hazards [Video file]. Retrieved from https://www.youtube.com/watch?v=MVwSpGVfWVo&feature=youtu.be

(8) USGS. (2013, March 5). The Science of Sinkholes [Video file]. Retrieved from https://www.youtube.com/watch?v=wubMuKDGBuk&feature=youtu.be

(9) Varnes, D.J., 1978. Slope movement types and processes. In Schuster, R.L and Krizek, R.J. (Editors) 1978: Landslides Analysis and control. Transportation Research Board Special Report 176, National Academy of Sciences, Washington, 11-33.

(10) News Direct. (2013, April 3). Causes of sinkholes [Video file]. Retrieved from https://www.youtube.com/watch?v=YnUovucMSjo&feature=youtu.be

(11) BBC Earth Unplugged. (2013, September 3). What Causes Sinkholes? - Earth Juice (Ep 40) - Earth Unplugged [Video file]. Retrieved from https://www.youtube.com/watch?v=RUjo3K_00tY&feature=youtu.be

(12) BBC News. (2015, December 21). Drone reveals China landslide destruction - BBC News [Video file]. Retrieved from https://www.youtube.com/watch?v=eeKb0fv85Ik&feature=youtu.be

(13) Sinkhole.org. (n.d.). Learn About Sinkholes: Types of Sinkholes. Retrieved from http://www.sinkhole.org/facts4.php

(14) Save Our Suwannee, Inc. (2006). Sinkholes 101. Retrieved from http://www.saveoursuwannee.org/sinkholes-101/

(15) Saferworldcomm. (2013, February 8). Do-it-yourself experiments-Landslide [Video file]. Retrieved from https://www.youtube.com/watch?v=6tSnA9I6uL4&feature=youtu.be

(16) Luke Pajer. (2014, October 16). Simple Cylindrical Slip Surface Model Demonstration [Video file]. Retrieved from https://www.youtube.com/watch?v=mb4O7YDX7N8&feature=youtu.be

Disaster Readiness and Risk Reduction

120 MINS

Interpreting Geohazard Maps

Content Standard
The learners demonstrate understand of related geological hazards including: rainfall-induced landslides and sinkholes.

Performance Standard
The learners shall be able to:

- develop a family emergency preparedness plan to guide them on what to do before, during and after the occurrence of events that *are caused by* geological hazards.

Learning Competency
The learners are able to:

- Recognize signs of impending geologic hazard events **DRR11/12 IIa-b-29**

Specific Learning Outcomes
At the end of the lesson, the learners will be able to:

- recognize common signs of an impending landslide and sinkhole; and
- explain the mechanism underlying each of the common signs.

LESSON OUTLINE - DAY 1

Introduction	Communicating Learning Objectives	3
Motivation	Film Viewing	2
Instruction	Discussion	25
Practice	Reading Activity	20
Evaluation	Inquiry	10

Suggested Resources

(1) Department of Homeland Security. (n.d.). Landslides & Debris Flow. Retrieved from http://www.ready.gov/landslides-debris-flow
(2) InspectApedia.com. (2015). Detection & Warning Signs of Imminent Sinkhole Collapse - Visual & Other Clues Indicating the Risk of Developing Sinkholes. Retrieved from http://inspectapedia.com/vision/Sink_hole_Detection.php
(3) Nature Education. (2014). Lesson 8: Landslides Hazards. Retrieved from http://www.nature.com/scitable/topicpage/lesson-8-landslides-hazards-8704578
(4) Sinkhole.org. (n.d.). Common Signs of Sinkholes With Pictures of Actual Damage. Retrieved from http://www.sinkhole.org/CommonSigns.php
(5) U.S. Geological Survey. (2013). Landslide Preparedness. Retrieved from http://landslides.usgs.gov/learn/prepare.php
(6) ABS-CBN News. (2012). Mga pangarap, iginuho ng landslide sa Cherry Hills Subdivision, Antipolo [Video file]. Retrieved from https://www.youtube.com/watch?v=NVTzOGVQl8U&feature=youtu.be

INTRODUCTION (3 MINS)

Communicate learning objectives (5 mins)

After the end of the lesson, the learners will be able to

1. Recognize common signs of an impending landslide and sinkhole.
2. Explain the mechanism underlying each of the common signs.

MOTIVATION (2 MINS)

Film Viewing

1. Show the following video about the Cherry Hills Landslide: https://youtu.be/NVTzOGVQl8U.
2. Before showing the video, ask the class to take note of some of the early warning signs the residents of Cherry Hills noticed before the landslide.

INSTRUCTION (25 MINS)

Discussion

1. Show the picture below and asks the class if they can identify the 11 warning signs on an impending landslide.
2. Learner should write down their answers on a sheet of paper according to the numbers in the picture.
3. Learners exchange papers and the teacher give the correct answer and explains the underlying reason for each of the early warning signs.

Answers:

1. Bulging ground appearing at the base (toe) of a slope or retaining wall.
2. Water breaks through the ground surface in new location.
3. Fences, retaining walls, utility posts or trees tilt or move.
4. Cracks appear on slope.
5. Water pipes break.
6. Cracks appear on the ground or in the foundation of houses, buildings and other structures.
7. Doors and windows become stuck or jammed for the first time.

Teacher Tip:

This exercise is based on an exercise contained in resource (1) above but modified to specifically relate to rainfall-induced landslide hazards even though the term *landslide* is generally used to describe the downward movement of earth materials driven by gravity.

Landslides occur in response to a variety of both natural and manmade triggering events, such as earthquakes, heavy rainfall, volcanic activity, or road and building construction.

There are more variations in landslide mechanisms and triggering events than can be covered in an introductory course.

Therefore, the most important outcome of any lesson on landslides is that learners develop the curiosity and willingness to critically evaluate what their surroundings can tell them about landslides.

8. Water appear at the base of the slope.
9. Slowly widening cracks appear on the ground or on paved areas such as paved streets, driveways and concreted path ways.
10. Land movements and debris downslope.
11. Outside walls, walks or stairs being pulling away from the building.

PRACTICE (20 MINS)

Reading Activity

1. Give learners 5 minutes to read the following resource materials:
   I. http://inspectapedia.com/vision/Sink_hole_Detection.php
   II. http://www.sinkhole.org/CommonSigns.php
2. Using the information obtained from the above sources, have learners develop a list of warning signs for a impending formation of a sinkhole.

Teacher Tip:

1. As the landslide mass slowly moves down, it pushes the ground at the bottom or toe of the slope and causes it to bulge.
2. Water seeping down a slope is one of the most common sources of landslides, and is manifested by water collecting or emerging at the bottom or toe of the slope.
3. Tilted vertical objects like trees, post, and fences is evidence that a slope is moving. A forward tilt into the prone position indicates (as shown in the pictures) indicates that the landslide is shallow and translational. A back tilt into the recumbent/reclining position indicates that the landslide is rotational and relatively deep seated.
4. Downward movement of the materials near the surface of the slope results in the formation of tension cracks on the slope surface.

The following signs are normally caused by ground surface movements which can result either from geological hazards such as landslides and formation of sinkholes.

1. Ground movements cause underground pipes to break
2. Ground movements causes the foundation of buildings and other structures made from concrete to break.
3. Ground movements result in tilting and differential settlements in structures. These cause hinges to be misaligned and make doors difficult to open. These can also cause auxiliary structures, such as exterior stairways, to separate from the main structure.

3. Ask learners to integrate warning signs for landslides into one list, indicating which signs are unique to landslides, unique to sinkholes, similar signs in landslides and sinkholes, or identical for both sinkholes and landslides.

EVALUATION (10 MINS)

Film Viewing

1. At the end of the practice session, Teacher has learners exchange papers and discuss their answers. A suggested key is shown below.

SIGNS TO OBSERVE	NOTE	COMMENTS
Cracks in interior joints areas, windows, and doors	C	
Cracks in exterior masonry walls and plaster finishing	C	
Windows and doors become harder to close properly	C	
Deep cracks and separation of paved concrete walks and drives	C	
Outside walls, walks or stairs being pulling away from the building	C	
Water pipes break.	C	
Titled trees, posts and signs.	D	In landslides, tilting is toward downward direction in translational slides, away downward direction in rotational slide. For sinkhole, tilting is toward the center of the depression.

SIGNS TO OBSERVE	NOTE	COMMENTS
Circular patches of wilted plants	D	
Neighboors have had or confirmed possible sinkhole or landslide activity	B	
Observation of an actual cavity beginning to open	A	
Land movements and small landslides	A	
Water appearing at base of slope or in depression in the ground	C	
Sediments/minerals in water	B	
Tension cracks form in slope	A	
Bulging at the base/toe of a slope	A	

Note:

1. *Unique to landslides*
2. *Unique to sinkholes*
3. *Identical signs in both landslides and sinkholes*
4. *Similar signs in both landslides and sinkholes with differences noted in the comments.*

1. Point out to class that often, many of the signs for landslides and sinkholes appear to be similar if not identical. Teacher asks how then can we determine what kind of hazard is present. (Answer: These signs are a signal to consult an expert like an engineering geologist, or geotechnical engineer who may recommend steps to determine what type of hazard is present in the area.
2. However, if these signs occur in places that have known sinkholes, the likelihood that the observed signs are due to sinkholes is greater. Also, landslides generally do not occur in flat or level areas, but in sloping areas. If these signs are observed in an open flat area, it is likely that they are due to geological hazards other than landslides.

EVALUATION

1. Ask learners to put away all resource materials (closed notes), and answer the following five questions.
   I. Enumerate three (3) warning signs that are common and identical to both landslides and sinkholes.
   II. Give one example of a warning sign that is unique to landslides, and explain the mechanism underlying this warning sign (i.e . what geological process during the occurrence of a landslide leads to the warning sign).
   III. Give one example of a warning sign that is unique to sinkholes, and explain the mechanism underlying this warning sign (i.e . what geological process during the occurrence of a sinkhole leads to the warning sign).

Assignment

1. Have learners create a similar picture to the shown above for landslides, this time for sinkholes.
2. Have learners create a poster or 3-minute multi-media presentation/video to communicate the warning signs for landslide or sinkholes.
3. Interview a geologist on what other warning signs for landslides and sinkholes can be added to the list.

SPECIFIC LEARNING OUTCOMES	4	3	2	1
RECOGNIZE COMMON SIGNS OF AN IMPENDING LANDSLIDE AND SINKHOLE	Learner can enumerate all of the warning signs and can associate with the correct hazard.	Learner can enumerate most of the warning signs and can associate with the correct hazard.	Learner can enumerate some warning signs but cannot associate with the correct hazard.	Learner cannot enumerate any warning signs.
EXPLAIN THE MECHANISM UNDERLYING EACH OF THE COMMON SIGNS	Learner can explain the mechanism underlying all warning sign.	Learner can explain the mechanism underlying some warning sign.	Learner if familiar with warning signs but cannot explain the mechanism underlying each warning sign.	Learner does not understand the mechanism underlying each warning sign.

120 MINS

Precautionary and Safety Measures for Landslides

Content Standard
The learners demonstrate understand of related geological hazards including: rainfall-induced landslides and sinkholes.

Performance Standard
The learners shall be able to:

- develop a family emergency preparedness plan to guide them on what to do before, during and after the occurrence of events that *are caused by* geological hazards.

Learning Competency
The learners are able to:

- apply mitigation strategies to prevent loss of lives and property **(DRR11/12 IIa-b-31)**

Specific Learning Outcomes
At the end of the lesson, the learners will be able to:

- analyze stability of slope using non-expert tools for assessing susceptibility to rain-induced landslides; and
- synthesize an action plan involving both preventionation/mitigation and adaptation/preparedness components.

LESSON OUTLINE - DAY 1

Introduction	Communicating Learning Objectives	3
Instruction	Reading Activity	22
Practice	Group Work and Optional Activities	35

Materials:
Hammer and nail, large protector or square pieces of paper that can folded, calculator or computer with MS Excel

Suggested Resources

(1) Hong Kong Slope Safety Website of Geotechnical Engineering Office. (2012). Layman's Guide to Slope Maintenance. Retrieved from http://hkss.cedd.gov.hk/hkss/eng/layman_guide.aspx

(2) Hong Kong Slope Safety Website of Geotechnical Engineering Office. (2012). Layman's Guide to Treatment of Slopes. Retrieved from http://hkss.cedd.gov.hk/hkss/eng/lpmit/eLayman_Guide_Landscape.pdf

(3) Hong Kong Slope Safety Website of Geotechnical Engineering Office. (2012). Simple Guide to "Dangerous Hillside Orders". Retrieved from http://hkss.cedd.gov.hk/hkss/eng/slopemainten/cedd_DHO_booklet_eng.pdf

INTRODUCTION (3 MINS)

Communicate learning objectives (5 mins)

1. Tell learners that the will learn in today's lesson a method for determining if a slope is unstable and susceptible to landslides, so that they can identify which areas to avoid during strong rains and which areas are safe from landslides where they can go to.
2. Write the specific learning outcomes for the lesson on an index card before the class and asks learners to read the specific learning outcomes.
    I. Analyze stability of slope using non-expert tools for assessing susceptibility to rain-induced landslides.
    II. Synthesize an action plan involving both prevention/mitigation and adaptation/preparedness components.

INSTRUCTION (23 MINS)

Reading Activity

1. Assign learners to read Rain-induced Landslide Susceptibility: A Guidebook for Communities and Non-experts to familiarize them with the procedure for estimating the susceptibility of a slope to rain-induced landslides. The procedure requires the estimation of seven parameters namely: Slope angle, slope material, presence of springs, and effect of drainage, frequency of ground movement, predominant vegetation and present land use.
2. Explain the simplified procedure for susceptibility assessment of rainfall-induced shallow depth landslides as follows:
    I. Explain the materials that will be needed (pages 1-2)
    II. Explain that it is a must either take a picture or make a sketch and document the slope (Chapter2 on pages 3-5)
    III. Explain how to measure the slope angle using either a protractor or origami method (Chapter 3 pages 6-8)
    IV. Explain how to identify the slope material (Chapter 4, pages 9 to 41).
    V. Explain how to compute the basic Factor of Safety (Chapter 5, page 42)
    VI. Explain how to take into account other factors affecting slope stability and compute the final factor of safety (Chapter 6, pages 43-46).

Teacher Tip:

The simplified procedure for susceptibility assessment of rainfall-induced landslides is specifically for shallow landslides which generally comprise a majority of the landslides affecting most areas of the Philippines.

The guidebook on the non-expert landslide assessment tool is fairly detailed in explaining the procedure. The teacher needs to study the procedure before explaining it to the learners.

Of the 7 parameters to be measured, the two that have the most effect on the value of the resulting factor of safety against slope failure are the slope angle and slope material.

Ideally, slope angle should be measured using a protractor. However if not available, the learners can use the paper folding technique described in the handbook.

For rock slopes, it is sufficient to use the nail and hammer to determine if the rock is hard or soft. If a nail cannot be driven into the slope material, use Hard Rock 4. If a nail can be driven into the slope material, use Soft Rock 2.

For soil slopes, some judgment is needed to determine, but the following guidelines which are not in the guidebook can be used to help in determine the type of slope material for a soil slope. If it is difficult to dig into the slope with a shovel, spade or trowel, the slope material is Hard Soil 1.

VII. Explain what appropriate action should be taken depending on the final factor of safety (Chapter 7, page 47)

3. Learners can compute the factor of safety using a calculation. Calculations should be included as part of the documentation of the susceptibility assessment of the slope.

PRACTICE (35 MINS)

Group Work

1. Find a slope or set of slopes within the premises of the school grounds which learners can assess.
2. Organize class into groups and assign a slope to assess.
3. Have learners document the slope using the procedure described in the guidebook and submit the document with the supporting calculations. At the end of the period.
4. If there is time, have learners do a sensitivity analysis with their calculations. Have learners comment on the assumptions they made in arriving at their computations as well as the sensitivity of their calculations.
5. To aid in the discussion on the second day, teacher should identify groups where the slope evaluated had a factor of safety less than 1.0. If no group was able to evaluate a slope with a factor of safety less than 1.0, groups can meet outside to class to find a slope within their community they know has failed and evaluate that slope.

Optional Activities

1. Learners ask a geotechnical engineer or engineering geologist to review their assessment of the slope and corresponding mitigation.
2. Learners read the eBook "When Hillsides Collapse: A century of Landslides in Hong Kong (2nd Ed)," and write a term paper on how we can learn from documenting and studying past landslide disasters. What best practices for reducing disaster risk due to landslides can we learn from Hong Kong?
3. Learners can consult the nearest local office of the Mines and Geoscience Bureau and consult them regarding what other geological hazards are present in their area, and what mitigation measures are appropriate for these geological hazards.
4. Revise the Excel spreadsheet for the case where rainfall data is available where the learner lives. Rainfall data can be obtained from the local PAGASA office

Teacher Tip:

If it is possible to dig into the slope with a shovel, spade or trowel, the slope material is soft soil. If the soil is loose and predominantly made up of hard rounded stones, the material should be considered as gravelly soil and falls under category Soft Soil 1.

If the soil is loose and made up of mostly fine grains like sugar, with a few stones, then the soil should be considered Soft Soil 2. If the soil is soft but sticky then the slope material should be considered as clay and considered as Soft Soil 3.

If there is access to a computer with Microsoft Excel, the attached worksheet can be used to expedite the computation of the factor of safety and aid in documenting the procedure. Another advantage of using the spreadsheet is that sensitivity analysis can be performed. In a **sensitivity analysis**, any of the 7 parameters can be changed to investigate how sensitive the assessment of the slope is to changes in the parameters. Learners can be asked to change parameters by one category up or down and see how the factor of safety changes.

In general, learners need some supervision from the teacher, even after reading the guidebook.

If the teacher feels that the entire exercise is too technical for learners, the teacher can simplify the exercise by concentrating on the first two factors (slope angle and slope material). Doing so simplifies the computation of the factor of safety to evaluating the quotient of these two factors (slope material rating/slope angle rating).

120 MINS

Precautionary and Safety Measures for Landslides

Content Standard
The learners demonstrate understand of related geological hazards including: rainfall-induced landslides and sinkholes.

Performance Standard
The learners shall be able to:

- develop a family emergency preparedness plan to guide them on what to do before, during and after the occurrence of events that *are caused by* geological hazards.

Learning Competency
The learners are able to:

- apply mitigation strategies to prevent loss of lives and property **(DRR11/12 IIa-b-31)**

Specific Learning Outcomes
At the end of the lesson, the learners will be able to:

- analyze stability of slope using non-expert tools for assessing susceptibility to rain-induced landslides; and
- synthesize an action plan involving both preventionation/mitigation and adaptation/preparedness components.

LESSON OUTLINE - DAY 2

Instruction	Group Activity	15
Practice	Presentation	45

Materials:
Hammer and nail, large protector or square pieces of paper that can folded, calculator or computer with MS Excel

Suggested Resources

(1) Hong Kong Slope Safety Website of Geotechnical Engineering Office. (2012). When Hillsides Collapse: A century of Landslides in Hong Kong (2nd Ed). Retrieved from http://hkss.cedd.gov.hk/hkss/eng/when_hillsides_collapse_2nd.aspx

(2) Peckely, D.C., and Bagtang E.T. (2009). Rain-induced Landslide Susceptibility: A Guidebook for Communities and Non-experts. Retrieved from http://drh.edm.bosai.go.jp/files/4f010574fadd691b2b04e620fe3912553ef74a1e/LandslidesGuidebook.pdf

INSTRUCTION (15 MINS)

Group Activity

1. Start the class by asking groups to meet together, and discuss what mitigation measures are appropriate either for the slope they evaluated (either in class or outside the class period) which had a factor of safety less than 1.0, or learner can imagine there is a slope next to the school with a factor of safety less than 1.0. For the later case, learners can modify some of the inputs in the previous analyses as follows so that the factor of safety is less than 1.0:
   I. Increase the slope angle;
   II. Decrease the strength of slope material;
   III. Assume the presence of spring or ground movement;
   IV. Assume there is no drainage or that drainage is not working;
   V. Assume there is less vegetation;
   VI. Assume more critical land use.
2. Instruct each group needs to read the following references:
   I. Layman's Guide to Slope Maintenance for best practices in ensuring maintaining and monitoring/observing the slope for signs of progressive failure. This part of the plan focuses on the preventive and/or mitigation measures.
   II. Simple Guide to "Dangerous Hillside Orders" to develop a plan regarding the appropriate actions to be taken just before, during and after period of very heavy rainfall. This part of the plan focuses on the adaptive and/or preparedness measures.

PRACTICE (45 MINS)

1. Have each group synthesize a "Safe Slope" Plan which has preventive and/or mitigation as well as adaptive and/or preparedness components. Teacher should emphasize that the recommended measures contained in the "Safe Slope" Plan must be founded on the results of the susceptibility analysis (see comments in Meeting Learner's Needs). Give each group 20 minutes to accomplish this task.
2. Groups draw lots in presenting.
3. As each group presents that Safe Slope Plan, other learners comment.
4. Evaluate the output of each group according to the evaluation rubrics below.

Teacher Tip:

Unlike many hazards like earthquakes, typhoons which are regional in scale (i.e. affect relatively wide areas), lanslides are generally localized and site specific in scale (i.e. the normally affect an area within the close proximity of the affected slope). As such, much of the responsibility for mitigating and preparing for landslides falls on the affected communities. The success with which a community is able to protect itself against the risk of a landslide hazard is largely dependent on the resources and capacities of the community.

Experience collected from all over the world indicates that a general rainfall threshold of landslides is 100 mm to 150 mm falling within a 24-hour period preceded by 300 mm of rainfall falling over a period of 15 days. If the school or a nearby weather station has a rain guage, this can be used as a early warning system.

Most reference materials do not discuss how long after a period of exceeding the rainfall threshold is it safe to return to the area. This is because landslides have been known to occur several days after this period. Tell learners about this fact and ask them, given this situation, what would be a prudent way of deciding when to return to the area.

SPECIFIC LEARNING OUTCOMES	4	3	2	1
ANALYZE STABILITY OF SLOPE USING NON-EXPERT TOOLS FOR ASSESSING SUSCEPTIBILITY TO RAIN-INDUCED LANDSLIDES	Learner is able to complete both the slope assessment exercise and sensitivity analysis correctly.	Learner is able to complete the slope assessment exercise with minimal help from teacher, and assessment is correct.	Learner is able to complete the slope assessment exercise with minimal help from teacher, but assessment is wrong.	Learner is unable to complete the slope assessment exercise even with minimal help from teacher.
SYNTHESIZE A ACTION PLAN INVOLVING BOTH PREVENTATION/ MITIGATION AND ADAPTATION/ PREPAREDNESS COMPONENTS	Learner is able to formulate a rational and coherent plan with original and innovative elements.	Learner is able to formulate a rational and coherent plan.	Learner is able to formulate some strategies with some minimal help from teacher, but proposed strategies do not have a rational basis.	Learner is unable to formulate any strategies, even with minimal help from teacher.

120 MINS

Different Types of Hydrometeorological Hazards

Content Standard
The learners demonstrate understanding of hydrometeorological hazards

Performance Standards
The learners shall be able to:

- develop a family emergency preparedness plan to guide them on what to do before, during, and after the occurrence of events that cause hydrometeorological hazards; and
- develop proficiency in executing emergency response plans through safety drills.

Learning Competency
The learners are able to:

- distinguish and differentiate among and between different hydrometeorological phenomena/hazards **(DRR11/12-IIc-d-32)**

Specific Learning Outcomes
At the end of the lesson, the learners will be able to:

- explain the mechanisms/formation of different hydrometeorological phenomena; and
- distinguish between different hydrometeorological hazards

LESSON OUTLINE

Introduction	Definition of Hydrometeorological Hazards	10
Motivation	Video on Hydrometeorological Disaster	15
Instruction	Lecture on the Principles of Hydrometeorological Phenomena	30
Evaluation	Quiz	15
Enrichment	Group Work on Simple Watershed Model	50

Suggested Resources

(1) American Meteorological Society. (2012). AMS Glossary. Retrieved from http://glossary.ametsoc.org/wiki/Main_Page
(2) National Oceanic and Atmospheric Administration. (n.d.). Ten Basic Cloud Types. Retrieved from http://www.srh.noaa.gov/srh/jetstream/clouds/cloudwise/types.html
(3) Philippine Atmospheric, Geophysical and Astronomical Services Administration. (n.d.). PAGASA | Philippine Atmospheric Geophysical and Astronomical Services Administration. Retrieved from https://kidlat.pagasa.dost.gov.ph/
(4) The COMET Program. (n.d.). Teaching and Training Resources for the Geoscience Community. Retrieved from https://www.meted.ucar.edu/
(5) United Nations Office for Disaster Risk Reduction. (n.d.). United Nations Office for Disaster Risk Reduction. Retrieved from http://www.unisdr.org/
(6) Watershed Atlas of the Allegheny River. (n.d.). Watershed Atlas of Western Pennsylvania. Retrieved from http://www.watershedatlas.org/
(7) Wanderlusting /LifeInThePhilippines. (2014, November 8). Super Typhoon Haiyan: Inside the Belly of the Beast [Video file]. Retrieved from https://www.youtube.com/watch?v=H0ozabA7Mxs
(8) kristofferabellanosa. (2011, December 17). Typhoon Sendong - Cagayan de Oro Aerial View [Video file]. Retrieved from https://www.youtube.com/watch?v=xivpP7qVrEU

INTRODUCTION (10 MINS)

Communicate Learning Objectives

1. Introduce the following learning objectives using any of the suggested protocols.
    I. I can explain how hydrometeorological phenomena occur
    II. I can critically identify elements exposed to specific short-term hydrometeorological hazards within my school/school grounds that may lead to a disaster.

Pre-Test

1. Ask learners to enumerate/briefly define the types of hydrometeorological hazards discussed in class:
    I. Hydrologic cycle
    II. Types of clouds
    III. Rain / precipitation
    IV. Thunderstorm
    V. Floods / flash floods
2. Ask the class to explain the following (ask learners to illustrate on the board)
    I. What is PAGASA and enumerate the information we get from that agency?
    II. Differentiate floods from flashfloods?

MOTIVATION (15 MINS)

Video on Hydrometeorological Disaster

1. Hydrometeorological phenomena are essential to life on Earth. It can be both beneficial and detrimental. Water is life and it is because of the Earth's hydrological cycle that we get the water we use in everyday life, however, changes brought about by this cycle can be hazardous as well.
2. Show a video of a devastating hydrometeorological disaster (show a video of the Typhoon Haiyan/ Yolanda and its effects on Leyte/Samar with emphasis on storm surge). https://www.youtube.com/watch?v=H0ozabA7Mxs

Teacher Tip:
Most people rely on past experiences in their understanding and/or appreciation of weather hazards.

3. In addition, a video showing the aftermath of Typhoon Sendong in Cagayan de Oro. https://www.youtube.com/watch?v=xivpP7qVrEU
4. If school has no IT facility, the teacher can recount a similar event that has happened in or near their locality, otherwise he/she can ask the learners to relate their own experiences.
5. After playing the video/listening to the local disaster account, ask the class if
   I. they have experiences of similar events
   II. their school is at risk of experiencing similar hydrometeorological hazard.

INSTRUCTION (30 MINS)

Lecture

Hydrometeorology is the study of the atmospheric and terrestrial phases of the hydrological cycle with emphasis on the interrelationship between them. It deals with the transfer of water and energy between land surface and the lower atmosphere. Fig. 1 shows an illustration of the hydrological cycle. Here, we will discuss how rain is generated, and what happens to water when it reaches Earth's surface. The outline of the discussion is as follows.

Processes of the hydrologic cycle

1. Precipitation
   I. Cloud formation and type
   II. Rainfall
   III. Associated hazards
2. Formation of snow covered mountain tops (not applicable in the Philippines)
3. Melting of snow and ice (not applicable in the Philippines)
4. Interception of precipitation by vegetation cover
5. Storage in land surface depressions
6. Infiltration of water into soil
7. Evapotranspiration
8. Recharge of groundwater
9. River runoff

Teacher Tip:

Because the hydrological cycle is a cycle, it does not necessarily have a starting or ending point.

Engage the learners in discussing fig. 1 and its importance to life of Earth.

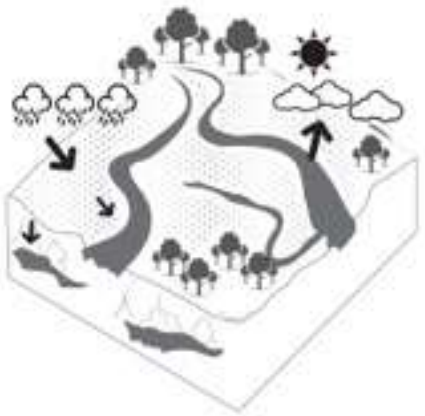
Clouds are so common that most of the time people do not pay attention to it. There are cloud appreciation societies worldwide that encourage people to look at clouds. Cloud spotting is an activity that can be informative to the learners and teachers alike.

Clouds

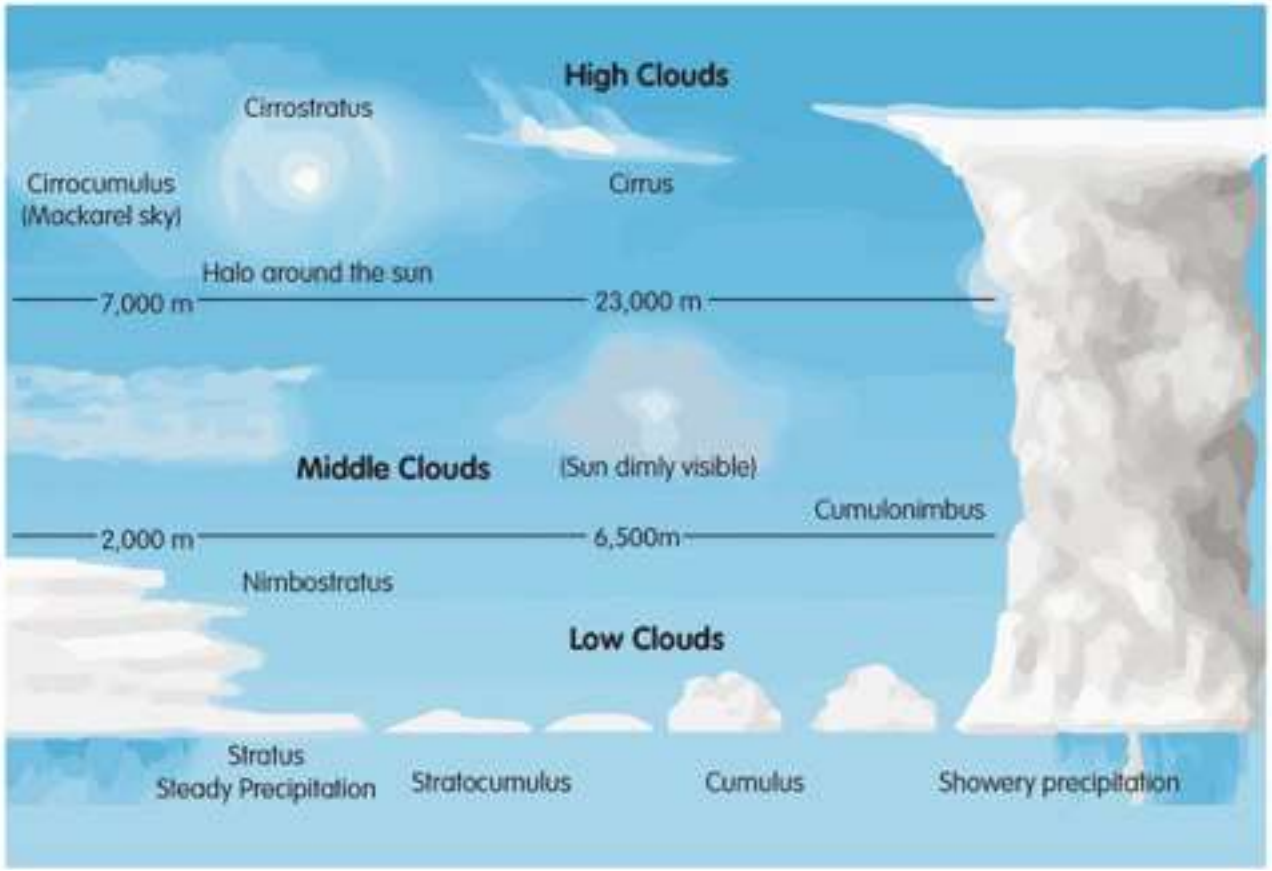
Clouds are ubiquitous in our daily lives, so much so that most people don't pay attention to them anymore. Clouds are essential in the hydrologic cycle of Earth because their formation and movement initiates the transport of water.

A cloud is a visible aggregate of small water droplets and/or ice particles in the atmosphere above earth's surface and they form in the atmosphere as a result of condensation of water vapor rising from the surface.

There are 10 general cloud types and they are classified depending of their height (low, mid and high), appearance and their corresponding precipitation (refer to Fig. 2).



The Hydrologic Cycle



General Cloud Types

Low clouds: Clouds with height of less than 2 km

Cumulus – individual dense clouds with sharp outlines, often develop vertically

Stratus – gray cloud layer with a uniform base which may (if thick enough) produce drizzle

Stratocumulus – gray or whitish sheet or layered clouds with regularly arranged small cloud elements

Cumulonimbus – *the thunderstorm cloud*. This is a heavy and dense cloud in the form of a tall tower. The base of the cloud is often dark and produce precipitation. This cloud type also produce hail and tornado.

Mid Clouds: Clouds with height in between 2 km and 7 km

Altocumulus – a sheet of layered clouds composed of rounded masses or rolls.

Nimbostratus – a dark gray cloud layer covering the sky with continuous falling rain

Altostratus – gray cloud sheets of fibrous clouds that totally or partially covers the sky, but thin enough to reveal the sun

High Clouds: Clouds with height greater than 7 km

		
Cirrus – clouds in the form of white, delicate filaments. They have fibrous and/or silky sheen appearance.	**Cirrostratus** – transparent, whitish veil clouds with a fibrous appearance	**Cirrucumulus –** thin, white sheet or layer of clouds without shading

Nimbus refers to rain producing clouds, hence the two general type of rain producing clouds have the word *nimbus* in it, namely ***Cumulonimbus*** (thunderstorm clouds) and ***Nimbostratus*** (continuous rain cloud). Clouds are associated with different types of precipitation and distinguishing between cloud types can give us a glimpse of an impending hydrometeorological hazard.

How is rain measured?

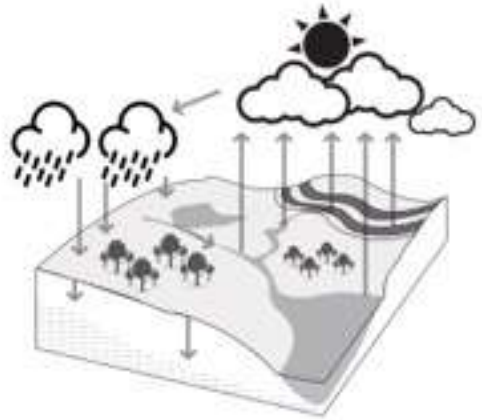
Rainfall is measured using a rain gauge, rain gauge is thought to be one of the oldest weather instruments. Rain gauges can be as simple as a cylinder that catches rain water (Fig. 3). The height of rain water that collects in the cylinder is the measured amount of rainfall, usually expressed in millimeters.

Terrestrial phase of the hydrologic cycle

As water returns to the surface of the Earth from precipitation, it doesn't just stay in one place, gravity takes it to the ground either as ***infiltration***, or it begins running downhill as ***surface runoff***. Most of this moving water will end up in streams or rivers flowing towards the ocean.

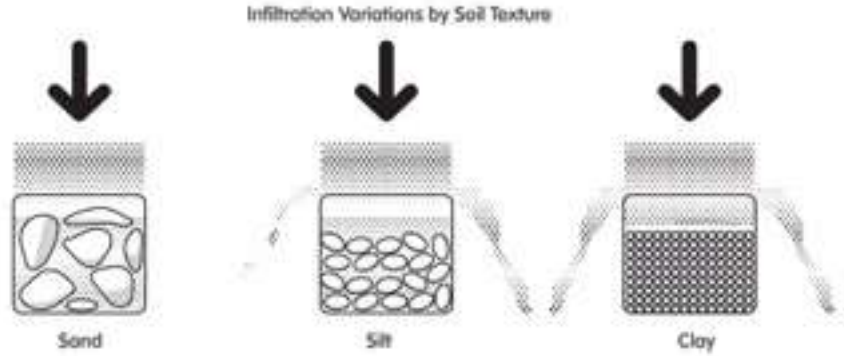
Since the Philippines is composed of islands with complex topography and mountainous regions, certain

processes happen while water flows through land. A ***watershed*** (Fig.4) is a basin-like landform defined by highpoints and ridgelines that descend into lower elevations and stream valleys. Water is channeled into soils, groundwater, creeks and streams making its way to larger rivers and eventually the sea.

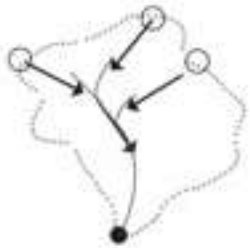


The following are the processes that govern terrestrial water flow

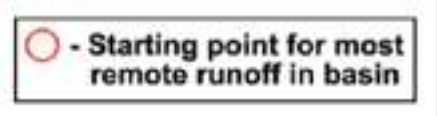
1. Interception of precipitation by vegetation cover
    I. Before reaching the land surface, a part of the precipitation may be intercepted by vegetation and/or other types of surface cover. A portion of intercepted rainfall evaporates and the other portion may flow down on vegetation stems
2. Storage in land surface depressions
    I. Detention of a part of precipitation on depressions. While most waters flows back to the ocean, some can flow in streams towards closed lake, or purposely diverted for human use, and stored there for a time.
3. Infiltration of water into soil
    I. Flow of water through soil surface
4. Evapotranspiration
    I. total evaporation from surface water and plants is referred to as evapotranspiration
5. Recharge of groundwater
    I. Water storage in the soil-rock system
6. River runoff
    I. Part of the precipitation that flows into river systems



Infiltration is the flow of water through the soil surface. The rate of infiltration depends on certain soil properties like texture, structure and moisture content. Soil profiles, or the vertical organization of the different soil layers and the depth of the soil column, also influence the hydrologic processes as infiltration rates will vary with different soil



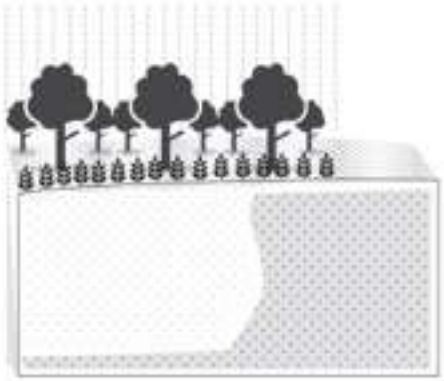
Surface runoff is the flow of water over land surfaces. The size of the basin or the contributing area of the rainfall in a basin has a significant influence on the amount of runoff. Consider two similarly shaped basins (Fig. 7) but one is larger than the other. Runoff starting from a further distance will take a longer time to reach the outlet of the watershed than the one starting from a shorter distance. On the other hand, a single local heavy rainfall event will affect only a small portion of a big basin. While this same event can cover the whole of a small basin, which can lead to severe flooding or a flash flood.



Aside from the size, the shape of a basin also has influence on the magnitude and timing of the flow of water along the basin outlet. Consider two basins of the same size (Fig. 8), but one is round (left image) and the other is long and narrow (right image). Consider water coming from the furthest point in each of the basins. Water will flow quicker for the round basin, and water will likely converge in the outlet at the same time, leading to greater peak flow. The narrower basin, on the other hand, water from multiple locations is less likely to arrive at the same time, resulting to lower peak flow.

Slope of the basin is also an important factor to consider not only for surface runoff but infiltration as well. The steeper the slope, the lower the infiltration rate because gravity pulls less water into the land surface.

Influences of soil profiles in infiltration and groundwater recharge



SUMMARY

1. Heavy rain and efficient runoff leads to more flooding events
2. In certain situations, runoff characteristics can be more important than rainfall
3. Soil properties like texture or vertical profile can significantly influence surface runoff
4. Basin characteristics (e.g. shape, size, slope) also influence infiltration and runoff

EVALUATION (15 MINS)

Quiz

1. Ask the learners what to expect when they see pictures of the two rain producing clouds.
2. Is your school, house, or community affected by the hydrometeorological hazards that were discussed?

	
Cumulonimbus	**Nimbostratus**
• Forms on hot and humid days • Thunderstorm clouds usually precipitates in the afternoon or evening • Associated with lightning and thunder • Brief but intense rain • Gusty winds • May form hail and/or tornado • Can trigger flooding	• Generally forms from frontal systems • Tail-end of the cold front weather system that affects northern and eastern Luzon • Overcast conditions with cool temperature • Continuous light to moderate rain • Can lead to water-saturated surfaces

ENRICHMENT (50 MINS)

Project: Make a simple watershed model using different soil materials (soil, sand, rocks, etc.)

Materials needed

- Plastic tray
- Plastic cup (with water)
- Needle
- Soil material (soil, clay, pebbles, sand, rocks, etc.)

What to do:

1. Put soil material on a plastic tray.
2. Put a mound of soil material to create a mountain on one side of tray and flat surface on the other side (as in Fig. 9 below).
3. Poke holes at the base of a plastic cup and fill the cup with water.
4. Let water drop on the 'mountain side' of the model.
5. Measure the amount of water needed in the experiment before surface flow/runoff is apparent.

    In doing this experiment, the class can be divided into several groups, with each group using a different type of soil material. This will simulate the influence of soil properties to different rates of infiltration and surface runoff.

Teacher Tip:
In doing this experiment, the class can be divided into several groups, with each group using a different type of soil material.

Presentation of Results

1. Discuss infiltration and surface runoff and how this relates to the experiment
2. Present the amount of water used and compare results with other groups.
3. How does soil type, texture, moisture, etc. influence the movement of water?
4. How can this relate to real world flooding in your community?

Photos from the following sites:

(1) General Cloud Types. Retrieved from: https://upload.wikimedia.org/wikipedia/commons/thumb/5/57/Cloud_types_en.svg/2000px-Cloud_types_en.svg.png. (December 12, 2015)

(2) Cumulus. Retrieved from: https://upload.wikimedia.org/wikipedia/commons/b/b1/Cumulus_cloud_before_rain.jpg. (December 12, 2015)

(3) Stratus clouds. Retrieved from: https://upload.wikimedia.org/wikipedia/commons/7/71/Close_Cirrostratus_stratiformis.JPG. (December 12, 2015)

(4) Stratocumulus. Retrieved from: https://upload.wikimedia.org/wikipedia/commons/4/4b/Above_the_Clouds.jpg. (December 12, 2015)

(5) Cumulonimbus. Retrieved from: https://upload.wikimedia.org/wikipedia/commons/6/66/Cumulonimbus_cloud.jpg. (December 13, 2015)

(6) Altocumulus. Retrieved from: https://upload.wikimedia.org/wikipedia/commons/1/13/Altocumulus.jpg (December 13, 2015)

(7) Nimbostratus. Retrieved from: https://upload.wikimedia.org/wikipedia/commons/4/4f/Ns1.jpg. (December 13, 2015)

(8) Altostratus clouds. Retrieved from: https://upload.wikimedia.org/wikipedia/commons/c/cb/Altostratus_translucidus_mamma.JPG. (December 13, 2015)

(9) Cirrus. Retrieved from: https://upload.wikimedia.org/wikipedia/commons/7/73/Cirrus_clouds2.jpg. (December 14, 2015)

(10) Cirrostratus. Retrieved from: https://upload.wikimedia.org/wikipedia/commons/8/8a/Strange_Cirrostratus.JPG. (December 14, 2015)

(11) Cirrucumulus. Retrieved from: https://upload.wikimedia.org/wikipedia/commons/7/7b/Cirrocumulus_above_Cumulus.JPG. (December 14, 2015)

90 MINS

Signs of Hydrometeorological Hazards

Content Standard
The learners demonstrate understanding of hydrometeorological hazards

Performance Standard
The learners shall be able to:

- develop a family emergency preparedness plan to guide them on what to do before, during, and after the occurrence of events that cause hydrometeorological hazards
- develop proficiency in executing emergency response plans through safety drills.

Learning Competency
The learners are able to:

- recognize signs of impending hydrometeorological hazards (and prepare a hydrometeorological hazard map) **(DRR11/12-IIc-d-33)**

Specific Learning Outcomes
At the end of the lesson, the learners will be able to:

- interpret weather forecasts; and
- draw a short-term hydrometeorological hazard map of their school/ school grounds as a function of its location

LESSON OUTLINE

Introduction	Definition of some Hydrometeorological Hazards	10
Motivation	Video on Weather Forecasting	15
Instruction	Group Work on Short Term Meteorological Hazards	30
Practice	Presentation of Hazard Maps	15

Suggested Resources

(1) American Meteorological Society. (2012). AMS Glossary. Retrieved from http://glossary.ametsoc.org/wiki/Main_Page
(2) Department of Science and Technology. (n.d.). DOST - Project NOAH. Retrieved from http://noah.dost.gov.ph/
(3) Japan Meteorological Agency. (n.d.). Tropical Cyclone Information. Retrived from http://www.jma.go.jp/en/typh/
(4) Philippine Atmospheric, Geophysical and Astronomical Services Administration. (n.d.). PAGASA | Philippine Atmospheric Geophysical and Astronomical Services Administration. Retrieved from https://kidlat.pagasa.dost.gov.ph/
(5) United Nations Office for Disaster Risk Reduction. (n.d.). *United Nations Office for Disaster Risk Reduction*. Retrieved from http://www.unisdr.org/
(6) PAGASA TV. (2015, April 9). PAGASA Weather Forecast [Video file]. Retrieved from https://www.youtube.com/watch?v=B0alqHpiO-Y
(7) GMA KapusoTV Shows. (2013, November 7). UNANG HIRIT: SUPER TYPHOON YOLANDA (HAIYAN) NEWS UPDATE as of 5:00 am with Mang Tani [Video file]. Retrieved from https://www.youtube.com/watch?v=IDTobZivwBQ
(8) Philippine Atmospheric, Geophysical and Astronomical Services Administration. (n.d.). General Flood Advisories. Retrieved from http://pagasa.dost.gov.ph/index.php/floods/general-flood-advisories

INTRODUCTION (10 MINS)

Communicate Learning Objectives

1. Introduce the following learning objectives using any of the suggested protocols (Verbatim, Own Words, Read-aloud).
    I. I can critically identify common hydrometeorological hazards in the Philippines and the elements exposed to those hazards within my community / school / home that may lead to a disaster.
    II. I can work together with other people to map elements exposed to specific hazards.

Definition of Hydrometeorological Hazards

2. Ask learners to enumerate/briefly define the types of short-term hydrometeorological hazards discussed in class:
    I. Typhoon
    II. Thunderstorm
    III. Floods / Flash Floods
    IV. Storm Surge
3. Ask the class to explain the following (ask learners to illustrate on the board)
    I. How typhoons develop over the Pacific Ocean
    II. Differentiate floods from flash floods
    III. Areas prone to storm surges

MOTIVATION (10 MINS)

Video on Weather Forecasting

1. Show a video of a PAGASA weather forecast (https://www.youtube.com/watch?v=B0alqHpiO-Y)
2. Video of a TV weather forecast (Weather forecast by TV stations also get their information from PAGASA) (https://www.youtube.com/watch?v=IDTobZivwBQ)

Teacher Tip:
Even though presentation of weather forecasts may appear different for various media (e.g. tv, radio, etc.), it is expected that all media will use PAGASA as its source since PAGASA is the official weather forecast agency of the Philippines.

INSTRUCTION (30 MINS)

Lecture

Tropical cyclone is a rotating, organized system of clouds and thunderstorms that originates over the tropical waters. Tropical cyclones rotate in a counterclockwise direction in the northern hemisphere (conversely, clockwise in the southern hemisphere). The term tropical cyclone encompasses tropical depressions, tropical storms, typhoons and hurricanes.

After formation, tropical cyclones usually move to the west and generally slightly poleward, then may "recurve," that is, move into the mid-latitude and back toward the east. However, not all tropical cyclones recurve. **It** derives its energy from the latent heat of condensation which made them exist only over the oceans and die out rapidly on land. The intensity of tropical cyclones vary, thus, we can classify them based upon their degree of intensity.

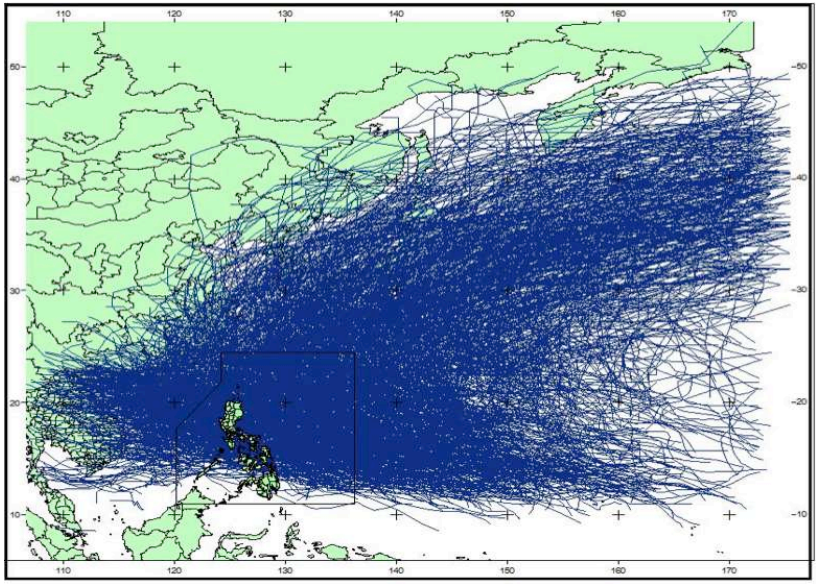
The classification of tropical cyclones according to the strength of the associated winds as adopted by PAGASA (***as of 01 May 2015)*** are as follows:

- **TROPICAL DEPRESSION (TD) -** a tropical cyclone with maximum sustained winds of up to 61 kph.
- **TROPICAL STORM (TS) -** a tropical cyclone with maximum wind speed of 62 to 88 kph.
- **SEVERE TROPICAL STORM (STS) -** a tropical cyclone with maximum wind speed of 89 to 117 kph.
- **TYPHOON (TY) -** a tropical cyclone with maximum wind speed of 118 to 220 kph.
- **SUPER TYPHOON (STY)**, a tropical cyclone with maximum wind speed exceeding 220 kph.

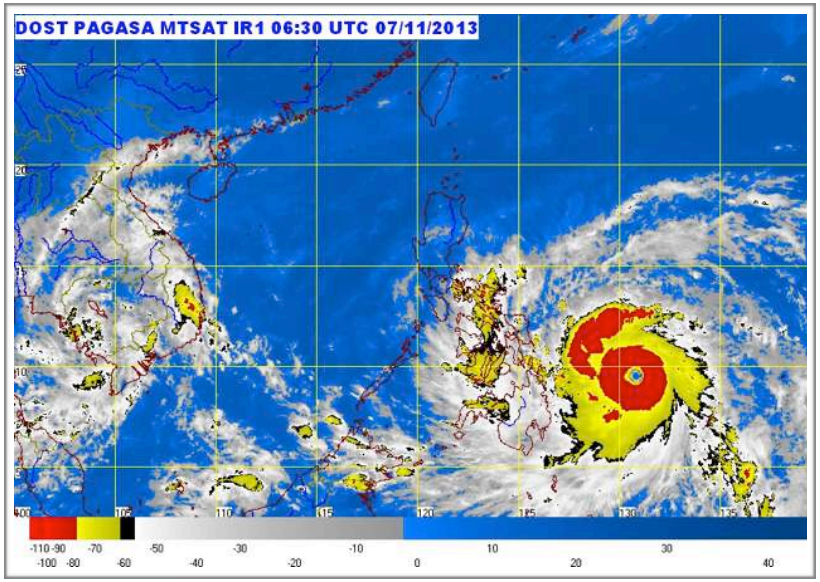
Every year, an average of 19 tropical cyclones enter the Philippines Area of Responsibility (PAR), and about half (9-10) make landfall in the Philippines. In the Western Pacific Ocean, tropical cyclones can form in any month of the year.

Teacher Tip:
American Meteorological Society (AMS) definition of Hydrometeorological terminologies.

NOTE: the word 'hurricane' is used only in Eastern Pacific and Western Atlantic Ocean. Although it is essentially a typhoon, this terminology is not applicable to the Philippines.



Tracks of tropical cyclones that formed in the Western North Pacific (WNP) during the period 1948-2010 (1154 out of 1641 TC or 70% entered or formed in the Philippine Area of Responsibly (PAR) (Source: JMA Data set, 2010)



MTSAT IR satellite image of Yolanda (Haiyan) on 7 Nov 2013

THE TROPICAL CYCLONE

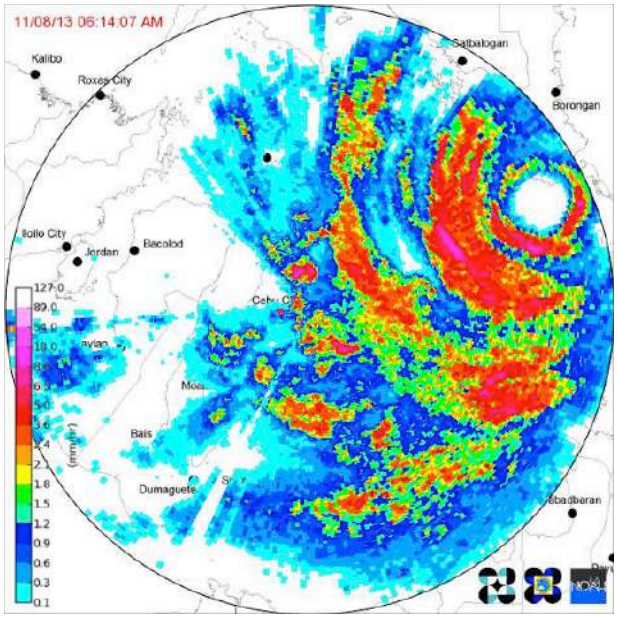
A tropical cyclone can be seen in a satellite image due to its characteristic spiral/circular shape. The stronger and more intense a tropical cyclone becomes, the more symmetrical the inner clouds or rainbands are and a distinctive "eye" at the center of circulation becomes visible. This means that a tropical cyclone tends to be more circular and it's center will have a cloudless region. Weather forecasters use satellite images like that in Fig. 2 to track the movement and estimate the intensity of tropical cyclones.

Tracks of tropical cyclones that formed in the Western North Pacific (WNP) during the period 1948-2010 (1154 out of 1641 TC or 70% entered or formed in the Philippine Area of Responsibly (PAR) (Source: JMA Data set, 2010)

THE WEATER RADAR

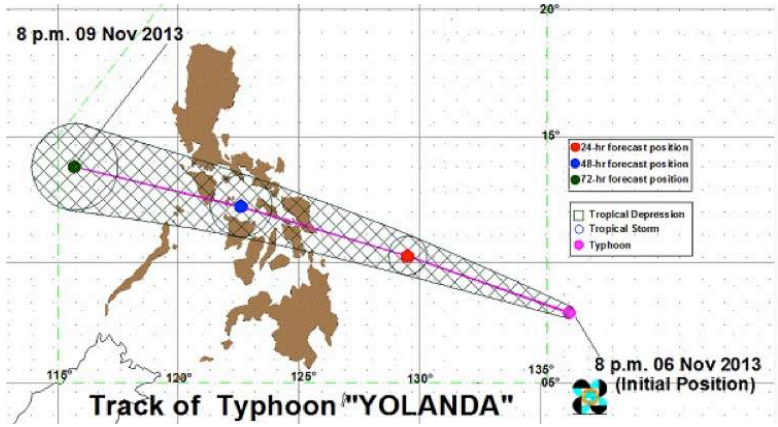
Another way weather forecasters track the movement of tropical cyclones is with the use of weather Radars. RADAR is an acronym which stands for RAdio Detection And Ranging. A Radar sends out electromagnetic waves to the atmosphere that is then reflected by hydrometeors (e.g. rain, clouds) present in the sky. An image is created from the received signal and information on rain clouds can be gathered. While radar images give more details of a storm, it is limited to a range of approximately 400 km from the radar site.

Fig. 3 shows the eye and parts of Yolanda (Haiyan) in the morning of 8 Nov 2013 when it made landfall in Eastern Visayas as observed by the Mactan (Cebu) Radar. The image is color coded depending on the amount of rain a cloud carries: Blue – light rain, green/yellow – moderate rain, red – intense rain.



Mactan Weather Radar image of Typhoon Yolanda (Haiyan)

Once a tropical cyclone enters PAR, a 5-day forecast track (previously 3-day) is issued by PAGASA every 6 hours at 5am, 11am, 5pm and 11pm. A forecast track gives the expected location of a tropical cyclone in the succeeding 24-hour interval for the next 120 hours or 5 days.



PAGASA forecast track of Yolanda (Haiyan) issued on 11pm 6Nov2013

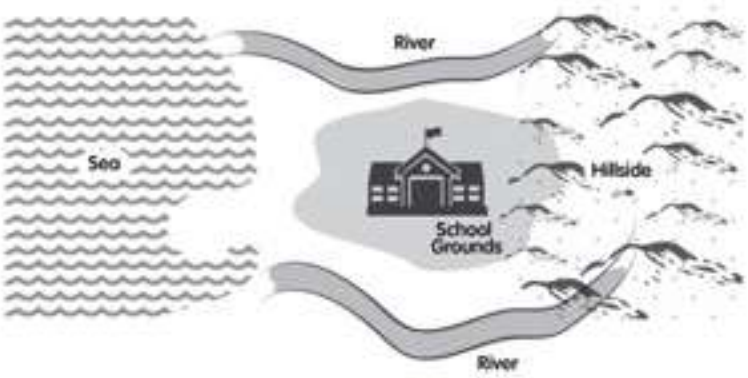
Together with the forecast track, PAGASA also issues the Public Storm Warning System (PSWS) to warn citizens of impending wind strength. The PSWS is as follows:

PSWS	LEAD TIME * (hrs)	WINDS (KPH)	IMPACTS OF THE WIND
#1	36	30 - 60	No damage to very light damage
#2	24	61-120	Light to moderate damage
#3	18	121-170	Moderate to heavy damage
#4	12	171-220	Heavy to very heavy damage
#5	12	more than 220	Very heavy to widespread damage

PAGASA Public Storm Warning System

Group Work on Short Term Meteorological Hazards

1. Divide the class into groups of 5.
2. Distribute the school/school grounds maps to each of the groups.
3. Let learners analyze, based on the Teacher Tips, whether their school/school grounds is/are prone to typhoons and/or thunderstorms. Show a map of the Philippines for reference.
4. Bring the class outside to allow the learners to appreciate the location of their school relative to its surroundings with emphasis on topography, waterways/drainage system, mountain slopes, etc.
5. Ask each group to indicate areas in the map prone to hydrometeorological hazards discussed in class (floods, flash floods, storm surges):
6. Provide a color legend for the following hazards for standardization. Suggested color scheme:
7. Red – flood-prone, Orange – flash flood-prone, Purple – storm surge-prone
8. After finishing their hazard maps, ask each group to present their outputs.



Sample School/School Grounds Map and its surroundings

PAGASA Regional Flood Advisory
http://pagasa.dost.gov.ph/index.php/floods/general-flood-advisories

PRACTICE (15 MINS)

1. Ask the groups to post their hazard maps in the classroom bulletin board
2. Ask the class to vote on the "best" hazard map, based on the evaluation grade, to be posted on the school bulletin board.
3. Encourage the learners to investigate the surroundings of the school, to appreciate their proximity to any of the waterways/water bodies that may contribute to the hazards of floods, flash floods, storm surges.

60 MINS

Precautionary and Safety Measures for Hydrometeorological Hazards

Content Standard
The learners demonstrate understanding of hydrometeorological hazards

Performance Standards
The learners shall be able to:

- develop a family emergency preparedness plan to guide them on what to do before, during, and after the occurrence of events that cause hydrometeorological hazards; and
- develop proficiency in executing emergency response plans through safety drills.

Learning Competency
The learners are able to:

- apply measures/interventions before, during and after hydrometeorological hazards **(DRR11/12-IIc-d-34)**

Specific Learning Outcomes
At the end of the lesson, the learners will be able to:

- critically identify exposure to certain risks; and
- know what to do before, during and after hydrometeorological events.

LESSON OUTLINE

Introduction	Discussion on Common Hydrometeorological Hazards in the Philippines	10
Instruction	Lecture: What to do before, during, and after certain hydrometeorological hazards	30
Practice	Group Work on Short Term Meteorological Hazards	20
Enrichment	Assignment	

Suggested Resources

(1) Department of Education. (2008). Disaster Risk Reduction Resource Manual (Safer School Resource Manual). Retreived from http://www.deped.gov.ph/sites/default/files/Disaster%20Risk%20Reduction%20Resource%20Manual.pdf

(2) United Nations Office for Disaster Risk Reduction. (n.d.). *Terminlogy - unisdr*. Retrieved from https://www.unisdr.org/we/inform/terminology

INTRODUCTION (10 MINS)

Communicating learning objectives

1. Introduce the following learning objectives using any of the suggested protocols.
   I. I can identify hydrometeorological hazards that my community is exposed to
   II. I know what to do before, during and after severe hydrometeorological to minimize disasters.

Discussion on Common Hydrometeorological Hazards in the Philippines

1. Ask learners to enumerate the most common severe hydrometeorological hazards we experience in the Philippines
2. Ask learners about their personal experience with a severe hydrometeorological hazards

Teacher Tip:
The discussion on things to do are by no means complete. This can serve as a guide, but different situations would require different ways of preparation and avoidance of risk factors. Encourage the learners to analyze each situation carefully and let them think of other/more suitable ways on what to do before, during and after such events.

INSTRUCTION (30 MINS)

Lecture

1. Below is a list of thing to do prior, during and after the following hydrometeorological events:

TROPICAL CYCLONE	THUNDERSTORM	FLOOD / FLASH FLOOD	STORM SURGE
			
https://upload.wikimedia.org/wikipedia/commons/thumb/b/ba/Bruce_Dec_20_2013_0425Z.jpg/180px-Bruce_Dec_20_2013_0425Z.jpg	https://upload.wikimedia.org/wikipedia/commons/8/88/Thunderstorm_003.jpg	https://upload.wikimedia.org/wikipedia/commons/1/15/Flood_damage_in_Manila,_Philippines_2012._Photo-_AusAID_(10695554446).jpg	https://upload.wikimedia.org/wikipedia/commons/7/77/Tacloban_Typhoon_Haiyan_2013-11-14.jpg

Tropical cyclones are hydrometeorological hazards characterized by strong winds and heavy rain. Every year, an average of 19 tropical cyclones enter the Philippine Area of Responsibility and approximately 9-10 make landfall in the Philippines. This is because the Philippines is located on the western rim of the Pacific Ocean, where most tropical cyclones pass. Tropical cyclones can have a forecast lead time of 5 days. Below is a list of things that you can do before, during and after the passage of this type of weather disturbance.

TROPICAL CYCLONES

BEFORE	DURING	AFTER
• Coordinate with local community or barangay on safety plan during times of severe events • Ensure that your house (or school) can withstand strong winds and heavy rains. • Discuss with your family, friends, classmate about typhoon and other weather disturbances, understand weather forecasts and how to minimize our risks • Recommend trimming and removal of unstable trees, electric posts, or any infrastructure that could fall and may cause damage or injury. • Have a survival kit containing battery-operated radio, flashlight, emergency cooking equipment, candles, matches and first aid kit. • Participate actively in the school drills on disaster response	• Regularly monitor official updates of PAGASA or other reliable sources on the tropical cyclone. • Stay in a sturdy and stable shelter • Stay indoors and away from windows or things that may topple over. • Coordinate with the local community on possible evacuation measures (especially if you are in a low-lying area) • Remain calm and take notice of your situation.	• Attend to injuries if needed. • Apply first aid to minor cuts or wounds • Seek medical assistance at your nearest clinic or hospital • Check your immediate vicinity (house, school, surroundings) for any damages that can pose a potential hazard to people around it.

Thunderstorms are generally local storms produced by cumulonimbus clouds and are always accompanied by lightning and thunder, usually with strong wind gusts, heavy rain and sometimes with hail and/or tornado. Thunderstorms are typical in warm environments like the tropics and may persist for 1 to 2 hours. Below is the list of things that you can to do before, during and after a thunderstorm event.

THUNDERSTORMS

BEFORE	DURING	AFTER
• Learn about your area's thunderstorm risk by looking at past events. These risks differ for different places and different months • Discuss how you would know if a thunderstorm may produce light, moderate, heavy or torrential rain as well as duration. • Discuss the rainfall / thunderstorm warning system of PAGASA. • Recommend trimming and removal of unstable trees, electric posts, or any infrastructure that could fall and may cause damage or injury. • Ensure proper drainage in the surrounding by removing things that may hinder proper drainage flow • Participate actively in the school drills on disaster response	• Stay indoors and remain calm • Postpone all outdoor activities. Regularly monitor official updates by PAGASA or other reliable sources • Be on the lookout for falling debris and flashfloods. **If treat of lightning is eminent** • Turn off and unplug all electrical and electronic devices • refrain from using phones (mobile, landline) until the storm passes over. **If no immediate shelter and threat of lightning is eminent:** • Stay low • Stay away from structures such as trees, electrical lines, towers, or fences. • Water can conduct electricity, refrain from swimming or being in contact/submerged in bodies of water. • Distance of thunderstorm cloud can be estimated by counting the time interval between seeing lightning and hearing thunder. (1 second = 330m, 3 sec = 1 km). • Remain indoors at least 30 minutes after hearing the last thunder	• Continue monitoring PAGASA or local radio / television stations for weather updates • Always observe safety measures on if you need to go outdoors. • Stay away from storm-damaged areas. • Watch out for fallen tree branches, trunks, electric lines, etc.and report them to authorities. • Stay away from flood waters • It is possible to contract diseases from flood water • Uneven ground, open drainage and/or sharp debris under floodwater can be potentially harmful

Flood is the overflowing of the normal confines of a stream or bodies of water, or the accumulation of water over areas that are not normally submerged. Below is a list of things that you can to do before, during and after a flooding event. While flooding may last days or even weeks, **Flash Floods** are also caused by heavy precipitation in a short period of time, usually less than 6 hours.

FLOOD or FLASH FLOOD

BEFORE	DURING	AFTER
• Learn about your area's flood risk by by looking at past events. These risks differ for different places and different months • Know the flood hazard map in your community. • Learn from previous occurrences how frequent, how high and how fast flood can occur. • Take notice of rapidly rising water and prepare plans for evacuation. • Have a survival kit containing battery-operated radio, flashlight, emergency cooking equipment, candles, matches and first aid kit • As the ground soak up more water from continuous rains, possibility of flooding increases. • Participate actively in the school drills on disaster response	• Unplug all electric and electronic devices • Listen continuously to official updates on weather and flooding • Remain calm and be ready in case evacuation is necessary. • Do not to attempt to cross flowing streams unless they are assured that the water is below knee level. • Avoid areas prone to flooding. • Avoid swimming in swollen rivers. • Make sure you only drink clean water • Stay away from flood waters as • Its possible to contract diseases from flood water • Uneven ground, open drainage and/or sharp debris under floodwater can be risky and potentially harmful	• Report broken utility lines (electricity, water, gas, etc.) to appropriate agencies/ authorities. • Ensure that electrical appliances are checked by a competent electrician before switching them on. • Stay away from flood waters • It is possible to contract diseases from flood water • Uneven ground, open drainage and/or sharp debris under floodwater can be potentially harmful

Storm surge is the rise and onshore surge of seawater as the result primarily of the winds of a tropical cyclone, and secondarily of the surface pressure drop near the center of the tropical cyclone. The height of storm surge is dependent on the size, intensity and movement of the tropical cyclone, shape of the coastline as well as nearshore underwater topography and astronomical tides. Below is a list of things that you can to do before, during and after a storm surge event.

STORM SURGE		
BEFORE	**DURING**	**AFTER**
• Learn about your area's vulnerability to storm surge by looking at past events. If vulnerable, recommend relocation to safer grounds. • Stay away from beaches / shore during tropical cyclone passage. • Identify evacuation routes leading to safe higher grounds. • Establish evacuation plans and procedures. • Participate actively in the school drills on disaster response	• Regularly monitor official storm surge advisory/forecast updates of PAGASA • Remain calm and be ready in case of evacuation • Stay away from beaches / shore and low-lying areas • Head towards inland away from potential flow of water. • Turn off power supply. • If caught in a storm surge, you are advised to hold on large structures like big trees.	• Check structural damage of your surroundings and make sure structures are safe from collapsing. • Check surroundings for electrical damage. • Stay away from flood waters • It is possible to contract diseases from flood water • Uneven ground, open drainage and/or sharp debris under floodwater can be potentially harmful • Clean all mud and debris.

EXTREME CLIMATE EVENT: EL NIÑO

El Niño is a significant increase in ocean temperature over the eastern and central Pacific ocean. It occurs at irregular intervals ranging from 2-7 years usually developing in the early months of the year and decay the following year. In the Philippines, El Niño conditions are often characterized by dry and warm-hot events. Below is a list of things that you can to do before, during and after a El Niño condition.

EL NIÑO		
BEFORE	**DURING**	**AFTER**
• Listen and monitor PAGASA El Niño/ drought/dry spell forecast on what parts of the country will be affected severe conditions. • Plan your daily activities to avoid doing strenuous work during the hottest time of the day. • Learn about the symptoms of heat stress or exposure to extreme environmental heat, sunburn, heat exhaustion, heat stroke, dehydration, and other related conditions caused by very hot climate by discussing with local physicians / medical personnel.	• Avoid doing strenuous activity during the hottest time of the day. • Keep hydrated • During drought condition, conserve water. • Stay indoors whenever possible. • Regularly clean electric fans and air conditioner filters • Wear light-colored and lightweight clothing. • Take frequent breaks if you must work outdoors. • Never leave children or pets alone in closed vehicles. • Seek medical attention if you or another person experiences symptoms of heat stress.	• Seek medical attention if you or another person experiences symptoms of heat stress.

PRACTICE (20 MINS)

Group Work on Short Term Meteorological Hazards

1. Divide the class into several (5) groups
2. Assign a hazard exposure scenario for each group (does not have to be a single hazard, for instance thunderstorm and flooding in school, typhoon and storm surge in an evacuation area, these different hazards can occur as a single event)
3. Ask the learners to investigate the school surrounding and discuss among themselves what they can do to prepare before, minimize risk during and their response after such events.
4. Present their results by role playing as members of different sectors of our society (i.e. politician, teacher, weather forecaster, etc.).

ENRICHMENT

Assignment

1. Encourage the learners to discuss the lessons learned with their family / household members.

90 MINS

Hydrometeorological Hazard Maps

Content Standard
The learners demonstrate understanding of hydrometeorological hazards

Performance Standards
The learners shall be able to:

- develop a family emergency preparedness plan to guide them on what to do before, during, and after the occurrence of events that cause hydrometeorological hazards
- develop proficiency in executing emergency response plans through safety drills.

Learning Competency
The learners are able to:

- interpret different hydrometeorological hazard maps **(DRR11/12-IIc-d-35 and 36)**

Specific Learning Outcomes
At the end of the lesson, the learners will be able to:

- source different hydrometeorological hazard maps available on the internet; and
- use/apply the hazard maps in their local area as tools for risk assessment and planning

LESSON OUTLINE

Introduction	Common Hydrometeorological Hazards in the Philippines	5
Instruction	Lecture: Hazard Maps and their Online Sources	25
Practice	Exploration of Various Hydrometeorological Hazard Maps and their Applications	60
Enrichment	Hazard Maps of Local Barangay	

Suggested Resources

(1) Department of Science and Technology. (n.d.). DOST - Project NOAH. Retrieved from http://noah.dost.gov.ph/
(2) Mines and Geosciences Bureau. (n.d.). Retrieved from http://gdis.denr.gov.ph/mgbgoogle/
(3) National Mapping and Resource Information Authority. (n.d.). NAMRIA | The Central Mapping Agency of the Government of the Philippines. Retrieved from http://www.namria.gov.ph/
(4) Philippine Atmospheric, Geophysical and Astronomical Services Administration. (n.d.). PAGASA | Philippine Atmospheric Geophysical and Astronomical Services Administration. Retrieved from https://kidlat.pagasa.dost.gov.ph/
(5) Philippine Flood Hazards Map. (n.d.). Retrieved from http://www.nababaha.com
(6) United Nations Office for Disaster Risk Reduction. (n.d.). *Terminlogy - unisdr*. Retrieved from https://www.unisdr.org/we/inform/terminology

INTRODUCTION (5 MINS)

Communicating learning objectives

1. Introduce the following learning objectives using any of the suggested protocols. (Verbatim, Own Words, Read-aloud).
   I. I can identify hydrometeorological hazards and their respective hazard maps
   II. I can minimize my vulnerability to hydrometeorological hazards by proper preparation

Review of Common Hydrometeorological Hazards in the Philippines

1. What are hazard maps and how can these maps help us?
2. Ask learners to enumerate the most common severe hydrometeorological hazards we experience in the Philippines
3. Ask learners what particular hydrometeorological hazards are their community exposed to.

INSTRUCTION (25 MINS)

Lecture

Return period, also referred to as recurrence interval, is the probability of an event such as heavy rain, intense typhoon of floods to happen. It is a statistical measurement mainly based on historical data that gives the estimated time interval between similar extreme events.

For example, the return period of a heavy rainfall event is 100 years, this can be expressed as an event with a probability of happening equivalent to 1/100 or 1%. This does not mean that the next similar extreme event will happen 100 years after, instead, it means that in a given year, there is a 1% chance that the event will happen. Consequently, 100-year floods can happen in 2 consecutive years. In analysis of extreme hydrometeorological events, "return periods" are usually used to infer the severity of an event.

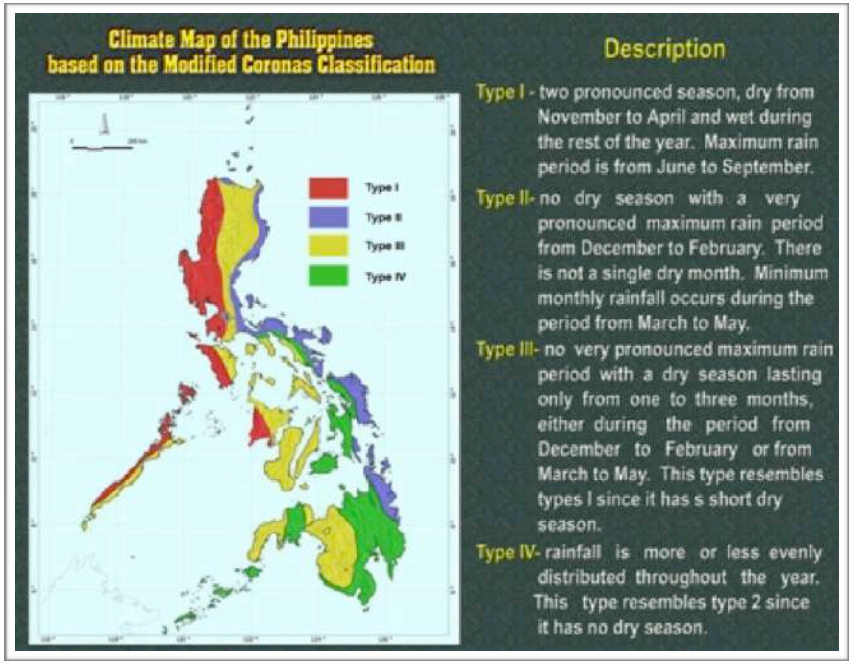


Fig. 1: Modified Coronas Climate Classification

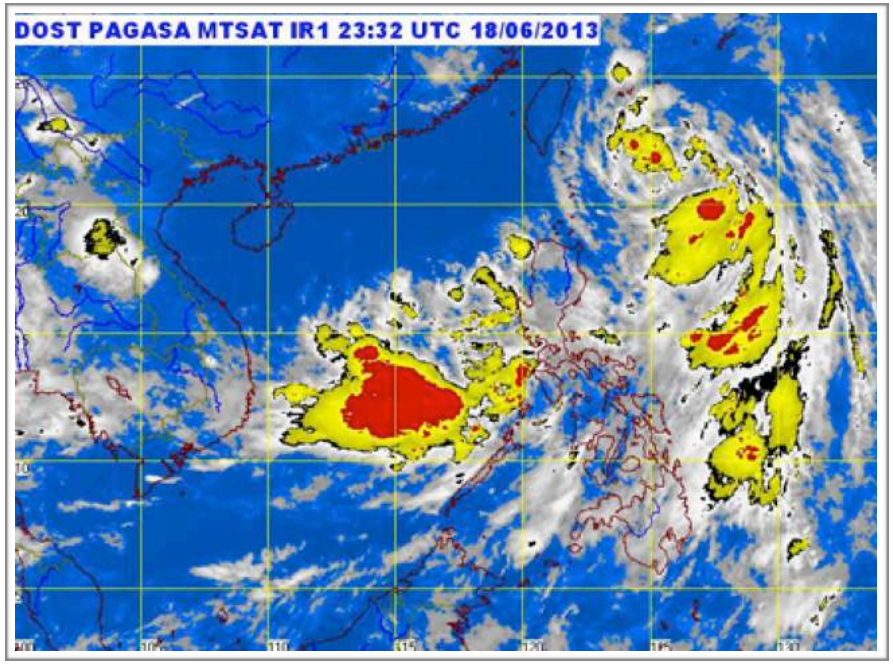


Fig. 2: MTSAT IR satellite image taken on 19 June 2013 (local time)

Rainfall in the Philippines

Rainfall is the most important climatic element in the Philippines. Rainfall distribution throughout the country varies from one region to another, depending upon the direction of the moisture-bearing winds and the location of the mountain systems.

The mean annual rainfall of the Philippines varies from 965 to 4,064 millimeters annually. Baguio City, eastern Samar, and eastern Surigao receive the greatest amount of rainfall while the southern portion of Cotabato receives the least amount of rain. At General Santos City in Cotabato, the average annual rainfall is only 978 millimeters for the whole year. What is the usual rainfall in you area?

The Modified Coronas Climate Classification (Fig. 1) describes the monthly rainfall variations in different parts of the country.

Rainfall observation

Aside from rain gauge monitoring in different parts of the Philippines, PAGASA publishes regularly updated color-coded satellite images (Fig. 2) from the Multi-Functional Transport Satellite or MTSAT (as of Dec 2015, but will soon shift to a newer satellite called Himawari-8) to visualize rain distribution across the country. Color code is as follows: Red – heavy rain; Yellow – light to moderate rain; White – clouds; Blue – clear sky.

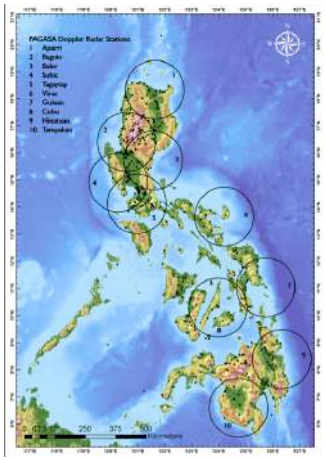


Figure 3: Location of Weather Radar operated by PAGASA

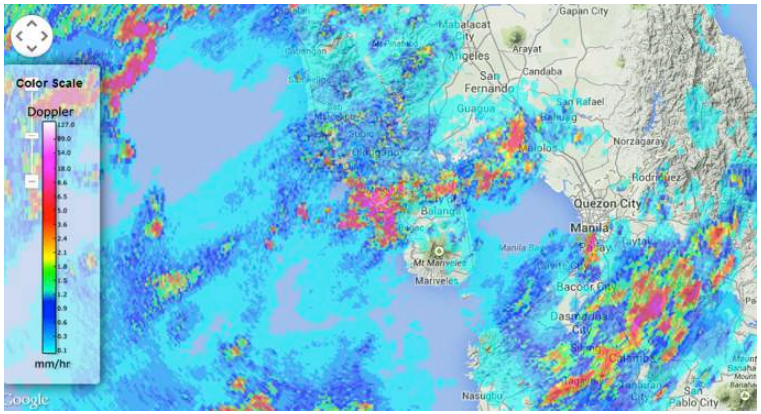


Figure 4: Radar image over Bataan / NCR showing extensive rain.

In addition to the satellite observation, PAGASA operates 10 weather radar stations (as of 2015) all over the Philippines. Fig. 3 shows the locations of these weather radar systems. Weather radar can detect hydrometeors (e.g. rain, clouds) by transmitting electromagnetic radiation to the atmosphere then analyze the returning "echoes" reflected by weather elements present in the sky. Figure 4 shows a sample radar image over Bataan also using a color coding scheme to visualize rainfall in the region.

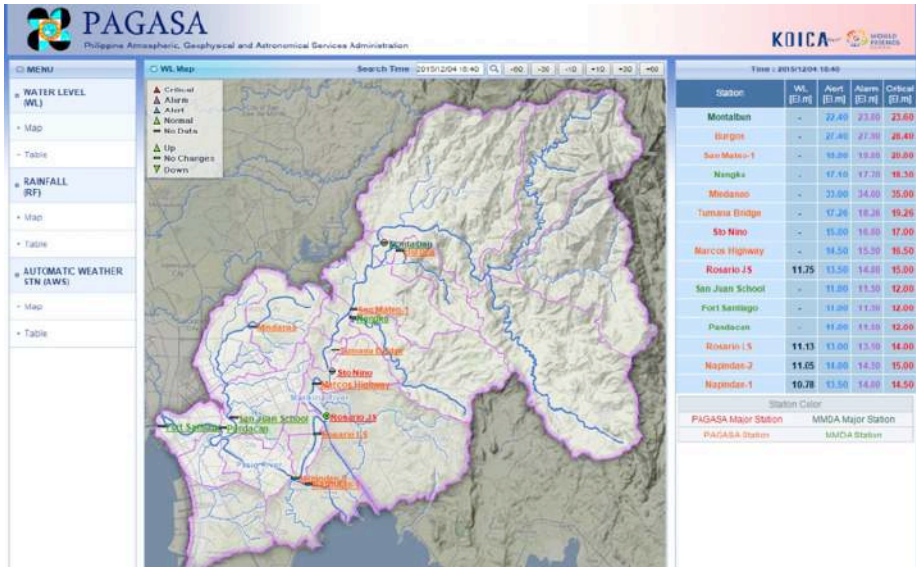
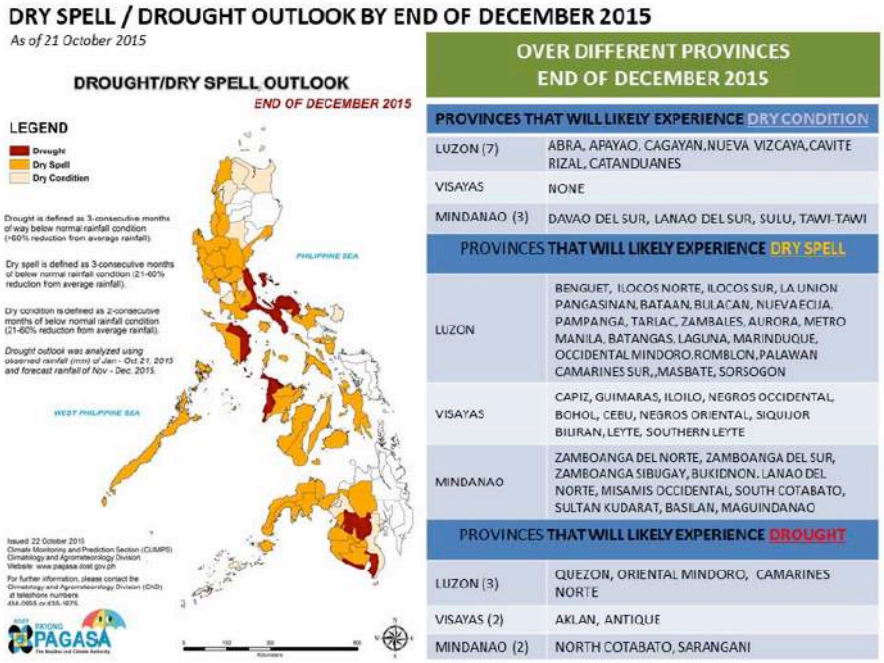


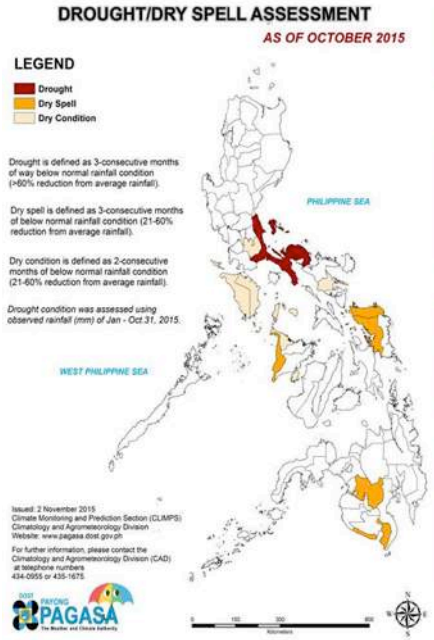
Figure 5: PAGASA Flood monitoring system

Another product of PAGASA is its watershed monitoring network or Flood monitoring system. Using water level sensors that measures the height of the water level of major river systems, users can monitor impending flooding in major river systems in the Philippines. Figure 5 show the major waterways of Metro Manila and their corresponding water levels.



OVER DIFFERENT PROVINCES END OF DECEMBER 2015	
PROVINCES THAT WILL LIKELY EXPERIENCE DRY CONDITION	
LUZON (7)	ABRA, APAYAO, CAGAYAN,NUEVA VIZCAYA,CAVITE RIZAL, CATANDUANES
VISAYAS	NONE
MINDANAO (3)	DAVAO DEL SUR, LANAO DEL SUR, SULU, TAWI-TAWI
PROVINCES THAT WILL LIKELY EXPERIENCE DRY SPELL	
LUZON	BENGUET, ILOCOS NORTE, ILOCOS SUR, LA UNION PANGASINAN, BATAAN, BULACAN, NUEVA ECIJA, PAMPANGA, TARLAC, ZAMBALES, AURORA, METRO MANILA, BATANGAS, LAGUNA, MARINDUQUE, OCCIDENTAL MINDORO,ROMBLON,PALAWAN CAMARINES SUR,,MASBATE, SORSOGON
VISAYAS	CAPIZ, GUIMARAS, ILOILO, NEGROS OCCIDENTAL, BOHOL, CEBU, NEGROS ORIENTAL, SIQUIJOR BILIRAN, LEYTE, SOUTHERN LEYTE
MINDANAO	ZAMBOANGA DEL NORTE, ZAMBOANGA DEL SUR, ZAMBOANGA SIBUGAY, BUKIDNON. LANAO DEL NORTE, MISAMIS OCCIDENTAL, SOUTH COTABATO, SULTAN KUDARAT, BASILAN, MAGUINDANAO
PROVINCES THAT WILL LIKELY EXPERIENCE DROUGHT	
LUZON (3)	QUEZON, ORIENTAL MINDORO, CAMARINES NORTE
VISAYAS (2)	AKLAN, ANTIQUE
MINDANAO (2)	NORTH COTABATO, SARANGANI

Figure 6: PAGASA Dry Spell / Drought Outlook



OVER DIFFERENT PROVINCES AS OF OCTOBER 31, 2015	
PROVINCES THAT EXPERIENCED DRY CONDITION	
LUZON	LAGUNA, OCCIDENTAL MINDORO, ORIENTAL MINDORO, ROMBLON, ALBAY
VISAYAS	AKLAN, GUIMARAS
MINDANAO	NONE
PROVINCES THAT EXPERIENCED DRY SPELL	
LUZON	
VISAYAS	ANTIQUE, NORTHERN SAMAR, SAMAR (WESTERN SAMAR)
MINDANAO	NORTH COTABATO, SARANGANI
PROVINCES THAT EXPERIENCED DROUGHT	
LUZON	QUEZON, CAMARINES NORTE
VISAYAS	NONE
MINDANAO	NONE

Figure 7: PAGASA Dry Spell / Drought Assessment

While we are usually concerned with heavy rainfall events, lack of rain is also a significant condition that we also experience. Weather in different parts of the Philippines can vary significantly for certain years as a response to changing global climate. One of the main climate drivers that affect the Philippines is the El Niño Southern Oscillation (ENSO) or simply El Niño.

El Niño is a significant increase in ocean temperature over the eastern and central Pacific ocean. It occurs at irregular intervals ranging from 2-7 years usually developing in the early months of the year and decay the following year. In the Philippines, El Niño conditions are often characterized by dry and warm to hot climate.

Months prior to the onset of El Niño, PAGASA publishes Drought/Dry spell outlook (Fig.6) that can warn us of impending dry conditions so we can prepare for such extreme events. Drought/Dry spell assessment (Fig.7) is also regularly published to report unusual climate conditions in different parts of the Philippines.

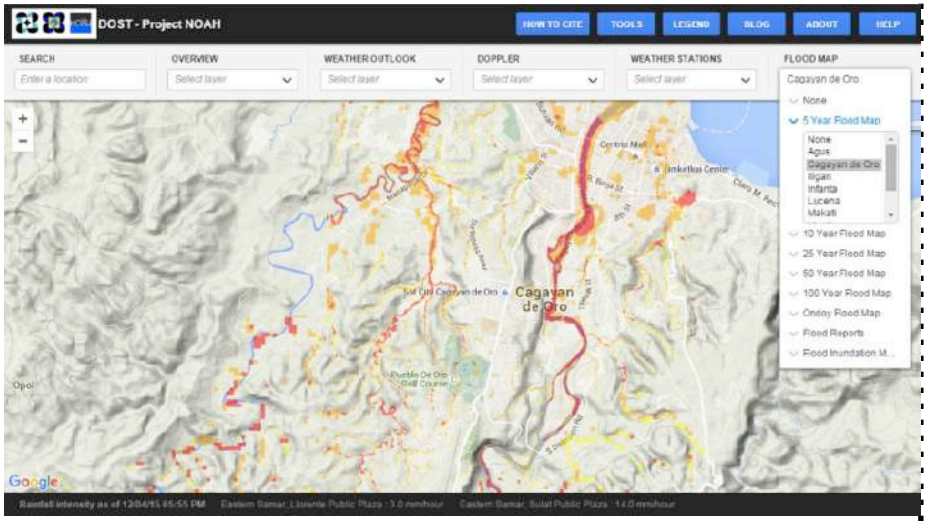


Figure 8: DOST-NOAH web portal.

The ***Nationwide Operational Assessment of Hazards*** or ***NOAH*** is a program under the Department of Science and Technology (DOST) with the mission to undertake disaster science research and development, advance the use of cutting edge technology and recommend innovative information services in government's disaster prevention and mitigation efforts. DOST-NOAH can be accessed online at http://noah.dost.gov.ph.

The NOAH website displays the PAGASA radar data, rainfall measurements of rain gauges of DOST, and has flood hazard maps for different regions of the Philippines with 5-year, 25-year, 50-year and 100-year return periods. Fig. 8 shows a sample 5-year flood hazard map accessible in its website.

The following figures are comparison of flood hazard maps with different return periods for Marikina in NCR (Fig. 9) and Cagayan de Oro (Fig. 10).

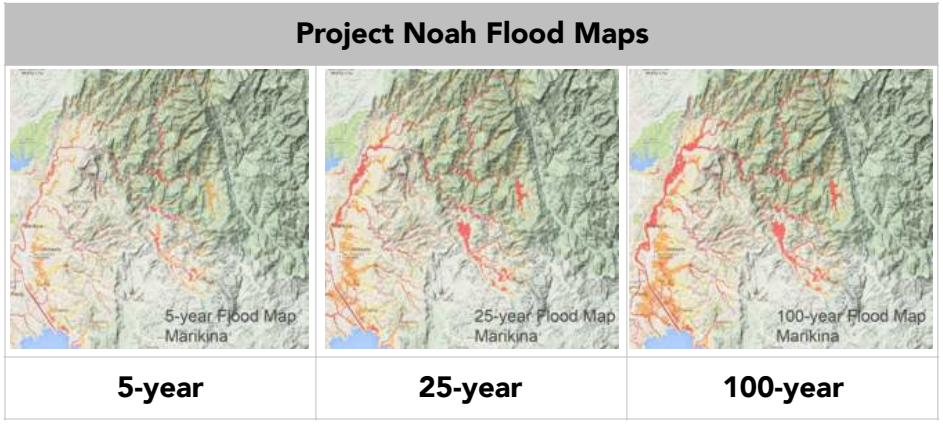
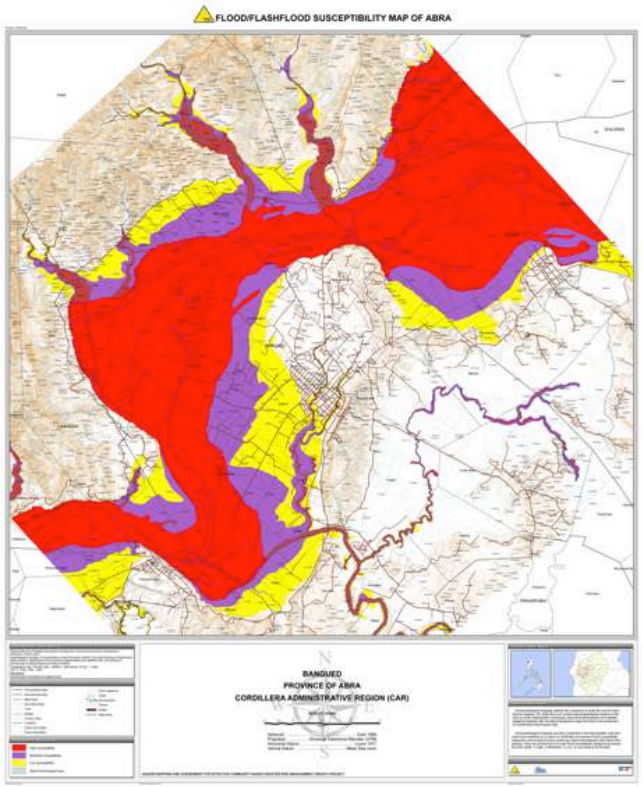


Figure 9: 5, 25, and 100-year Flood Maps of Marikina

Figure 10: 5, 25, and 100-year Flood Maps of Cagayan de Oro

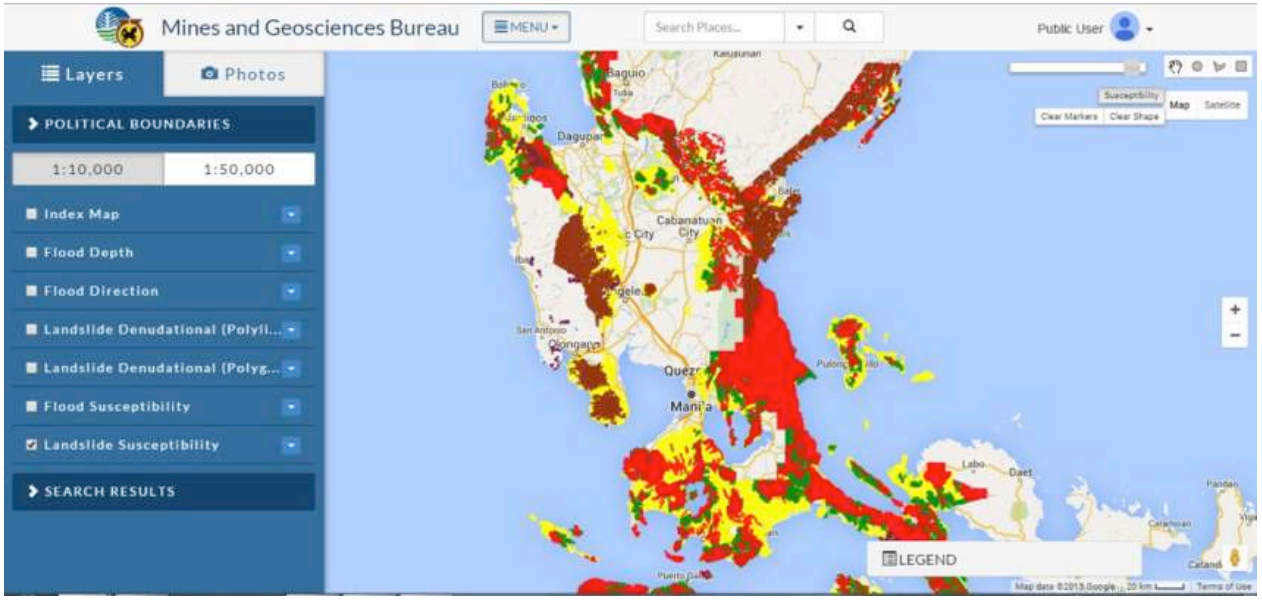
Another local website, **http://www.nababaha.com**, a non-profit project by the members of the Volcano-Techtonics Laboratory of the National Institute of Geological Sciences of University of the Philippines, publishes a list of flood hazard maps of different regions (http://www.nababaha.com/list.htm), with the same dataset as DOST-NOAH.



National Mapping and Resource Information Authority (NAMRIA) is an agency of the Philippine government under the Department of Environment and Natural Resources (DENR) responsible for providing the public with mapmaking services and acting as the central mapping agency, depository, and distribution facility of natural resources data in the form of maps, charts, texts, and statistics. On its website's download page, http://www.namria.gov.ph/download.php, hazard/susceptibility maps for storm surge, rain-induced landslide and flood are freely available.

On the left:

Figure 11: Flood/Flashflood susceptibility map (left image)



The ***Mines and Geosciences Bureau*** (MGB), a government agency also under the Department of Environment and Natural Resources (DENR), is responsible for the conservation, management, development and proper use of the country's mineral resources including those in reservations and lands of public domains. MGB maintains a geohazard visualization portal accessible at this URL http://gdis.denr.gov.ph/mgbgoogle/.

Figure 12: Mines and Geosciences Bureau GeoHazard Visualization Portal

PRACTICE (60 MINS)

1. Ask the learners to explore the publicly available hazard maps discussed and pin-point your location. (If school has no IT facility, the hazards maps can be printed beforehand and distributed to the students)
2. Enumerate the hazards of your area by providing corresponding hazard map
3. Discuss and enumerate the steps that can be taken to reduce future disasters in your community.
4. Present (individually or by groups) in front of class the results of the discussion.

ENRICHMENT

1. Ask the learners to go to their local *barangay* and see what hazard maps (or similar information) are being used to prepare the local community on certain hydrometeorological events.

60 MINS

Fire Triangle

Content Standards
The learners demonstrate understanding of the fire triangle.

Performance Standards
The learners shall be able to:

- develop a family emergency preparedness plan to guide them on what to do before, during, and after a fire incident.

Learning Competency
The learners are able to:

- recognize elements of the fire triangle in different situations. **(DRR11/12-IIe-f-37)**

Specific Learning Outcomes
At the end of the lesson, the learners will be able to:

- state the positive and negative effects of fire;
- define and identify the components of the fire triangle; and
- recognize elements of fire triangle in different situations.

LESSON OUTLINE

Introduction	Review the definition of hazards and introduce objectives	5
Motivation	Pros and Cons Activity	5
Practice	Fire Triangle Experiment	35
Evaluation	Describe and define each component of the fire triangle	15
Enrichment	Identify 5 Possible Situations where Fire is Present	

Materials:
Individual: writing paper, pens, personal protective equipment (goggles)

Per group: 3 candles, matches, glass jar with lid, glass of water, tissues/rags, cartolina, permanent markers, notebooks/worksheets

Suggested Resources

(1) UNISDR Terminology on DRR - http://www.unisdr.org/
(2) DOST PAGASA website, https://kidlat.pagasa.dost.gov.ph/
(3) DOST NOAH website, http://noah.dost.gov.ph/
(4) Nababaha website, http://www.nababaha.com
(5) NAMRIA website, http://www.namria.gov.ph/
(6) Mines and geosciences Bureau website, http://gdis.denr.gov.ph/mgbgoogle/

INTRODUCTION (5 MINS)

Review (3 minutes)

1. Ask the learners what is the meaning of a hazard.
2. Ask the learners to name the hazards that have been described in detail in class. This could be done by learners listing the hazards on the board.

   Sample responses:

   I. Earthquake hazards

   II. Volcanic hazards

   III. Storms, and other hydrometeorological hazards
3. Ask them about the remaining hazard that they need to know. They should be able to name fire hazards.

Communicate learning objectives (2 minutes)

1. Introduce learner objectives:

   I. I can state the positive and negative effects of fire.

   II. I can distinguish what materials are necessary to create fire - the fire triangle.

Teacher Tip:
Definition of hazard based on RA 10121: a dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihood and services, social and economic disruption or environmental damage.

MOTIVATION (5 MINS)

Pros and Cons Activity

Pre-Activity

1. Ask the learners to get a piece of paper and fold it in two.

During the Activity

1. On one side, they need to write what could be considered as positive qualities of fire (PROS).
2. On the other, they need to write what could be considered as negative qualities of fire (CONS).
3. Give them 3 minutes to come up with their lists.
4. Afterwards, ask to learners to form pairs and discuss what they have written.
5. Call on 2 learners to share their lists to the class.

Post Activity

1. Explain to the learners that fire has both positive and negative effects and that the goal of everyone is to minimize the negative effects of fire.

Teacher Tip:
Make sure that the learners will be able to write at least two Pros and two Cons.

PROS	CONS
It gives warmth.	It causes injury or even death.
It is used for cooking food.	It destroys important materials.
It is used in many industrial processes.	It burns down houses or forests.
It is used as a light source.	

PRACTICE (30 MINS)

Fire Triangle Experiment

Pre-Activity

1. Let the learners recall instances where they have witnessed fire.
2. Ask the learners what could be the materials needed to make fire.
3. Tell the learners that fire needs three elements for it to be formed and that they will find out what the fire triangle is based on experiments.
4. Prepare the materials needed for the experiment: candle, matches, glass jar in which the candle can fit inside and its lid, safety goggles, and notebook or worksheet.

Teacher Tip:
Remind the class that they should be very careful when dealing with fire. They should always be wearing their goggles.

The teacher may opt to prepare a worksheet for the learners to follow and answer so that the teacher could focus if the learners are conducting the activity properly.

During Activity

1. Divide the class into groups of 4-5 learners each.
2. Remind the learners that they should have their notebooks and goggles with them.
3. The activity is divided into three parts:

Part A.

A. Light a candle using the match. The learners should observe what happens before a fire is formed.
B. Using the wax from the burning candle, mount the candle to the lid of the jar. Make sure that they mount it on the underside of the lid.

C. Then, slowly put the jar on top of the candle and close the jar. Observe what happens to the candle and write this down on their notebooks.
D. Afterwards, wait for about 2 minutes to unscrew the jar. Note that the jar could still be hot.

Part B.

A. Soak the tip of the candle in water then try to light it up using the match. Does it light up easily? Observe what happens and write it down on their notebooks.
B. Afterwards, dry the tip of the candle using a tissue and again try to light the candle. Observe what happens and write it down on their notebooks.

Part C.

A. Using the same candle in Part B, try to light the bottom of the candle. Does it light up?
B. What could be needed for the candle to light up? Ask the learners to write their answers on their notebooks.

4. Give each group a cartolina and ask the learners to come up with their own version of a fire triangle based on the experiments that they have performed.

Post Activity

1. Ask each group to report their fire triangle to the class for two (2) minutes and post them around the room.
2. Use the following rubric to grade the reports:

	4	3	2	1
PRESENTATION OF FIRE TRIANGLES	The reporters were able to create an accurate fire triangle and adequately explain how they were able to come up with such.	The reporters were able to create an accurate fire triangle.	The reporters were able to describe at least one element of the fire triangle.	The reporters were not able to give a fire triangle.

Teacher Tip:
For the reporting, the learners need not use the terms OXYGEN, HEAT, and FUEL. They are given full points as long as they are able to describe the fire triangle.

Fire Triangle: (image from Wikipedia.org)

Teacher Tip on Groupings:
If the group has five (5) learners, use this configuration:
1 Group Facilitator
1 Scribe
2 Logistics Officers (in charge of the materials)
1 Reporter

The learners should give peer evaluations at the end of the activity based on their assigned task.

Discussion

1. Emphasize to the learners that fire needs three elements to burn: (1) Oxygen, (2) Heat, and (3) Fuel.
2. Part A shows the role of oxygen to the formation of fire. As the fire is being enclosed in the jar, the oxygen is being used up. Once the fire is enclosed, all the oxygen turns into carbon dioxide and eventually, fire won't be produced.
3. Part B shows the role of heat. Once the candle is soaked in water, it will not be able to produce enough heat to sustain a fire. If the candle is dry, then it could reach enough heat to sustain a fire.
4. Part C shows the role of fuel. Fire needs fuel to form. For the candle, the wick serves as the fuel. The wax is not capable of burning and is just there to support the fire.
5. If the fire triangle is incomplete, there will be no fire.

EVALUATION (15 MINS)

1. Give the learners a quiz in which they will identify the fire triangle in every situation.
2. They will need to evaluate and list down the fire triangle from these situations:
   A. Bonfire being lit while camping
   B. Stove fire used for cooking rice
   C. Lamp (gasera) used for areas where electricity is unavailable
   D. Lighter used for lighting cigarettes
   E. Grilling barbeques using charcoal
   F. Lightning striking a tree
   G. Newspapers being burned
   H. Fire crackers/fireworks used during celebrations
   I. Electrical fires during summers
   J. Chemicals stored in closed environments

ENRICHMENT

1. Ask the learners to identify 5 possible situations in their houses where fire is present. At least one (1) fire with negative effects should be included.
2. Let them identify the fire triangle for each situation.
3. Ask them to come up with concrete plans so that unwanted fires will be prevented.

Teacher Tip:
You may give one example where fire could start in their home (e.g. while cooking food) for them to have an idea.

60 MINS

Causes of Fires

Content Standard
The learners demonstrate understanding of the causes of fire.

Performance Standard
The learners shall be able to:

- develop a family emergency preparedness plan to guide them on what to do before, during, and after a fire incident.

Learning Competency
The learners are able to:

- The learners analyze the different causes of fires. **(DRR11/12-IIe-f-38)**

Specific Learning Outcomes
At the end of the lesson, the learners will be able to:

- analyze different causes of fire;
- know the different fire classes; and
- classify fire incidents according to fire classes.

LESSON OUTLINE

Introduction	Review the Fire Triangle and Introduce Objectives	5
Motivation	High - Low Game	10
Instruction and Practice	Different Causes of Fire	37
Evaluation	Classification of Fire Incidents	8
Enrichment	Research News Clippings	

Materials:
Manila papers, permanent markers, tape, graphing papers

Suggested Resources

(1) De Costo, S.B. and Gumela, M.V. 2004. Should the Fire Prevention Month Be Moved to April? (http://www.nscb.gov.ph/sexystats/2014/SS20140509_fire.asp) Accessed on October 5, 2015.

(2) Bureau of Fire Protection Operational Procedures Manual 2015. (http://bfp.gov.ph/wp-content/uploads/2015/09/BFP-Operational-Procedures-Manual.pdf) Accessed on October 5, 2015.

(3) Classes of Fire. (http://www.falckproductions.com/resources/fire-safety-and-firewatch/classes-of-fire-a-b-c-d-and-k/) Accessed on October 5, 2015

(4) Types of Fires. (http://www.femalifesafety.org/types-of-fires.html) Accessed on October 5, 2015.

Additional Resources at the Back

INTRODUCTION (5 MINS)

Review

1. Ask the learners what they remember about the fire triangle. Let one learner draw the fire triangle on the board.
2. Give one example of a fire incident and ask the learners to recognize the fire triangle in the example.

   Example: Fire produced by grilling barbecue
3. Emphasize that fire can form as long as the fire triangle is present and there is chemical reaction between the elements of the triangle.

Communicate learning objectives

1. Introduce learner objectives:
   I. I can analyze the different causes of fire.
   II. I can classify fires based on their source/cause.

Teacher Tip:
The teacher may opt to ask more examples of recognizing the fire triangle to further assess the understanding of the learners.

MOTIVATION (10 MINS)

High-Low Game

1. Using the statistics from Bureau of Fire Protection (BFP) and Philippine Statistics Authority (PSA) for 2010-2013, prepare questions requiring learners to guess the correct number/statistic.
2. Divide the class into two (2) groups. Toss a coin to see which group answers first.
3. The first group is asked the first question and has the chance to guess, the teacher responds with either HIGHER, LOWER, or CORRECT.
4. If the first group is not able to get the correct answer, the other group gets a chance to guess the answer. Again the teacher will respond with either HIGHER, LOWER, or CORRECT.
5. The groups will alternate in guessing until the correct answer is given.
6. The game ends once the learners have completely guessed all the statistics that the teacher has asked.
7. Let the learners internalize the statistics about fire incidences in the country.

Sample Questions:

A. How many fire incidents were recorded for 2013 nationwide? Ans. 12,301 incidents
B. How many people died from fire incidents for 2013 in NCR? Ans. 58 people
C. How many fire incidents were caused by cigarette butts for 2012 nationwide? For 2013? Ans. 581 and 736 incidents respectively
D. How many fire incidents were caused by faulty electrical wiring/connection for 2012 nationwide? For 2013? Ans. 2861 and 3532 incidents respectively
E. How many fire incidents were caused by neglected electrical appliances/devices for 2013 nationwide? Ans. 408 incidents

Alternative Motivation: Graph the statistics

1. Learners are given graphing papers.
2. Using the statistics from the Bureau of Fire Protection (BFP) and Philippine Statistics Authority (PSA) for 2010-2013, ask the learners to graph the data based on various criteria:
3. Number of fire incidents per year or per region
4. Number of casualties per year or per region
5. Number of fire incidents per cause of fire

Note: *Learners are given unique data to graph. Make sure that the data for the different years are distributed.*

6. Make sure that the learners will employ the same x- and y-axes and interval per axis.
7. Learners are asked to post their graphs on the board. Graphs having the same year may be lumped together. Another is moving some graphs to see the changes as the years go by.
8. The teacher will ask the learners questions about the graphs that they have done.

Sample Questions:

A. What can you say about the number of fire incidents from 2010 to 2013? Why do you think this is?
B. What can you say about the number of fire causes shown in the graphs?
C. Why do you think are there discrepancies between regions in terms of number of fire incidents?

Teacher Tips:

- The class could be further divided into smaller groups up to individuals.
- Teachers may vary their questions depending on their respective locations (e.g. regions).
- The teacher may opt to provide clues to facilitate the time in answering.
- Use the national data first then add in local statistics.
- For the graphing part: this could be used for more advanced learners. It utilizes graphing skills learned from other science and math classes.

INSTRUCTION AND PRACTICE (10 MINS)

Discussion 1

1. Ask the learners to list down all possible sources of fire that they can think of. Give as many as they can in 1 minute.
2. Ask the learner with the most answers to enumerate his answers on the board.
3. The teacher will check if the answers are correct. Afterwards, state that there are 16 identified causes of fires.
4. The BFP Operational Procedures Manual has list down the causes of fire as follows:
   A. Faulty electrical wiring or connection
   B. LPG-related
   C. Neglected cooking or stove
   D. Cigarette butt
   E. Unattended open flame: torch or *sulo*
   F. Unattended open flame: candle or *gasera*
   G. Matchstick or lighter
   H. Direct flame contact or static electricity
   I. Neglected electrical appliances or devices
   J. Electrical machineries
   K. Chemicals
   L. Incendiary device or ignited flammable liquid
   M. Spontaneous combustion
   N. Pyrotechnics
   O. Bomb explosion
   P. Lightning
   Q. Others (forest fire, vehicular fire, etc.)
5. Provide simple examples and pictures (if possible) for each.

Teacher Tip:

Definition of terms:

- **Incendiary** – designed to cause fires
  For incendiary fire, the teacher may opt to include the concept of arson or the criminal act of deliberately setting fire to property. Emphasize that arson is a criminal offense.

- **Pyrotechnics** – the art of making or displaying fireworks

- **Spontaneous combustion** – ignition of organic matter without apparent cause, typically through heat generated internally by rapid oxidation

For Discussion 1:

• The teacher may contact BFP officials regarding the explanation of fire causes and fire incidences.

Practice 1

1. Let the learners pick from 1, 2, 3, 4, or 5 (see end of guide).
2. Learners will be given two (2) news clippings of fire incidents in the Philippines each depending on what they picked from 1, 2, 3, 4, or 5.
3. Each learner will determine what caused each fire incident and the fire triangle for each.
4. After 5 minutes, the learners with the same numbers are grouped together and will discuss their answers.
5. Ask the groups to come up with a unified answer per incident. They will be given manila papers and permanent markers to write their answers on.
6. Afterwards, the groups will present a summary of the fire incidences, their causes, and respective fire triangles.
7. Let the learners leave their manila papers posted on the board.

Discussion 2

1. After all the groups have presented their answers, the teacher will introduce the different fire classes.
2. Each fire class is based on the fuel that they burn.
3. This classification is very useful in order to determine what substances or chemicals are effective in extinguishing the fire.
4. The substances or chemical that can be used to extinguish the different fire classes will be discussed in a separate meeting.
5. There are 5 fire classes:
    I. Class A – fuels are ordinary combustibles such as wood, paper, plastic, or anything that leaves ash.
    II. Class B – fuels are flammable or combustible liquids like petroleum oil, gasoline, paint, and flammable gasses such as propane and butane. Cooking oils and grease are NOT part of class B fires.
    III. Class C – fuels are energized electrical fires like motors, transformers, and appliances. Once the power or source of electricity is removed, the fire becomes one of the other classes of fire.
    IV. Class D – fuels are combustible metals like potassium, sodium, aluminum, titanium, and magnesium.
    V. Class K – fuels are cooking oils, grease such as animal fat and vegetable fats.

Teacher Tips:

For Practice 1:

- The teacher may opt to look for records of fire incidents within their local areas.
- The teacher may opt to give 1 news clipping per group if time is limited.
- Ask the learners to listen carefully to all of the reports of the groups since it is important to the next part of the discussion.

For Discussion 2:

- Emphasize that the fuel of the fire triangle is the basis for the classification of the fires.
- You may ask the learners why the type of fuel is the basis for classification.
- Also, emphasize that the substances that are used to extinguish each fire class will be discussed in the next meetings.

EVALUATION (8 MINS)

1. Ask the learners to classify the all the fire incidents according to the fire classes.
2. They will put their answers on their respective papers and will serve as their quiz for the day.

	3	2	1
ASSESSMENT	The learner was able to completely classify the fire incidences according to the fire classes.	The learner was able to partially classify the fire incidences according to the fire classes.	The learner was not able to classify the fire incidences according to the fire classes.

ENRICHMENT

Ask the learners to research another news clipping of a fire incident (separate from those given, e.g. Ozone Disco Fire or the Kentex Factory fire) and let them identify the fire cause, fire triangle, and the class of fire.

Teacher Tips:

For Assessment:

- The teacher may use the assessment part to check if the learners were really listening to the reporters by not giving a recap of the incidences during the test.
- Another option is to let the learners scan the different manila papers for the quiz.

Teacher Tip:

This activity could be used to bridge set-up the next competency: Observe precautionary measures and proper procedures in addressing a fire incident. (DRR11/12-IIe-f-39)

Some news articles available from the internet:

(1) 75 die in Philippine Hotel fire. (http://www.dailymail.co.uk/news/article-67223/75-die-Philippine-hotel-fire.html). Accessed on October 5, 2015.

(2) Philippines: Thousands homeless after Manila predawn fire. (http://www.ibtimes.co.uk/philippines-thousands-homeless-after-manila-predawn-fire-1490249). Accessed October 5, 2015.

(3) Couple's argument sparks Mandaluyong fire. (http://www.tempo.com.ph/2012/03/07/couples-argument-sparks-mandaluyong-fire/) Accessed October 5, 2015.

(4) Philippines Deals with Several Fires that Killed 7, Massive Fire in Manila Displaces Familes. (http://www.ibtimes.com/philippines-deals-several-fires-killed-7-massive-fire-manila-displaces-families-1771714). Accessed on October 5, 2015.

(5) Fire Incident in Brgy. Sta. Maria. (http://www.bauan.gov.ph/index.php/news/25-fire-incident-in-brgy-sta-maria). Accessed on October 5, 2015.

(6) 24 die in fire at Philippines department store. (http://www.cbc.ca/news/world/24-die-in-fire-at-philippines-department-store-1.628176). Accessed on October 5, 2015.

(7) Elderly killed, 40 houses burned in Zamboanga City fire. (http://kickerdaily.com/elderly-killed-40-houses-burned-in-zamboanga-city-fire/). Accessed on October 5. 2015.

(8) Fire breaks out in UP Diliman Alumni Center; fifth fire incident in seven years (http://www.filipinoscribe.com/2015/07/01/fire-breaks-out-in-up-diliman-alumni-center/). Accessed on October 5, 2015.

(9) During fire prevention month: 2 bushfire incidents hit Makilala forests (http://www.ndbcnews.com.ph/news/during-fire-prevention-month-2-bushfire-incidents-hit-makilala-forests). Accessed on October 5, 2015.

(10) 3 dead, 6 injured in Batangas fire (http://cnnphilippines.com/regional/2015/07/08/lian-batangas-fire.html). Accessed on October 5, 2015.

60 MINS

Precautionary Measures and Proper Procedures to Fires

Content Standard
The learners demonstrate understanding of the causes of fire and the fire triangle.

Performance Standard
The learners shall be able to:

- develop a family emergency preparedness plan to guide them on what to do before, during, and after a fire incident.

Learning Competency
The learners are able to:

- observe precautionary measures and proper procedures in addressing a fire incident. **(DRR11/12-IIe-f-39)**

Specific Learning Outcomes
At the end of the lesson, the learners will be able to:

- observe precautionary measures for a fire incident; and
- know proper procedures in addressing a fire incident.

LESSON OUTLINE

Introduction	Review the Fire Triangle and Different Causes of Fire	5
Motivation	Video or News Clippings of Real Fire Incidents	15
Instruction and Practice	Discussion and Activity on How Accidental Fires could be Prevented	30
Evaluation	Quiz	10
Enrichment	Assignment	

Materials:
Cartolina or Manila paper, permanent markers, thin candle, matchsticks, scissors, transparent drinking glass, bond paper

Suggested Resources
(1) Bureau of Fire Protection Operational Procedures Manual 2015. (http://bfp.gov.ph/wp-content/uploads/2015/09/BFP-Operational-Procedures-Manual.pdf) Accessed on October 5, 2015.

INTRODUCTION (5 MINS)

Review

1. Ask the learners about the different classes of fire.
2. Give one example of a fire event and ask the learners to recognize the fire triangle in the example. Also, ask under which class of fire this could be classified.

   Example: Fire produced by grilling barbecue
3. Emphasize that fire can form as long as the fire triangle is present and there is chemical reaction between the elements of the triangle.
4. Another to emphasize is that the different fire classes correspond to different fuel types.

Communicate learning objectives

1. Introduce learning objectives:
   I. I can observe precautionary measures for a fire incident to not happen.
   II. I can employ proper procedures in addressing a fire incident.

MOTIVATION (15 MINS)

Video of Real Fire Incidents

1. Divide the class into smaller groups (3-5 learners per group).
2. Show the learners a video of a fire incident.
3. From the video that they have seen, let them have a discussion about the following questions:
   I. What caused the fire? How did it start?
   II. Under which fire class could this be classified into?
   III. Is it possible for the fire incident to be prevented?
   IV. If yes, what steps could the people have taken? (Give at least 2 concrete steps.)
   V. If no, discuss why it is not possible to prevent the fire incident.
4. Ask the learners to present their answers in a 2-3-minute oral report.

Teacher Tip:
For the review of the fire classes, the classes of fire could be given and the learners would describe what each fire class is.

Classes of fire:
Class A – fuels are ordinary combustibles such as wood, paper, plastic, or anything that leaves ash.

Class B – fuels are flammable or combustible liquids like petroleum oil, gasoline, paint, and flammable gasses such as propane and butane. Cooking oils and grease are NOT part of class B fires.

Class C – fuels are energized electrical fires like motors, transformers, and appliances. Once the power or source of electricity is removed, the fire becomes one of the other classes of fire.

Class D – fuels are combustible metals like potassium, sodium, aluminum, titanium, and magnesium.

Class K – fuels are cooking oils, grease such as animal fat and vegetable fats.

Teacher Tip:
Video showing: Local news portals (ABS-CBN, GMA7, etc.) often upload their news stories on their YouTube accounts. You could access this via the internet. You may pick which are relevant to your locale/area or you may choose well-known fire incidents. It is better to choose videos which contain interviews with BFP officers concerning the cause of fire or residents who also state the possible cause of fire.

News Clippings of Real Fire Incidents

1. Divide the class into smaller groups (3-5 learners per group).
2. Give the groups a news clipping of a fire incident.
3. From the news clippings, let them have a discussion about the following questions:
   I. What caused the fire? How did it start?
   II. Under which fire class could this be classified into?
   III. Is it possible for the fire incident to be prevented?
   IV. If yes, what steps could the people have taken? (Give at least 2 concrete steps.)
   V. If no, discuss why it is not possible to prevent the fire incident.
4. Ask the learners to present their answers in a 2-3 minute oral report.

INSTRUCTION AND PRACTICE (30 MINS)

Discussion and Activity 1

1. Based from the learners' answers, summarize the preventive measures.
2. Discuss that there are many ways to prevent accidental fires.
3. First, look at the fire triangle.
4. If just a single component of the fire triangle is absent, then accidental fires could be prevented.
5. Give the groups of learners a set of the following materials: a thin candle, matchsticks, scissors, and a transparent drinking glass.
6. Impose to them the following questions:
   I. Is there a way to light the candle without using the matchstick, and only the other materials given to them?
   II. What is the purpose of the wick? Is it possible to light the candle without it?
   III. How does one remove the oxygen from the set-up?
7. Give them 5 minutes to think about their answers. They could make use of the materials given to them in seeking their answers.
8. Ask the learners to list down their answers on a piece of paper and demonstrate these to the class.

Teacher Tip:

News clippings:
Local news articles about fire incidents are available on periodicals and on the internet. Some of these news clippings are used from the previous competency. You may use these or search for more articles. There are also suggested news articles at the end of this lesson.

You may also contact your local fire stations under the Bureau of Fire Protection for cases of fire. Website: http://bfp.gov.ph

Note: The learners could have different sets of answers. Below could be some of their responses:

I. Is there a way to light the candle without using the matchstick, and only the other materials given to them?
   A. They may use the scissors to rub the wick and produce fire. However, this would have to take a long time.
   B. Another is they may rub their hands to produce friction and eventually fire. Using this method won't be effective since they need to rub their hands really fast to increase the amount of heat from their palms and produce fire.
   C. They may say that there is no way for the candle to be lit since there is no heat source.

II. What is the purpose of the wick? Is it possible to light the candle without it?
   A. The wick is the material being burnt to produce fire. It is the fuel of the set-up. It is not possible to light the candle without it.

III. How does one remove the oxygen from the set-up?
   A. They may say that one could blow out the candle. The oxygen is deprived with the introduction of carbon dioxide from their breath.
   B. Another is by placing the transparent drinking glass on top of the lighted candle and wait until all of the oxygen is consumed.

9. Summarize the ways at how the fire triangle was broken and what precautionary measures they could do in order to prevent unwanted fires.
10. For heat: make sure that materials that could easily warm up are not near sources of heat (i.e. curtains near the kitchen stove; matches near electrical plugs)
11. For fuel: recount the different types of fuel discussed in the classes of fire. Make sure that these materials are organized and do not have any contact with other combustible materials.
12. For oxygen: Presence of oxygen in air can't be regulated. Ensure that the area in which you will be starting your fires are well ventilated.

Discussion 2

1. Impose this question to your learners: What if there is an ongoing fire incident? What to do then?
2. Learners should be able to answer that they need to remove at least one component of the fire triangle to address the fire.

Teacher Tip:
Fire Triangle:
Heat + Fuel + Oxygen = Fire

Use a thin candle for this experiment.

The learners may be asked beforehand to prepare and bring the materials that are needed.
A. thin candle
B. matchsticks
C. scissors
D. transparent drinking glass

Emphasize to the learners that they should exercise caution in dealing with fire. Be ready with fire extinguishers.

If the learners bring up the topic of friction, you may emphasize that the heat produced by rubbing their palms is not enough to light the candle.

3. Emphasize that this is only possible if the fire incident is still manageable (e.g. small fires)
4. Give examples of fires that they could put out.
5. Remind them of the different classes of fire and the use of fire extinguishers.
6. Impose another question: If the fire can't be contained, what now?
7. Learners should be able to determine that they need to vacate the area of the fire incident and to contact the fire department.
8. Tell them that specific steps on how to handle a fire incident will be tackled in the next lesson.

EVALUATION (10 MINS)

1. Give the learners a piece of bond paper each and ask them to sketch their current classroom.
2. Ask them to identify areas where fire could start and mark these in their sketches.
3. Let them list at least five (5) precautionary steps to take in order to prevent fires.
4. Give one specific scenario inside the classroom when a fire incident would happen (e.g. short circuiting of electrical appliances, accident involving fires used in classroom and laboratory activities).
5. Ask the learners to list down the steps that they would take in order to address it.

ENRICHMENT

1. Using the same activity as that of the assessment, ask the learners to come up with a sketch of their homes.
2. Let them identify possible sources of fire and precautionary steps that they could take to reduce the possibility of fire.
3. Also, let them indicate possible exit routes that they could take in case of fire.
4. Ask them to research on the contact details of their nearest fire station and any other emergency contact number that they could call in case of fire.

Teacher Tip (for Enrichment)

Use this activity to set-up your lesson for the competency: Follow fire emergency and evacuation plans. (DRR11/12-IIe-f-41).

Suggested News Articles:

(1) 75 die in Philippine Hotel fire. (http://www.dailymail.co.uk/news/article-67223/75-die-Philippine-hotel-fire.html). Accessed on October 5, 2015.

(2) Philippines: Thousands homeless after Manila predawn fire. (http://www.ibtimes.co.uk/philippines-thousands-homeless-after-manila-predawn-fire-1490249). Accessed October 5, 2015.

(3) Couple's argument sparks Mandaluyong fire. (http://www.tempo.com.ph/2012/03/07/couples-argument-sparks-mandaluyong-fire/) Accessed October 5, 2015.

(4) Philippines Deals with Several Fires that Killed 7, Massive Fire in Manila Displaces Familes. (http://www.ibtimes.com/philippines-deals-several-fires-killed-7-massive-fire-manila-displaces-families-1771714). Accessed on October 5, 2015.

(5) Fire breaks out in UP Diliman Alumni Center; fifth fire incident in seven years (http://www.filipinoscribe.com/2015/07/01/fire-breaks-out-in-up-diliman-alumni-center/). Accessed on October 5, 2015.

(6) 24 die in fire at Philippines department store. (http://www.cbc.ca/news/world/24-die-in-fire-at-philippines-department-store-1.628176). Accessed on October 5, 2015.). Accessed on October 5. 2015.

60 MINS

Basic Response Procedures to Fires

Content Standard
The learners demonstrate understanding of the causes of fire and the fire triangle.

Performance Standard
The learners shall be able to:

- develop a family emergency preparedness plan to guide them on what to do before, during, and after a fire incident.

Learning Competency
The learners are able to:

- apply basic response procedures during a fire incident **(DRR11/12-IIe-f-40)**

Specific Learning Outcomes
At the end of the lesson, the learners will be able to:

1. learn about the phases of fire;
2. apply basic response procedures during a fire incident; and
3. develop a family emergency preparedness plan.

LESSON OUTLINE

Introduction	Review of Previous Lessons	5
Motivation	Video Showing	5
Instruction and Practice	Discussion and Activity on How Accidental Fires could be Prevented	50
Enrichment	Assignment	

Suggested Resources

(1) Bureau of Fire Protection Operational Procedures Manual 2015. (http://bfp.gov.ph/wp-content/uploads/2015/09/BFP-Operational-Procedures-Manual.pdf) Accessed on October 5, 2015.

(2) Fire Prevention. BWC Division of Safety and Hygiene (https://www.bwc.ohio.gov/downloads/brochureware/publications/SWPrograms/FirePrev.pdf) Accessed on February 1, 2016.

(3) Fire Safety. Phosphorus, Inorganic & Nitrogen Flame Retardants Association (http://pinfa.org/index.php/flame-retardants/fire-safety) Accessed on January 31, 2016.

(4) Fire Safety for Texans: A Lifetime for Fire Safety. Texas State Fire Marshal. (https://www.tdi.state.tx.us/pubs/sfmo/fmcurrguidehea.pdf) Accessed on January 31, 2016.

(5) Kilnoff, Robert. Introduction to Fire Protection. 3rd Edition. SlideShare. (http://www.slideshare.net/joeRCC/chapter-04-7082565) Accessed by January 31, 2016.

(6) Phases of Fire prezi presentation by Phil Raume (https://prezi.com/1xe96yltfdet/phases-of-fire/) Accessed on January 30, 2016.

(7) Stages of fire growth. Kirtika Sharma youtube channel. (https://www.youtube.com/watch?v=9qu4GCch-dM) Accessed on January 30, 2016.

(8) The 4 Stages of a fire. Journey to Firefighter. (http://journeytofirefighter.com/4-stages-of-a-fire/) Accessed on January 30, 2016.

(9) Traditional Fire Development video by NIST. GFDTraining's channel youtube page. (https://www.youtube.com/watch?v=KhjuvI1c2oE) Accessed on January 30, 2016.

INTRODUCTION (5 MINS)

Review

1. Let the students recall their previous lessons from the fire triangle to the precautionary measures needed to prevent incidences of fire.

Communicate learning objectives

1. Introduce learning objectives:
   A. I can know about the different phases of fire.
   B. I can properly address a fire incident by applying basic response procedures.
   C. I can make a preparedness plan in preparation of a fire incident at home.

Teacher Tip:
This should be concise and brief since the time will be used for discussions.

MOTIVATION (5 MINS)

Video Showing

1. Show the learners a video of how a fire develops. Two Youtube links are given.
2. Let them observe how the fire develops and how fast it engulfs the room.
3. Impose to them the question: If you were inside the room, up until what time would you have tried to put out the fire? Would you have survived if you stayed that long inside the room?

Teacher Tip:
You may also download copies of the videos using the site: http://www.keepvid.com. Don't forget to properly cite the sources.

INSTRUCTION AND PRACTICE (50 MINS)

Discussion

1. Introduce that there is the concept of phases of fire.
2. Define the phases of fire:
   I. Ignition – First stage: heat, oxygen, and fuel source combine and have a chemical reaction (fire triangle is complete)
      A. Also known as incipient
      B. 2 types: Piloted ignition and auto ignition
      C. Piloted ignition – fuel + oxygen + external heat source (spark)
      D. Auto ignition – combustion by heat without spark or flame
      E. Smoke and heat is produced.

F. Oxygen supply = 21%
G. Does not have high temperatures
H. Breathing is barely affected.

II. Growth – Expansion of fire, depletion of oxygen supply, and increase in temperature
A. Also known as free burning phase
B. Oxygen supply is less than 21%
C. Temperatures reach between 640° to 870°
D. Factors that affect the growth of fire: (1) fuel load, (2) fuel type, (3) orientation of fuel relative to fire, (4) available oxygen, (5) ceiling height, (6) potential for thermal layering
E. Fire influences the environment and is influenced by the environment.
F. High levels of carbon monoxide.
G. Breathing becomes difficult.
H. Highly dangerous flashovers may occur anytime.

III. Fully Developed – All fuels have been ignited and burning.
A. Hottest phase of a fire
B. Fire is now dependent on the amount of oxygen.
C. Spread of flammable gases within the area
D. Oxygen supply < 16%
E. Too much carbon monoxide is present

IV. Decay – Fire starts to diminish as fuel and/or oxygen is consumed
A. Also known as smoldering phase
B. Usually the longest stage of a fire
C. Characterized by significant decrease in oxygen and fuel
D. Backdraft could potentially occur.

Teacher Tip:
You may opt to prepare a presentation which makes use of the video that you have chosen to show each fire phase.

Some images could be searched from Google using the keyword "*phases of a fire*."

Definition of terms:
1. Backdraft – phenomenon in which fire that has consumed all available oxygen suddenly explodes when more oxygen is made available, usually because a door or window is opened
2. Flashover – rapid transition from the growth to fully developed stage; materials in room ignite all at once; tongues of flame roll across ceiling; radiant heat affects materials in room, raising them to ignition temperature
3. Fuel load – total amount of potential fuel for a fire in a given area
4. Ignition temperature – minimum temperature at which a substance burns
5. Thermal layering – tendency of gases to form into layers according to temperature (hottest gases at the top layer, cooler gases form at the lower layers)
6. Recall the ways on how heat is transferred:
    - Radiation – heat transfer through empty space by electromagnetic waves
    - Conduction – heat transfer through a medium without visible motion (mere contact)
    - Convection – heat transfer through a circulating medium (usually fluids)

3. Show the video again and identify the different phases of fire.

Practice

1. Show the students some screenshots from another video or images from the internet regarding the phases of fire.
2. Let them analyze what phase each image shows and whether or not they should still try to put off the fire.

Note: *The only time that they should still try to put off the fire is during the ignition phase when the fire is still small. Otherwise, evacuate the area immediately and contact the nearest fire station and other authorities.*

Activity 1

1. After knowing the phases of fire, the students will now learn the basic response procedures.
2. Divide them into groups (3-6 members each) and give them manila paper and markers.
3. Ask them to brainstorm about the following situations:
   I. If you are in a burning room (fire phase: from ignition to growth), what do you need to do in order to survive?
   II. If you are in a burning room (fire phase: fully developed to decay), what do you need to do to in order to survive?
   III. If you were able to observe a place being devoured by fire, what do you need to do?
4. Give them 8 minutes to brainstorm and write their answers on their papers.
5. Afterwards, ask the groups to report their answers.
6. Summarize and take note of the students' answers.

Discussion 2

1. Before an actual fire incident occurs, there are some information that people need to know.
   I. Emergency contact numbers specially the nearest fire station
   II. Exit points

Type of burns:

1. First degree – skin is red
   - "Cool a burn" = Hold burn under running cool tap water
2. Second degree – skin is red and blistery
   - "Cool a burn" and see a doctor if the burn is large or blisters are damaged.
3. Third degree – skin is gray, dry, and with no feeling
   - Don't remove clothing from burn area.
   - Go to emergency room immediately.

III. Location of fire hose and fire extinguishers
IV. Proper use of fire hose and fire extinguishers
V. Proper precautionary measures (e.g. proper storage of combustibles, fuels, etc.)

2. Discuss the basic response procedures.

Basic Response Procedures:

1. If inside a burning area
   A. Once you hear the fire alarm, evacuate to a safe area right away.
   B. If you see fires, pull fire alarms as you exit the area. Inform other people present in the area of the fire that is occurring.
   C. If the fire is still small and can be extinguished, use an appropriate fire extinguisher (recall the different classes of fire). Usually, normal fire extinguishers do the job, but if unavailable, buckets of water or damp cloths would do.

      Note: *One should only fight a fire if the fire department has been notified, the fire is small, fire is confined to its point of origin, an escape route is available, and one can fight the fire with their back to the exit.*

   D. If the fire is already large and is rapidly spreading (growth phase), immediately find the nearest exit and exit the area.
   E. Touch doors first to check if they are warm before opening them. If they are warm, do not attempt to open and proceed to a different route.
   F. Use the stairs not elevators.
   G. Close all windows and doors that you can reach as you exit.
   H. If there is smoke, stay as low as possible. Also, try to cover your nose to prevent inhalation.
   I. Once outside, move away from the exits and assemble in a safe area designated by the evacuation plan of the area or by emergency response teams.

2. If outside a burning area
    A. Do not attempt to go inside the burning area.
    B. Immediately contact the nearest fire station and other emergency response numbers.
    C. Listen and follow orders of the emergency response teams.
    D. Organize/Participate in a bucket relay. Bucket relay is when people help the fire fighters by passing buckets full of water either to try to extinguish the fire or to prevent the fire from further spreading.
3. If you catch fire, do the "stop, drop, and roll" right away.
4. If you are unable to leave the area unscathed or you have suffered burns, immediately attend to them depending on the degree of burn.

Activity 2

1. Ask the students: Are there any precautionary measures being observed in their homes? If yes, what are these?
2. If a fire were to occur in their own residence, are the members of their household prepared and knowledgeable on what to do?
3. Based on what they know about fire hazards; the students will individually come up with their household fire preparedness plan.
4. Discuss what a fire preparedness plan is. A fire preparedness plan is a document that details what one should do in case of fire. It essentially tells people what to do in case of a fire incident in their homes.
5. The students will envision their homes being engulfed by fire and they should be able to come up with how to deal with a fire incident, before, during, and after a fire.
6. They should come up with roles for each member of the household should a fire occur. Also, they should be able to establish evacuation routes inside their houses.
7. Aside from evacuation routes, they should also be able to come up with common location where they'll go and a communication plan should they be separated with one another.
8. Also, they should be able to prepare an emergency supplies kit where all important documents and supplies are kept.

ENRICHMENT

1. Ask the students to discuss the fire preparedness plan with their family.
2. Let them document the discussion (write-ups, pictures, videos, etc.).
3. Revisions and improvements should be noted.
4. Fire preparedness plan should be implemented for the household.

EVALUATION			
	Meets Expectations	**Needs Improvement**	**Not Visible**
Preparedness Plan	The created preparedness plan contains all important details, can be easily understood and implemented.	The created preparedness plan contains all important details. However, some details need to be revised for clarity and implementation.	The created preparedness plan lacks important key information (e.g. possible fire exits, important contact details, precautionary measures, etc.).

60 MINS

Following Fire Emergency and Evacuation Plans

Content Standard
The learners demonstrate understanding of the causes of fire and the fire triangle.

Performance Standard
The learners shall be able to:

- develop a family emergency preparedness plan to guide them on what to do before, during, and after a fire incident.

Learning Competency
The learners are able to:

- Follow fire emergency and evacuation plans **(DRR11/12-IIe-f-41)**

Specific Learning Outcomes
At the end of the lesson, the learners will be able to:

1. develop their own emergency preparedness plan in case of a fire; and
2. practice proper response in case of fire.

LESSON OUTLINE

Introduction and Motivation	Review Proper Response to Fire	7
Instruction and Practice	Discuss Existing Evacuation Plan of the School	43
Evaluation	Observation of the Drill	10
Enrichment	Coordination with Local Fire Stations	

Suggested Resources

(1) Conducting and Recording Fire Drills. Environmental Health and Safety – University of Washington. (https://www.ehs.washington.edu/fsoemerprep/assemblyoccevac.shtm) Accessed on January 31, 2016.

(2) Emergency Evacuations. (http://www.it-tallaght.ie/contentfiles//Documents/Estates%20Office/Full_Evacucation_Procedures_Nov%2013.pdf) Accessed on January 31, 2016.

(3) Fall Fire Drill Fun. (http://www.teachhub.com/fall-fire-drill-fun) Accessed on January 31, 2016.

(4) Fire Preparedness Guide. Quake Kare Inc. (http://www.quakekare.com/emergency-preparedness/fire-preparedness.html) Accessed January 31, 2016.

(5) Guide to Carrying out a Supervised Fire Evacuation Drill. University College of London. (http://www.ucl.ac.uk/estates/maintenance/fire/documents/UCLFire_TN_103.pdf) Accessed on January 31, 2016.

(6) Safety Drills. Lincoln County School District (http://lincoln.k12.or.us/documents/safety/safety_drills.pdf) Accessed on January 31, 2016.

INTRODUCTION (5 MINS)

Review

1. Briefly review the fire triangle, classes of fire, precautionary measures for fire, phases of fire, and basic proper response to fire incidents.
2. Ask the learners regarding their fire preparedness plans; have they oriented their household?
3. Tell the learners that they need to be familiar with following evacuation plans to be able to ensure that they could properly implement their preparedness plans.

Communicate learning objectives

1. Introduce learning objectives:
   A. I can follow fire and emergency evacuation plans properly.
   B. I know what to do in case of a fire incident.

Teacher Tip:
For this particular competency, the teacher may opt to plan a school-wide fire drill in coordination with the Bureau of Fire Protection (BFP). In which case, the BFP personnel could simulate real fire scenarios where members of the school community could have hands-on experience in basic response procedures like proper use of fire extinguishers.

MOTIVATION (2 MINS)

Video Showing

1. Pose this challenge to the learners:

   In the event of a fire incident, it takes less than 5 minutes for the fire to spread. Can you evacuate properly in that short amount of time?

Teacher Tip:
Be sure to emphasize that the learners will need to evacuate properly and not just mind the time.

INSTRUCTION (23 MINS)

Discussion

1. Discuss the school's current fire emergency procedure.
2. Ensure that a map as well as steps that the learners need to follow is on hand.
3. Discuss with the learners the (a) escape routes available to them; (b) where the evacuation areas are; (c) where the fire extinguishers are; (e) what to do when a fire alarm is sounded; (e) what to do while at the evacuation area.

Teacher Tip:
Be sure to notify the local fire station of the fire drill.

A fire drill report form will help efficient monitoring of the conducted fire drill. A sample is included below, feel free to edit it.

The Fire Drill

1. Let the learners practice the emergency and evacuation plans.
2. Do not forget to "*stop, drop, and roll*" when their clothes caught fire.
3. Let them check doors first if they are warm/hot before opening.

PRACTICE (20 MINS)

Conduct the Fire Drill

1. Phase 1: Alarm – Fire alarms are sounded.
2. Phase 2: Response – Learners will have to be alert for fire, and smoke.
3. Phase 3: Evacuation – All building occupants evacuate, following pre-determined routes to the evacuation areas.
4. Phase 4: Assembly – At the designated evacuation area, learners are grouped together.
5. Phase 5: Head Count – Teachers should check to make sure all participants are accounted for.
6. Phase 6: Evaluation – Evaluation of the drill is conducted to identify problems during the drill and how these be corrected.

EVALUATION (10 MINS)

Assessment

1. Conduct the fire drill again.
2. Observe the learner's behavior and attitude towards the drill.
3. Use a fire drill report form to check if the fire drill was conducted properly.

ENRICHMENT

1. Ask the learners to coordinate with their local fire stations to conduct a fire drill in their communities.
2. Learners may be grouped together to organize a fire drill in their respective communities, not just their households.
3. This may serve as their community outreach where they will organize events for their community.

Teacher Tip:
This may be given as a project to the learners. Their progress in terms of the planning and execution can be monitored and graded.

EVALUATION			
	Meets Expectations	**Needs Improvement**	**Not Visible**
Preparedness Plan	Learner was able to properly follow emergency and evacuation plans during the fire drill.	Learner was able to follow emergency and evacuation plans. However, there are areas of improvement (e.g. rate at which learner moves, etc.)	Learner failed to follow fire and emergency evacuation plans during the fire drill.

SAMPLE FIRE DRILL REPORT FORM

SCHOOL: _____ **DATE:**_____

TIMING:

	START TIME
	TIME SCHOOL / BUILDING WAS COMPLETELY EVACUATED
	TIME ALL LearnerS AND STAFF WERE ACCOUNTED FOR
	END TIME

QUESTION	**YES**	**NO**
Is the fire alarm loud enough to be heard by all drill participants?		
Did the drill participants eva		
Did the drill participants follow their designated routes to the evacuation area?		
Did the drill participants (A) Run; (B) Walk casually (C) Walk faster than normal		
Did the drill participants bring any first aid kit or any item noticeable during the evacuation?		
Is the evacuation area big enough to accommodate the evacuees?		
Any other problem observed during the drill that might need to be addressed?		
Any untoward incident observed during the drill?		

60 MINS

Concept of Exposure

Content Standard
The learners demonstrate understanding of various elements that may be exposed to hazards including physical, social, economic, and environmental.

Performance Standard
The learners shall be able to:

- conduct hazard hunts of exposed elements and propose corresponding corrective actions of one's preparedness.

Learning Competency
The learners are able to:

- enumerate elements exposed to hazards **(DRR11/12 Ic-7)**

Specific Learning Outcomes
At the end of the lesson, the learners will be able to:

1. explain the definition of exposure based on the UNISDR Terminology;
2. identify elements exposed to hazards and give examples for each types; and
3. differentiate between tangible and intangible exposed elements.

LESSON OUTLINE

Introduction	Review Terms	3
Motivation	Inquiry	2
Instruction	Definition of Exposure and its Three Components	35
Practice	Inventory of Elements at Risk	20
Evaluation	Quiz	10
Enrichment	Inventory at Home	

Materials:
Pingpong balls, hard boiled egg, and cardboard or plastic egg tray

Suggested Resources:

(1) Asian Disaster Preparedness Center. (n.d.). Capacity building in asia using information technology applications module 3: Vulnerability and risk. (n.p.).
(2) Center for Disaster Preparedness. (n.d.). CBDRM training handouts: Basic concepts on disaster and disaster risk management. (n.p.).
(3) Republic of the Philippines. Congress. (2010). An act strengthening the philippine disaster risk reduction and management system, providing for the national disaster risk reduction and management framework and institutionalizing the national disaster risk reduction and management plan, appropriating funds therefor and for other purposes, fourteenth congress, third regular session. Manila: Author. (RA 10121)
(4) United Nations Office for Disaster Risk Reduction. (2009). *Terminology*. Retrieved from https://www.unisdr.org/we/inform/terminology
(5) Van Westen, C., Kingma, N., & Montoya, L. (2009). *Guide book session 4: Elements at risk.* (n.p.).

INTRODUCTION (3 MINS)

Review of Terms

1. Prior to this lesson, assign learners to review the definition of terms contained the 2009 UNISDR Terminology on Disaster Risk Reduction as well as Philippine Disaster Risk Reduction and Management Act of 2010 (RA 10121)
2. Write the following terms enumerated below and ask learners questions about the meaning of the following terms to verify if they understand the meaning of these terms:
   I. disaster
   II. disaster risk
   III. hazard
   IV. exposure
   V. vulnerability
   VI. capacity
3. Write the Specific Learning Outcomes for the lesson on the board before the class and ask learners to read the specific learning outcomes.

Teacher Tip:
The main purpose of this lesson is to develop a deeper understanding of the concept of hazard exposure as well as recognize that exposed elements at risk can be both intangible and tangible entities.

The concept of risk factors and how these affect the level of disaster risk is center to DRRM. The definition of these terms may have been discussed in a previous lesson on differentiating risk factors. Nevertheless, it is generally necessary to review and reinforce the concept of risk factors with a variety of examples.

MOTIVATION (2 MINS)

Inquiry

1. Ask the learners the following question: "What would happen if a very strong typhoon passes through a highly populated city". You can follow up with a historical example like "such as in case of Typhoon Yolanda when it passed through the city of Tacloban? Why?"
2. Follow up the discussion with the following question: "What if instead, the strong typhoon passed through an uninhabited island without people, would this still result in a disaster? Why? Why not?"

Teacher Tip:
Modify the question by using a different hazard. If possible, use recent local examples so that learners can better related.

Ask several learners to give answers. In general, learners assume it will not result in a disaster. However, some learners may given a qualified answer such as "if there are rare and endangered species of plants and animals living on that island"

INSTRUCTION (35 MINS)

Definition of Exposure and its Three Components

1. Write the definition of exposure on the board and ask a learner to read aloud the definition.
2. Emphasize that the definition of exposure has three (3) essential components:
   I. **People, property, systems and other elements.** Exposure involves specific elements which we must be able to identify and give a name to. Elements may be tangible or intangible.

II. **Present in hazard zones.** Elements should be located within an area and duration of time during which a specific hazard event or set of hazard events can occur.

III. **That are thereby subject to potential loss.** Elements should have value or importance assigned to them for it to be subject to potential loss.

3. Use the **Shaking Egg Tray Demonstration** to illustrate the subtle aspects of hazard, exposure and vulnerability. Tell the class to imagine that you are a ground shaking hazard, and that the egg tray is the hazard zone. Show the ping pong balls and hard boiled eggs and explain to the class that these are the exposed elements. Tell the class that you will do four (4) experiments to illustrate the concept of hazard exposure and vulnerability.

   I. **Case 1**: Place a pingpong ball and an egg on the edge of egg tray. Shake the tray in a vigorous manner so that the pingpong ball and egg edge fall off and hit the floor. Show the cracked egg and pingpong ball to the class. Place a new hardboiled egg on the edge of the egg try. Shake the egg tray again, but this time in a slow and gentle manner so that neither the egg nor the pingpong ball fall off the tray. Ask the class why the egg did not fall off the tray and break. Use their answer to emphasize that while the vulnerable element (the egg) was subjected to a hazard, the magnitude of the hazard was not sufficient to result in damage of the exposed element (the egg).

   II. **Case 2:** Place a second the hardboiled egg in the center of the egg tray and vigourously shake the tray while trying to make sure that the egg on the edge falls off the tray, but the egg in the center does not. Ask the class why the egg on the edge fell off the tray, but the egg in the center did not.

   III. **Case 3**: Move the egg from the center of the egg tray to the edge. Ask the class what would happen if the egg on the egg tray is suddenly grabbed just before the shaking begins. Will the egg stil fall off and break? Demonstrate this with the help of a learner to grab the egg just before you shake the tray vigorously. Agree with the learner that you will shake the egg tray at the count of 3 and ask the learner to grab the egg just before the shake the tray.

   IV. **Case 4**: Shake the egg tray with nothing on it.

Teacher Tip:

The UNISDR defines **exposure** as people, property, systems and other elements present in hazard zones that are thereby subject to potential loss. (UNISDR, 2009) The term **susceptibility** is often used to indicate that an element is exposed to a hazard.

Case 1: Use this demonstration to illustrate the concept of vulnerability. Emphasize that both elements (the egg and pingpong ball) were exposed to the same shaking hazard by both falling off the egg tray. But only the vulnerable element (the egg) suffered damage./loss, whereas the element that was not vulnerable did not suffer any damage/ loss, i.e. both the egg and the pingpong ball were susceptible but only the egg was vulnerable.

Case 2: Use their answers to emphasize that exposure is dependent on location and that it varies spatialy. Depending on the type and magnitude of the hazard event, there may be areas that are "safer" that others .

Case 3: Use this demonstration to explain that for an element to be considered exposed, it need to be in the hazard zone at the time that the hazard event occurs. Some elements are mobile and are not always present in the hazard zone and there are not always exposed i.e. exposure has a temporal dimension to it.

Case 4: Use this demonstration to explain that no damage or loss can take place if there are no exposed elements in the damage zone.

4. Have learners read the section on Guide Book Session 4: Elements at Risk by Cees van Westen, Nanette Kingma and Lorena Montoya. Ask learners to answer the following questions in their notebooks:
   I. How are elements at risk defined in the above reference?
   II. The reference defines systems for classifying elements at risk. In the Philippines, the one used by the Asian Disaster Preparedness Centers (ADPC) is the one most widely used. In this system, elements at risk are classified into four types namely: Physical, Societal, Economic and Environmental Elements with examples of for each type of element at risk. Can you give at least three (3) other examples for each type.
   III. Based on the reference, what is the difference between tangible and intangible elements at risk?
   IV. An element that can be quantified but not mapped indicates that its position is not fixed with time. How does this affect the exposure of this element?

Teacher Tip:
Tangible elements which can be quantified. If they occupy a fixed postion, tangible elements can be mapped. Intangible elements are quantities that cannot be quantified or mapped as they do not have a particular spatial dimension.

PRACTICE (20 MINS)

Inventory of Elements at Risk

1. Organize the class into groups of between 4 to 6 learners per group. Appoint a facilitator and scribe for each group.
2. Ask each group to imagine the community in which they live and list down all the exposed elements they think can be affected by *any of the hazards the community is exposed* to. The list is supposed to be an exhaustive invetory of all possible elements at risk in the community.
3. The list should include at least one element from the all four (4) types. It should include both tangible and intangible elements.
4. Summarize the invetory by creating a table as shown below.

Community at Risk:			
Element at Risk:	**ADPC Classification**	**Can it be quantified? (Y / N)**	**Can it be mapped? (Y / N)**

5. Have groups share to the class their lists and compare their results with other groups.

Teacher Tip:
This is a modified version of the inventory exercise in Guide Book Session 4: Elements at Risk by Cees van Westen, Nanette Kingma and Lorena Montoya.

EVALUATION (10 MINS)

1. Explain in your own words the definition of exposure based on the UNISDR Terminology.
2. What are the three (3) essential components of exposure?
3. What are the four (4) general types of exposed element in the APDC classification system?
4. Give examples for each of the four (4) general types of exposed element in the APDC classification system.
5. What distinguishes a tangible element at risk from one that is intangible?
6. Give at least 5 examples of intangible elements at risk.
7. Give at least 3 examples of elements that can be quantified but cannot be mapped.
8. If an element at risk can be mapped, what does this tell us about it location?

ENRICHMENT

1. Have learners to an inventory of the exposed element in their home using the same exercise done in class.
2. On a piece of graphing paper, have learners draw a floor plan of their home showing all important features such as doors, window, stairs and walls. Use symbols to help draw the floor plan.
3. Draw on the floor plan the exposed elements in the inventory that can be mapped.
4. Ask learner's parents/guardians to check the map.

EVALUATION				
Specific Learning Outcome	**EXCEEDS EXPECTATIONS**	**MEETS EXPECTATIONS**	**NEEDS IMPROVEMENT**	**NOT VISIBLE**
Definition of exposure	Learner is able to explain in his/her own words the definition of exposure accurately with all the important components included. Learner is unable to enumerate all three essential components of exposure.	Learner is able to explain in his/her own words the definition of exposure accurately with all the important components included. Learner is unble to enumerate all three essential components of exposure.	Learner is able to explain the definition of exposure, but definition is similar if not identical to that presented in class. Learner is only able to enumerate at most two essential components of exposure.	Learner is able to explain the definition of exposure, but definition lacks at least one important component. Learner is unable to enumerate any of the three essential components of exposure.
Enumerate exposed elements	Learner is familiar with all of the general types in the APDC classification system, and able to give examples for all the general types in the APDC classification system distinct from those described in the reference materials.	Learner is familiar with all of the general types in the APDC classification system, and able to give examples for all of the general types in the APDC classification system.	Learner is familiar with all of the general types in the APDC classification system, but is unable to give examples for some of the general types in the APDC classification system.	Learner is unfamiliar with some of the general types in the APDC classification system. Learner is unable to give examples for some of the general types in the APDC classification system.
Distinguishing between tangible and intangible exposed elements.	Learner is able to distinguish between tangible and intangible exposed elements, and is able to give examples for both types. Learner is able to distinguish between elements that can be mapped from those that cannot be mapped.	Learner is able to distinguish between tangible and intangible exposed elements, and is able to give examples for both types.	Learner is able to distinguish between tangible and intangible exposed elements, but is unable to give examples for both types.	Learner is unable to distinguish between tangible and intangible exposed elements.

60 MINS

Concept of Vulnerability

Content Standard
The learners demonstrate understanding of various elements that may be exposed to hazards including physical, social, economic, and environmental.

Performance Standard
The learners shall be able to:

- conduct hazard hunts of exposed element and propose corresponding corrective actions of one's preparedness.

Learning Competency
The learners are able to:

- explain the meaning of vulnerability **(DRR11/12 Ic-8)**

Specific Learning Outcomes
At the end of the lesson, the learners will be able to:

1. explain the meaning of vulnerability, capacity and resilience within the context of disaster risk; and
2. distinguish between physical, social, economic and environmental factors that affect vulnerability of exposed elements and give examples.

LESSON OUTLINE

Introduction	Review	3
Motivation	Demonstration	7
Instruction	Physical, Social, Economic, and Environmental Factors	20
Practice	Group Work	30
Enrichment		

Materials:
Paper cup, plastic cup, ceramic, glass cup, table and pillow

Suggested Resources

(1) United Nations Office for Disaster Risk Reduction. (n.d.). *Terminlogy - UNISDR*. Retrieved from https://www.unisdr.org/we/inform/terminology
(2) Rep. Act No. 10121 (2010), Available at http://www.ndrrmc.gov.ph/attachments/article/95/Implementing_Rules_and_Regulartion_RA_10121.pdf
(3) Capacity Building in Asia using Information Technology Applications. (n.d.). *Module 3: Vulnerability and Risk*. Retrieved from http://www.adpc.net/casita/course-materials/Mod-3-Vul-Risk.pdf
(4) Center for Disaster Preparedness. (n.d.). CBDRM Training Handouts: Basic Concepts on Disaster and Disaster Risk Management. (n.p.): Author.
(5) Van Westen, C. (n.d.). Vulnerability Assessment. (n.p.): (n.p.).

INTRODUCTION (3 MINS)

Review

1. Show OHT/PPS #1 showing the Specific Learning Outcomes, and volunteers from the class to read out each of the learning outcomes, and explain in their own words how they understand the learning out come.
2. Ask the class to enumerate the different risk factors including hazard, exposure, vulnerability and capacity.

Teacher Tip:
OHT = Overhead transparency
PPS = PowerPoint Slide

MOTIVATION (7 MINS)

Demonstration

1. Use the following demonstration to illustrate the difference between the risk factors hazard, exposure, vulnerability and capacity.
   I. Place the paper, plastic and glass cup on the edge of a table and explains these are the elements at risk.
   II. Ask the class to imagine a strong earthquake taking place. Ask learners to describe what will happen to each of the three cups when the table vigorously shakes (the glass cup will fall and break, but the paper and plastic cup will be undamaged even if they fall off the table). Emphasize that all three elements are exposed to the same hazard.
   III. Then, place a pillow on the floor and ask a learner to describe what will happen to the glass cup if it lands on the pillow instead of the hard floor during the earthquake. Note that the same glass cup was subjected to the same hazard but the outcomes are different.
   IV. Ask the class to imagine a fire occuring and asks learners to describe what will happen to each of the cup if exposed to intense heat and flames (the paper cup will burn, the plastic cup will melt, the glass cup may crack).
   V. Ask the class to image a flood that submerges the room until the ceiling. Ask learners what will happen if the three cups are submerged in water and kept there for a day (the plastic and glasscup will be undamaged, but the paper cup with prolonged exposure to water may soften or break up)

Teacher Tip:
This exercise is a modified version on the Shaking Table exercise cited in the CBDRM Training Hand-outs published by the Center for Disaster Preparedness.

INSTRUCTION (20 MINS)

Physical, Social, Economic, and Environmental Factors

1. Ask learners to identify the intrinsic property or conditions of for each of the three elements that made it **vulnerable** to the hazard. Teacher does this for all three hazards.
2. Summarize learners' explanations under the **Vulnerability Column** using the Table shown in OHT/ PPS #2.
3. Ask learners to identify the intrinsic property or conditions of for each of the three elements that made it **resilient** to the hazard. Teacher does this for all three hazards.
4. Summarize learners' explanations under the **capacity** column using the Table shown in OHT/PPS #2. Sample answers are shown below:

HAZARD	EXPOSED ELEMENT	VULNERABILITY	CAPACITY
Earthquake	Paper Cup	Resilient	Lightweight, does not break upon hitting a hard surface
	Plastic Cup	Resilient	Lightweight, does not break upon hitting a hard surface
	Glass Cup	Brittle – breaks when object hits a hard surface.	Does not break when object hits a soft surface.
Fire	Paper Cup	Combustible – burns when exposed to flames.	Vulnerable to fire.
	Plastic Cup	Melts when exposed to heat and flames.	Not flammable
	Glass Cup	Brittle, cracks due suddenly exposed to extreme heat	Not flammable

HAZARD	EXPOSED ELEMENT	VULNERABILITY	CAPACITY
Flood	Paper Cup	Disintegrates with prolonged exposure to water.	No capacity to resist prolonged exposure to water.
	Plastic Cup	Resilient	Is not affected by prolonged exposure to water.
	Glass Cup	Resilient	Is not affected by prolonged exposure to water.

5. Ask a learner to explain what their concept of vulnerability, capacity and resilience as based on the demonstration. Accept all ideas as learner will eventually discover if their answers are correct.
6. Show OHT/PPS #3 through #5, and asks learners to volunteer reading the definitions of vulnerability, capacity and resilience based on the UNISDR Terminology.
7. Show OHT/PPS #6 and then emphasize the fact that vulnerability or capacity are affected by many factors depending on the exposed element. These factors are generally classified under four (4) categories namely: physical, social, economic and environmental. Show the table with examples under each of the four catergories for humans/people, structures and businesses. Then, ask learners to suggest additional factors for each category and exposed element that can be added to the table.

PRACTICE (30 MINS)

1. Organize the class into groups of 5, and instructs each group to elect a facilitator and scribe.
2. Then, instruct each group to do one of the following:
   I. Each group thinks of a disaster that all group members have first hand knowledge of;
   II. Each group thinks of a disaster that all group members are familiar although may not have first hand information;
   III. Read a news clipping provided by the teacher about a disaster.
3. Ask learners to identify the hazards and exposed elements. For each exposed element, write down

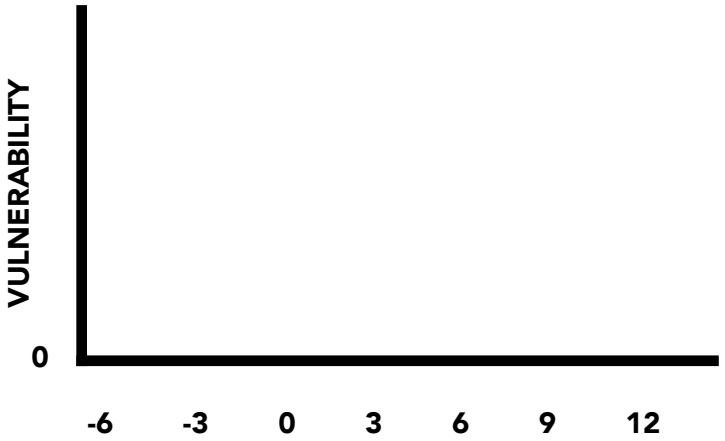
the specific factor they think may have made this exposed element vulnerable/resilient to the hazard. Have learners identify if the vulnerability/capacity is physical, social, economic or environmental. Have the elected facilitator manage the discussion.

4. After 15 minutes, have the elected scribe of each group present the group's work to the class. Learners from other groups can comment and give suggestions regarding either additional elements at risk or the corresponding vulnerabilities or capacities.

ENRICHMENT

1. **Vulnerability Assessment and Capacity Building Plan:** Have learners together with the parents do a vulnerability assessment of their home, involving the following steps:
   I. Make a list of the three (3) most possible hazards likely to affect their home. These can be natural, technological, or biological hazards.
   II. Identify all the elements within the home that will be exposed to these hazards.
   III. Identify how each exposed element is vulnerable to each of the three hazards.
   IV. Based on identified vulnerabilities, make an action plan on how to address these vulnerabilities. The goals of this plan must be SMART (Specific, Measurable, Action-oriented, Reasonable, Time-bound).
2. **Seismic Assessment Survey:** Organize learners into groups and have learners do a seismic exposure and vulnerability survey of houses in their *barangay* using the "How safe is my house?" questionnaire. Have learners draw a map of their *barangay* showing the location of the houses they surveyed and the score for each house. Learners share this with the appropriate *barangay* official.
3. **Flood Vulnerability Curves:** Vulnerability curves show the percentage damage to a structure and its contents for a given magnitude or intensity of hazards. Shown in the figure below are four different structures:
   I. A 5-storey reinforced-concrete building approximately 17 meters in height.
   II. A single wooden house founded on stilts 3m above the ground level in which the space under the house is not used as a living space.
   III. A 2-storey masonry house with a basement. Basement contains a store-room, laundry area and home-office.
   IV. A single storey wooden house founded directly on the ground.

4. Have learners estimate the amount of damage from 0% to 100% (based on the repair or replacement cost versus the value of the structure and its contents) from flood levels ranging from 1m to 9m. In estimating the amount of damage, you can make the following assumptions:
   I. For all structures, each story has a height of 3m.
   II. The cost of repair to the structure relative to the total value of the structure depends on the number of floors/storeys of the structure are fully or partially inundated by flood, as well as the building typology (material from which the structure is made). As an example, a 3m flood will fully inundate one floor for type A and D buildings, two floors for type C buildings, and not inundate any floors for type B.
   III. For a reinforced concrete structure, the cost of repair is 10% for a given floor if less than half the height of the floor (does not exceed 1.5m) is flooded, 20% for a given floor if more than half of the floor is flooded but does not reach the ceiling, and 40% if flood waters are height than the ceiling.
   IV. For a masonry structure, the cost of repair is 30% for a given floor if less than half the height of the floor (does not exceed 1.5m) is flooded, 45% for a given floor if more than half of the floor is flooded but does not reach the ceiling, and 60% if flood waters are height than the ceiling.
   V. For a wooden structure, the cost of repair is 70% for a given floor if less than half the height of the floor (does not exceed 1.5m) is flooded and 90% for a given floor if more than half of the floor.
   VI. For any building typology, the cost of replacement or repair the contents relative to their total value for a given floor depends on the height of the flood waters H within that floor varies according to the relationship: cost = H/3 x 100%. If the depth of the flood is above the ceiling, cost of replacement/repair the 100%.
   VII. The cost of the contents and structure are assumed to make up 60% and 40% respectively.
5. As an example a 1m flood will cause the following damages for a type A: For the structure, only 20% of the first floor will be damaged, with the other four floors undamaged, resulting in a total damage to the structure of 4%. For the contents, the cost of damage is 33% for the first floor, with contents of the remaining floors undamaged, resulting in a total cost of damage equal to 6.6% of the total value of the contents of the structure. The total damage to both the contents and structure are 0.6*6.6%+0.4*4% which is equal to 5.6% of the total cost of the structure and its contents.
6. Make a graph of the vulnerability versus the flood height. If possible, have learners consult an architect or civil engineer to verify their answers, or get suggestion regarding a better ways of estimating.



EVALUATION				
	EXCEEDS EXPECTATIONS	**MEETS EXPECTATIONS**	**NEEDS IMPROVEMENT**	**NOT VISIBLE**
Explain the meaning of vulnerability, capacity, and resilience within the context of disaster risk	Learner xplains meaning of vulnerability, capacity and resilience in own words supported by both concrete as well as abstract concepts. Learner demonstrate deep understanding of the concepts.	Learner explains meaning of vulnerability, capacity and resilience in own words supported by concrete examples to explain concepts. Learner shows substantial understand of the concepts.	Learner explains meaning of vulnerability, capacity and resilience exactly as presented in references. Learner cannot provide concrete examples to illustrate understanding of concept. Learner shows minimal signs of learning.	Learner explains meaning of vulnerability, capacity and resilience based solely on inaccurate opinion with no visible signs of learning.
Distinguish between physical, social, economic, and environmental factors that affect vulnerability/capacity of exposed elements and give examples	Learner is able to identify all factors affecting vulnerability/ capacity of exposed elements and is able to identify under what category these factors fall under.	Learner is able to identify majority of the factors affecting vulnerability/capacity of exposed elements and is able to identify most of the time under what category these factors fall under.	Learner is only able to identify some of the factors affecting vulnerability/capacity of exposed elements, but is unable to identify the general category these factors fall under.	Given a specific hazard and exposed elements, learner cannot identify any of the factors affects vulnerability/ capacity.

60 MINS

Variation of Vulnerability across Sectors

Content Standard
The learners demonstrate understanding of various elements that may be exposed to hazards including physical, social, economic, and environmental.

Performance Standard
The learners shall be able to:

- conduct hazard hunts of exposed element and propose corresponding corrective actions of one's preparedness.

Learning Competency
The learners are able to:

- explain why certain sectors of society are more vulnerable to disaster than others **(DRR11/12 Ic-9)**

Specific Learning Outcomes
At the end of the lesson, the learners will be able to:

1. explain the challenges a person with disability faces when coping with hazards;
2. explain the connection between physical disability and social vulnerability to hazards; and
3. discuss strategies of helping persons with disabilities.

LESSON OUTLINE

Materials:
See list of props needed to "Not able to do" simulation game.

Suggested Resources

(1) Capacity Building in Asia using Information Technology Applications. (n.d.). *Module 6: Social, Cultural and Economic Vulnerability*. Retrieved from http://www.adpc.net/casita/course-materials/mod-6-social-cul-econ-vul.pdf

(2) CBM.Org. (n.d.). *Working Towards A Disabilit*y Inclusive World. Retrieved from http://www.cbm.org/index.php

(3) United Nations Office for Disaster Risk Reduction. (2014). Living with Disability and Disasters: UNISDR 2013 Survey on Living with Disabilities and Disasters - Key Findings. Retrieved from http://www.unisdr.org/2014/iddr/documents/2013DisabilitySurveryReport_030714.pdf

(4) Center for Disaster Preparedness. (n.d.). Integrating Gender into Disaster Risk Management. (n.p.): (n.p.).

(5) Thomas, D. S. K., Phillips, B. D., Fothergill, A., and Blinn-Pike, L. (eds.). (2009). *Social Vulnerability to Disaster*. Boca Raton, FL: CRC Press.

(6) Cutter, S. L., Boruff, B. J. and Shirley, W. L. (2003), Social Vulnerability to Environmental Hazards. *Social Science Quarterly*, 84: 242–261. doi: 10.1111/1540-6237.8402002

(7) Enarson, E. (2007). Identifying and Addressing Social Vulnerabilities, in Waugh, W. L. Jr., and Tierney, K. (eds.), *Emergency Management: Principles and Practice for Local Government, 2nd Edition*, pp. 257-278. Washington, DC: ICMA

(8) VERA Files. (2012, October 8). *DISASTERS and the DISABLED* [Video file]. Retrieved from https://www.youtube.com/watch?v=DLBa4gobjVY&feature=youtu.be

INTRODUCTION (2 MINS)

Communicate Learning Objectives

1. Write the following Specific Learning Outcomes on the board or on an index card and asks learners to read them out aloud.

MOTIVATION (8 MINS)

Video Clip

1. Show the following video clip on the experiences of people with disabilities during floods. DISASTERS and the DISABLED (VERA Files, 2012). https://youtu.be/DLBa4gobjVY.
2. After showing the video, ask the class the following questions based on the video clip.
   I. What physical challenges did the residents of *Tahanan Walang Hagdan* (TWH) face during Typhoon *Ondoy*?
   II. Why are people with disabilities vulnerable to discrimination during disasters?

INSTRUCTION (20 MINS)

Simulation Game "Not Able To"

1. Tell that the class that they will play a simulation game called "Not Able To" to help them gain empathy for persons with disabilities.
2. Show the following list of common disabilities: blindness, deafness, mute, stuttering, dyslexia, dysgraphia, speech impediments, cataract, ADHD (attention deficient hyperactivity disorder).
3. First, ask learners to explain each disability is and what the disabled person is unable to do. Correct any misconceptions about disability learners may have. If learners are unfamiliar with disability, teacher explains the disability and what the disabled person is unable to do.
4. Each learner chooses by lottery, a disability and performs a specific task from the following table:

Teacher Tip:
Select a similar video showing both the physical and social challenges face during and immediately after a hazard event.

Disability is a term used to refer to both physical and mental/psychological impairment that substantially limits one or more major life activities such as walking, seeing, thinking, speaking, or hearing. Person with disability comprise a significant segment of the general population. It is the only segment that any person can join at any time.

Teacher Tip:
You may limit the types of disabilities to choose from depending on the availability of props.

Depending on the props available and the number of learners in the class, teacher can limit the number of learners who participate in this activity by arbitrarily selecting learners or by lottery.

Teacher should emphasize that for this activity, the disability is temporary. However, in real life person need to learn how to live the disability.

In lieu of the classroom discussion, teacher can ask learners to write down their answer to the discussion questions. Afterwards, teacher collects the learners answers and reads out some of the learners answers.

DISABILITY	PROP	RULE	TASK
Blind	Blindfold or eye mask	Blindfold or eye mask must be worn at throughout the ativity. No peeking	Go from seat to farthest exit as fast as is safely possible.
Cataract	Safety glasses covered with translucent plastic or paper.	Glasses must be worn at throughout the activity. No peeking	Go from seat to farthest exit as fast as is safely possible.
Deaf	Ear muffs or ear plugs	It is assumed that the deaf person is also mute.Ear plugs or ear muff should we worn throughout the activity. The deaf person should not know beforehand what the hazard is or where the hazard is located.	Have helper inform the deaf person that there is a hazard in a particular part of the classroom and that the deaf person needs to go away from this area.
Mute	Ear muffs or ear plugs	Cannot talk. It is assumed that the mute person is also deaf. The helper should not know beforehand what the hazard is or where the hazard is located.	Communicate to the helper that there is a hazard in a particular part of the classroom. Helper should be able to understand what the mute person is trying to communicate.
Stutterer	None	Says each word three times. The helper should not know beforehand what the hazard is or where the hazard is located.	Communicate to the helper that there is a hazard in a particular part of the classroom. Helper should be able to understand what the mute person is trying to communicate.
Speech impediment (different in stuttering in that the person may have a physiological condition that prevents the person from speaking in a audible manner e.g. hair lip, cleft palate, removal of vocal chords).	Paper or plastic tube with tissue or wax paper fastened at both ends using rubber bands.	All talking must be done by speaking through the tube. The helper should not know beforehand what the hazard is or where the hazard is located.	Communicate to the helper that there is a hazard in a particular part of the classroom. Helper should be able to understand what the mute person is trying to communicate.

DISABILITY	PROP	RULE	TASK
Paraplegic (both legs paralyzed)	Wheelchair	Must remain in the wheelchair. May not stand up or walk.	Go from seat to farthest exit as fast as is safely possible.
Paralyzed leg	Leg splint and or crutch.	Splint may not be removed; crutch must be used.	Go from seat to farthest exit as fast as is safely possible.
Club foot	Shoes with different sized heels, or ankle weight.	Shoes need to stay on during the activity.	Go from seat to farthest exit as fast as is safely possible.
Foot amputated	Wear a sock with a raw egg inside on one foot.	Wear sock with raw egg below the foot. Egg should not break.	Go from seat to farthest exit as fast as is safely possible.
Hand amputated with prosthesis	Ice tongs or fingers taped together.	Use only dominant hand.	Transfer small objects from one container to another container in a short a time without dropping the object.
Neuropathy of the hands (numbness or weakness)	Oven mitts	Must leave oven mitts on throughout activity.	Transfer small objects from one container to another container in a short a time without dropping the object.
Dysgraphia	Pen and paper	Must use only the non-dominant hand	Transfer small objects from one container to another container in a short a time without dropping the object.
Dyslexic	Book	None	Learner must read book upside down.
Helper	None	Can only help the disabled person when asked. Will not do things the disabled person can do.	Help the disabled person when asked.

5. After 30 minutes, ask the class the following discussion questions:
    I. How did it feel to be disabled?
    II. What were you not able to do? Conversely, what were you able to do?
    III. Do you think that person with disabilities focus on what they are able to do rather than what they are unable to do?
    IV. Why might it be a good idea to tell others about your disability?
    V. How did you want to be treated while you were a person with a disability?
    VI. Why did the only when asked and then only did those things the person with the disability could not do for him/herself?
6. What qualities do have a disability have instill in people? Trying thinking of both positive and negative qualities.

EVALUATION (10 MINS)

1. Besides those disabilities discussed in class, enumerate at least 3 other disabilities that can increase an individuals vulnerability to hazards. For each hazard, explain what challenges a person with this type of disability faces.
2. For each type of disability, explain how the disability can increase an individuals vulnerability to the following hazards: Earthquake, fire, flood, typhoon.
    I. Blind
    II. Deaf & Mute
    III. Paraplegic
    IV. Hand amputated with prosthesis
3. Why are persons with disability socially more vulnerable during a hazard event?
4. What can be done to help persons with a disability reduce their vulnerability to hazards?

Teacher Tips:

Some typical answers to the questions are as follows:

1. Answers range from fun to frustrating.
2. Answer will vary depending on the disability.
3. When persons focus on their disability, they normally get frustrated, depressed and resort to self-pity. Being depressed makes them vulnerable to hazards because it reduces their persistence in the midst of difficulty and challenge, and makes them give up easily. Focusing on what one can do minimizes the chances of the person getting frustrated, depressed or feeling sorry for themselves.
4. It is best to tell others about the disability so that they can understand the special needs associated with the disability and be more helpful. At the same time, persons with disability should be careful not to appear that they are using their disability to gain undue advantage over other people, or gain sympathy from other people.
5. Persons with disabilities want to be given due respect, consideration, kindness and understanding.
6. Helping when not asked can be paternalistic i.e. treating the disabled person like a baby. Also, it is not helpful to do something for someone else that they can do themselves because that can make them dependent on you and can cause them to think they are not capable.
7. Answers range from strong, courageous, persistent, patient, understanding.

ENRICHMENT

Any of the following activities can be done by learners outside of the class period to enhance the learning.

1. Learners can interview a disabled person and ask some of the discussion questions in class, and report on their findings in class. Learners can also interview a disabled person who has experienced a disaster emphasizing the role their disability had on surviving the disaster (note that the disability could be both a liability or an asset with regards to surviving the disaster).
2. Learners can search the internet for information on some of the more uncommon types of disabilities, and report in class what they find out.
3. While the lesson focused specifically on persons with disabilities, learners can also research other factors that influence vulnerability to hazards. Specifically, these include Socio-economic status; Gender; and Age. Listed among the references are some materials that learners can use.
4. Learners can interview a social scientist regarding the different factors that affect social vulnerability to hazards. Such social scientist include: psychologist, sociologist, geographer, anthropologist, social worker.

Typical answers:

1. Most learners will give physical disabilities related to those discussed in class. Less common disabilities include: chronic and degenerative illness such as those suffering from COPD, Alzheimers, Parkinson's, victims of stroke, mental illness in which the individual is not able to function normally, congenital conditions such as autism and Down's syndrome.
2. During an earthquake or fire, a blind person will have difficult evacuating the buildings. A person with missing a hand with prosthesis can have difficulty turning doorknobs to get out of a room. A paraplegic will have difficult evacuating a building during any of the hazards.
3. Persons with disabilities are more socially vulnerable because they have to rely on others to help them do things they cannot do because of their disability. A person's physical disability can cause a person to easily get frustrated, depressed, engage in self pity and lose hope. The additional attention persons with disabilities get causes resentment of regular able persons.
4. Person's with disabilities need to focus on the things they can do rather that the things they cannot do. They also need to learn how to tell others about their disabilities so that others can understand their special needs. People living with persons with disabilities need to resist the temptation of doing things persons with disabilities can do for themselves. This is to minimize the dependency on able people of the persons with disabilities.

EVALUATION				
Specific Learning Outcome	**EXCEEDS EXPECTATIONS**	**MEETS EXPECTATIONS**	**NEEDS IMPROVEMENT**	**NOT VISIBLE**
Explain the challenges a person with disability faces when coping with hazards.	Learner can explain in detail the connection between physical and psycho-social disability and vulnerability to hazards for any type of disability including the uncommon ones.	Learner can explain the connection between physical and psycho-social disability and vulnerability to hazards for the most common types of disabilities.	Learner can only explain the connection between physical disability and vulnerability to hazards for the most common types of disabilities.	Learner explain how physical disabilities increase a person's vulnerability to hazards.
Explain the connection between physical disability and social vulnerability to hazards.	Learner is able to explain in detail all the important mechanism underlying the connection between physical disability and social vulnerability. Learner is able to propose other mechanisms on how physical disability and social vulnerability are related particularly for the disabilities not discussed in class.	Learner is able to explain all the important mechanism underlying the connection between physical disability and social vulnerability.	Learner is able to explain only of the many mechanisms underlying the connection between physical disability and social vulnerability.	Learner is unable to explain the connections between physical disability and social vulnerability.
Discuss strategies of helping persons with disabilities	Strategies provided by learner lead to reducing the vulnerability to hazard of the person with the disability, and/or better understanding by others of the special needs of persons with disability. Strategies provided by learner are original and innovative.	Strategies provided by learner lead to reducing the vulnerability to hazard of the person with the disability, and/or better understanding by others of the special needs of persons with disability.	Strategies provided by learner does not lead to reducing the vulnerability to hazard of the person with the disability, or better understanding by others of the special needs of persons with disability.	Learner is provide any strategy for helping persons with disabilities.

Disaster Readiness and Risk Reduction

60 MINS

Physical Vulnerability

Content Standard
The learners demonstrate understanding of various elements that may be exposed to hazards including physical, social, economic, and environmental.

Performance Standard
The learners shall be able to:

- conduct hazard hunts of exposed element and propose corresponding corrective actions of one's preparedness.

Learning Competency
The learners are able to:

- analyze why certain structures are more vulnerable to specific hazards than others. **(DRR11/12 Ic-10)**

Specific Learning Outcomes
At the end of the lesson, the learners will be able to:

1. explain the structural vulnerabilities of physical structures with respect to different hazards; and
2. distinguish between structural, non-structural and functional vulnerabilities.

LESSON OUTLINE

Introduction	Research on 2013 Bohol Earthquake	3
Motivation	Discussion on Bohol Earthquake	7
Instruction	CASITA Module 5	20
Practice	Discussion Questions	20
Enrichment	Outside Activities	
Evaluation	Quiz	10

Suggested Resources

(1) Capacity Building in Asia using Information Technology Applications. (n.d.). *Module 5: Vulnerability of Physical Structures.* Retrieved from http://www.adpc.net/casita/course-materials/Mod-5-Physical-Vul.pdf
(2) Levy, M., and Salvadori, M. (1992). How buildings fall, how structures fail. New York, NY: W.W. Norton & Company
(3) White, J. (n.d.). *Five reasons buildings fail during earthquakes- and how to avoid them.* Retrieved from http://christnerinc.com/uploads/wysiwyg/hcd-five-reasons-buildings-fail-during-earthquakes-jeff-white.pdf
(4) Hawkesbury-Nepean Floodplain Management Steering Committee & Hawkesbury-Nepean Floodplain Management Steering Committee & New South Wales. Department of Natural Resources (2006). *Reducing vulnerability of buildings to flood damage: guidance on building in flood prone areas.* [Hawkesbury-Nepean Floodplain Management Steering Committee], Parramatta, N.S.W
(5) Federal Emergency Management Agency. (2005). *FEMA 74: Earthquake Hazard Mitigation for Nonstructural Elements.* Retrieved from http://mitigation.eeri.org/files/FEMA74_FieldManual.pdf
(6) Agarwal, A. (2007). *Cyclone Resistant Building Architecture.* Retrieved from http://www.unisdr.org/files/11711_CycloneArchitecture1.pdf

Additional Resources at the End of this Lesson

INTRODUCTION (3 MINS)

Research on 2013 Bohol Earthquake

1. Before class meeting, assign the class to research on the 15 October 2013 Bohol Earthquake. Learners should research the details of the event (time of day, day of the week, magnitude of the earthquake), impacts of the earthquake on exposed elements, number of people killed, injured and affected, economic damage resulting directly or indirectly from the earthquake. Also research eye witness accounts of the earthquake.
2. At the start of the class, show the OHT/PPS #1 showing the Specific Learning Outcomes, and volunteers from the class to read out each of the learning outcomes, and explain in their own words how they understand the learning outcomes.

Teacher Tip:
You may substitute another disaster showing structures exposed to the same hazards, but whose response during the hazards was significantly differed.

MOTIVATION (8 MINS)

Discussion on Bohol Earthquake

1. Ask learners to volunteer information about the 2013 Bohol Earthquake.
2. Show OHT/PPS #2 & #3 showing the damage to the Baclayon church and a house in Carmen, Bohol damaged by the 2013 earthquake. Then, show OHT/PPS #4 showing an undamaged house very close to the ground rupture of the 2013 earthquake.
3. Ask learners why they think the first two structures were destroyed by the earth, whereas the house was undamaged despite being exposed to equally strong ground motions. Allow learners to give their answers.

INSTRUCTION (20 MINS)

CASITA Module 5

1. Divide the class into groups of 5 to 6 learners per group. Each group appoints a facilitator and a scribe.
2. Provide each group with CASITA Module 5 and gives each group 15 minutes to read the modules. Alternatively, teacher can assign learners to read the modules before coming to class.
3. Each group will be assigned to answer the following guide questions:
   I. What is the difference between structural, non-structural, and functional vulnerability?
   II. For earthquakes, what are the causative factors of structural vulnerability?
   III. What particular types of structures (typology) are vulnerable to earthquakes (flood, or typhoon)?

Teacher Tip:
Although this section focuses on the physical vulnerabilities of structures with respect to earthquake. You can also provide a copy of HCD-Five Reasons Buildings Fail to give learners a broader understanding of the other factors leading to building failures during earthquakes.

IV. Why are non-engineered or owner constructed structures generally more vulnerable than engineered structures.

V. What general categories comprise the non-structural elements at risk? Give local examples for each of these categories.

VI. In the modules gives examples of functional vulnerability in terms of the operations of a hospital. Identify what elements would be at risk with regards to the functional vulnerability of a school.

Possible Answers to questions:

I. Structural vulnerability pertains to the vulnerability of parts of the building structure that carry load such as the columns, beams, floor, or roof. Non-structural vulnerability pertains to the vulnerability of the parts of the building structure that do not carry loads such as walls intended for partitioning the interior space of a building into individual rooms, ceiling tiles, or decorative moldings or finishes. Functional vulnerability pertains to the ability of the structure to function properly. For example if the stairway collapses or elevator becomes inoperable, mobility within the structure is affected.

II. Causative factors include the location of the structure, number of buildings and space in between buildings, number of stories, shape, symmetry, age of building, construction typology (material used in construction of the loading carrying elements of the building), age of the building, and alterations to the building and use of the building.

III. Masonry structures that are brittle and massive are generally vulnerable to earthquake. Light structures made from bamboo and straw are generally vulnerable to typhoon and strong winds. Timber structures are generally vulnerable to flood. Steel structures are vulnerable to fire.

IV. An non-engineered structure is a structure that has been designed and constructed without proper supervision from an architect and/or engineer. They generally are designed to withstand normal conditions, but often are not designed to resist wind or earthquake loads that would have been considered had an architect or engineer designed and supervised the construction.

V. Non-structural vulnerabilities include: partition walls, ceilings, lighting fixtures, door frames, mechanical equipment, plumbing and sewerage, electromechanical devices (elevators or machines). Note that non-structural vulnerabilities pertain to elements of the structure or *its contents* that can either fall or move around and kill/injure people or damage property within the structure. Examples would include walls or ceilings falling or the occupants of a school or hospital during an earthquake.

Teacher Tip:

Teacher has the option to choose a different hazard. For flood, teacher may provide learners with a copy of "Reducing Vulnerability of Buildings to Flood Damage" For typhoons, teacher may provide learners with Cyclone Resistant Building Architecture, UNDP 2007

For structural failures due to faulty design, teacher can ask learners to read Matthys Levi and Mario Salvadori. How buildings fall, how structures fail. W.W. Norton & Company 1992.

VI. Examples of functional vulnerabilities for a hospital would be damage to electrical systems which would prevent electrical life support equipment in the hospital from being operated. Example of functional vulnerabilities for a school would include the roof being damaged during a strong typhoon leaving the school building exposed to elements and preventing the holding of classes.

PRACTICE (20 MINS)

Discussion Questions

1. Each group is asked to share their answer to the following discussion questions.
2. Other groups can make comments and suggestions to the each groups answers.
3. Depending on how much time is available, do one or two of the following enrichment activities.

ENRICHMENT (CAN BE DONE IN CLASS DURING PRACTICE SECTION)

1. Building Resonance. This exercies is aimed at illustrating how the frequency of ground vibrations together with the typology and shape of the structure afect how the structure will shake during an earthquake. Teacher constructs BOSS model before class. See attached instructions on how to construct mode.
2. Video presentation. Show the following Youtube Multimedia clips to understand the following concepts:
   I. Resonance: https://youtu.be/LV_UuzEznHs; https://youtu.be/6IJ99phNArM ; https://youtu.be/H4VQul_SmCg
   II. Soft Storey: https://youtu.be/RBVxWh9TiFM; https://youtu.be/G_tJcy2nD8s; https://youtu.be/H6sLvSE7SVc
   III. Effects of typology on seismic response: https://youtu.be/CeWPPvFutbo; https://youtu.be/Yp1cQmBlgUQ; https://youtu.be/7Q67_LoMqRI
3. How safe is my house? Review the questions in the "How safe is my house and determine what causative factor is being assessed.
4. Consult an Architect or a Structural Engineer about the following mechanisms:
   I. Structural Pounding
   II. Soft Storey Construction

Teacher Tip:

While watching the videos, the following discussion questions are useful:

Resonance: How does the distance of a structures local to the fault that rupture affect the frequency of ground motions? Why are short structures more vulnerable than tall structures if located near a fault? Why are tall structures more vulnerable than short structures if located away from a faulty? How does the mass of a structure affect the seismic loads it will be exposed to during an earthquake. How does the flexibility/ductility of a structure affect its period? Why are concrete and masonry structures more vulnerable than timber structures if located close to the fault.

Soft-storey: Why are soft storeys generally located on the first floor of a building? Can you think of cases where the soft storey is located above the ground?

Builidng Typology: Based on the PHIVOLCS video, why are non-engineered structures more vulnerable that engineered structures. Based on the videos why are masonry structures more vulnerable that timber structures?

III. Short Column Effect
IV. Out-of-plane failure of in-fill walls
V. Lack of ductile detailing.

EVALUATION

Formative questions of vulnerability of structures:

1. Why are non-engineered or owner built structures more vulnerable to hazards? (Answer: In all likelihood, the person designing and supervising construction lacks a comprehensive knowledge of hazard resistant/resilient design and construction).
2. Within the class room, identify what the structural, non-structural and functionaly vulnerable elements considering earthquake are and why they are vulnerable.
3. Reinforced concrete structures are the most common type of building in the Philippines. Explain the mechansim underlying the the short-column and soft-storey effects that contribute to the vulnerability of reinforced concrete structures.

Questions on Structural Resonance during earthquakes

1. A stiffer building will _____ than a more flexible building under the same applied loading?
   A. Displace less *
   B. Displace more
   C. Displace the same amount

2. As the mass of a building increases, the natural frequency of the building or rate oscillation:
   A. Increases, the building wants to move back and forth faster
   B. Decreases, the building wants to move back and forth slower *
   C. Remains the same

Teacher Tip:

How safe is my house: The following are the answers to the "House safe is my house": For each factor, the corresponding question in the survey is identified.

1. Location: 11
2. Engineered construction: 1
3. Number of Stories, 4
4. Shape/Configuration: 4
5. Symmetry: 4
6. Age: 2
7. Construction: 6, 7, 8, 9, 10
8. Alteration: 5
9. Maintenance: 3, 12

3. As the stiffness of a building increases, the natural frequency of the building or rate of oscillation:
   A. Increases, the building wants to move back and forth faster *
   B. Decreases, the building wants to move back and forth slower
   C. Remains the same
4. The natural period of a building is:
   A. The inverse of the natural frequency
   B. Is measured in seconds*
   C. Is measured in Hertz
   D. A and B
   E. A and C
5. A shorter building will tend to be _____ than a taller building
   A. Stiffer*
   B. Stronger
   C. More flexible
   D. Weaker
6. During the Mexico City earthquake of 1985 certain buildings collapsed, while others remained standing. What was the issue with the buildings that collapsed? How could these collapses have been avoided?
7. Resonance occurs when two motions match, thus causing the amplitude of the motions to increase. Ground motions due to earthquakes can cause a building to displace by a large amount. Pushing someone on a swing is another example of resonance – if you push the person at the correct rate the arc of the swing will increase. What are some other examples of resonance? How does resonance affect these different systems?
8. Structural engineers consult with geologists to help predict the expected frequency of earthquake motions at a given site. They use this information to then make sure that buildings on that site do not have the same natural frequency as the expected earthquake input motions to avoid setting up resonance, in which the displacements of the building are amplified. What are some different strategies you might use to change the frequency of a building? Is it better to design buildings that are stiffer or more flexible?

Answer Key:

On Structural Resonance during earthquakes

1. A.
2. B.
3. A.
4. B.
5. A.

EVALUATION				
	EXCEEDS EXPECTATIONS	**MEETS EXPECTATIONS**	**NEEDS IMPROVEMENT**	**NOT VISIBLE**
Understanding physical vulnerability of structures	Can explain the specific mechanism underlying most causative mechanisms and can give concrete examples.	Can explain the specific mechanism underlying most causative mechanisms.	Familiar with general causative factors but is unable to explain the specific mechanism.	No evidence of significant learning
Understanding the difference between structural, non-structural and functional vulnerability	Can distinguish between structural, non-structural and functional vulnerability. Can explain vulnerability of structures. In addition can identify vulnerability of non-structural and functional elements.	Can distinguish between structural, non-structural and functional vulnerability. Can explain vulnerability of structures.	Show minimum signs of learning. Is familiar with structural vulnerability, but cannot distinguish structural vulnerability from non-structural vulnerability.	No evidence of significant learning

Additional Resources:

(1) Bukowski, R. (2001). Fire as a Building Design Load. Retrieved from http://fire.nist.gov/bfrlpubs/fire01/PDF/f01106.pdf
(2) Federal Emergency Management Agency. (2006). Designing for Earthquakes: A Manual for Architects. Retrieved from http://www.fema.gov/media-library-data/20130726-1556-20490-5679/fema454_complete.pdf
(3) mstkwon. (2008, September 11). SDOF Resonance Vibration Test [video file]. Retrieved from https://www.youtube.com/watch?v=LV_UuzEznHs
(4) IRIS EPO. (2015, March 15). Building Resonance: Why do some buildings fall in earthquakes? [video file]. Retrieved from https://www.youtube.com/watch?v=6IJ99phNArM
(5) Ted-Ed. (2015, January 26). Why do buildings fall in earthquakes? - Vicki V. May [video file]. Retrieved from https://www.youtube.com/watch?v=H4VQul_SmCg
(6) Academy of Earthquake Safety. (2013, September 5). Soft Storey [video file]. Retrieved from https://youtu.be/RBVxWh9TiFM
(7) Andy Oreta. (2012, August 12). DLSU STEQUAK Video - 1 Soft Story Building [video file]. Retrieved from https://youtu.be/G_tJcy2nD8s
(8) Degenkolb Engineers. (2010, September 10). We Can Solve the Soft-Story Problem [video file]. Retrieved from https://youtu.be/H6sLvSE7SVc
(9) Pia Ranada. (2014, February 18). Concrete Hollow Block House testing by JICA and PHIVOLCS [video file]. Retrieved from https://youtu.be/CeWPPvFutbo
(10)TheSlickyDick. (2010, April 17). Depreme karşı - earthquake vs. house in wood - Holzhaus Erdbebentest [video file]. Retrieved from https://youtu.be/Yp1cQmBlgUQ
(11)ISISE.HMS. (2014, March 22). Shaking table test on strenghtened existing masonry building [video file]. Retrieved from https://youtu.be/7Q67_LoMqRI

60 MINS

Identifying Exposed Elements

Content Standards
The learners shall be able to:

- demonstrate understanding of various elements that may be exposed to hazards including physical, social, economic, and environmental.
- demonstrate understanding of the vulnerability of each element.

Performance Standards
The learners shall be able to:

- conduct hazard hunts of exposed element and propose corresponding corrective actions of one's preparedness.

Learning Competency
The learners are able to:

- determine the elements that are exposed to a particular hazard **(DRR11/12 Id-11)**

Specific Learning Outcomes
At the end of the lesson, the learners will be able to:

1. identify elements exposed and vulnerable to a specific hazard; and
2. formulate preventive, mitigative and adaptive strategies for reducing hazard exposure of exposed elements.

LESSON OUTLINE

Introduction	Communicating Learning Objectives	2
Motivation	Video Clip	8
Instruction and Practice	Steps to Reducing Hazards	40
Evaluation	Other Hazards	10
Enrichment		

Materials:
Computer and projector to show videos.
Blackboard with chalk or white board with markers to write down answers during class discussion.

Suggested Resources

(1) Federal Alliance for Safe Homes, Inc. (n.d.). *FLASH - Video*. Retrieved from http://www.flash.org/video.php
(2) Southern California Earthquake Center. (n.d.). STEP #1: Identify potential hazards in your home and begin to fix them - Putting Down Roots in Earthquake Country. Retrieved from http://www.earthquakecountry.org/roots/step1.html
(3) Centers for Disease Control and Prevention. (2014). *Inspecting for Home HazardsIEarthquakes*. Retrieved from http://emergency.cdc.gov/disasters/earthquakes/inspecting.asp
(4) Centers for Disease Control and Prevention. (2014). *People with Special NeedsIEarthquakes.Retrieved* from http://emergency.cdc.gov/disasters/earthquakes/disabilities.asp
(5) Centers for Disease Control and Prevention. (n.d.). *Be Ready! Earthquakes* [Poster]. Retrieved from http://www.cdc.gov/phpr/documents/BeReady_Earthquakes.pdf

Additional Resources at the End of this Lesson

INTRODUCTION (2 MINS)

Communicating Learning Objectives

1. Tell the class that the lesson will involve identifying exposed element for specific hazards and formulating strategies
2. Write the following Specific Learning Outcomes on the board or on an index card and asks learners to read them out aloud.

MOTIVATION (8 MINS)

Video Clip

1. Tell the class that one of the most preventable hazards is fire because there are ways on reducing the potential for fires as well as reducing exposure to fire.
2. Show the video: *Christmas tree fires can turn devastating and deadly within seconds* (National Fire Protection Association, 2015)
3. If no equipment is available for showing the video, you can invite a victim of a fire to narrate the experience his or her experience. If there person is available during class period, you can interview of fire victim before the class period, and write a detailed narrative of his/her experience which the learners can read during the class period.

INSTRUCTION AND PRACTICE (40 MINS)

Steps to Reducing Hazards

1. Review the class on the definitions of the terms hazard, exposure and vulnerability.
2. Explain using the UNISDR terminology that there are steps to reduce exposure to hazards. These steps can be classified under three categories:
    I. PREVENTION – steps that can be taken to eliminate hazard or exposure to the hazard.
    II. MITIGATION – steps that can be taken to reduce the hazard or exposure and/or vulnerability of the elements exposed to the hazard.
    III. ADAPTATION – modifications in the normal or natural behavior aimed at reducing the exposure and/or vulnerability to the hazard.
3. Ask the class based on the Christmas Tree Fire video (or narration of the fire victim) shown, to answer the following questions. Teacher instructs learner to write their answers on a sheet of paper.

Teacher Tip:
As an alternative to the video, you can also show the following videos:

- National Fire Protection Association. (2012, November 5). Fire Power (Original). Retrieved from https://youtu.be/_OEdL6mDluo
- National Fire Protection Association. (2011, February 16). Fire Power - Revisited! Retrieved from https://youtu.be/9JU59Nsv2vg

Teacher Tip:
To provide more time for learners to watch the video, you can assign learners to watch the video before coming to class. You can also provide in advance the guide questions to be discussed in class. Teacher still shows the video in class as part of the motivation for the lesson.

1. If learners have difficulty in remembering the definition of hazard, exposure and vulnerability, teacher should review these concepts with the class before proceeding.
2. Most people have difficulty differentiating between prevention, mitigation and adaptation strategies. The teacher can use the following guidelines.
3. Prevention is aimed at effectively eliminating either the hazard itself, or exposure and/or vulnerability of exposed elements. Mitigation and adaption reduce the hazard, or the exposure and/or vulnerability of exposed elements. Adaptation generally pertains to a change in the normal/natural human reaction of behavior to reduce the risk, whereas mitigation generally involve external intervention strategies aimed at reducing exposure and/or vulnerability.

Give learners 15 minutes to answer the questions.

I. What specific hazards related to fire can you identify in video? (Electrical fire, extreme heat, smoke and noxious gases, water damage)

II. What are the exposed elements that are exposed and vulnerable to each of these hazards?

III. What specific steps can you think of for preventing a christmas tree fire. Have learners write these steps under the heading PREVENTION.

IV. What specific steps can you think of for reducing the likelihood of a christmas tree fire? Have learners write these steps under the heading MITIGATION

V. What changes to our normal/normal behavior can we adopt to prevent or reduce the risk from fire hazard? Have the learners write these steps under the heading ADAPTATION.

4. Ask learners to summarize their answers in table form as illustrated below:

HAZARD	ELECTRICAL FIRE	EXTREME HEAT AND COMBUSTION
Expose Elements	Christmas Lights	Any nearby furniture or objects that are combustible. People (Physical well being, psycho-social well being) House and contents; loss of place to live; loss of place; loss of economic and sentimental value of lost or damaged possessions.
Prevention	Regularly maintain christmas lights. Check for any exposed wires that may cause a short circuit. Not using christmas lights on the christmas tree.	Use Christmas Tree and ornaments made from non-combustible material. Locating Christmas Tree away from combustible furniture and objects.
Mitigation	Buy only christmas lights with ICC or PS Certification. Use a timer on outlet to turn christmas lights off.	Install a fire alarm. Regularly maintain fire alarm so that it is working properly. Place a fire extinguisher near the Christmas tree.
Adaptation	Do not overload electrical socket. Do not leave christmas lights on for an extended period of time.	Locate Christmas tree outside the house (instead inside the house).

Teacher Tip:

1. Even with the above distinctions, some amount of flexibility is allowed in the definition of these three strategies.
2. You should tell the class to assume that the fire occurs in a normal house occupied by people, pets, and other material belongings. If learner say fire, teacher needs emphasize that fire is a general term which comprises numerous hazards including intense heat, combustion, smoke, and noxious gases. Many exposed elements may be damaged by smoke or heat even of even if they do not burn. People are killed from smoke inhalation rather than regretting burned due to the fire. Teacher should guide the learners in identifying elements both fixed as well as movable, tangible as well as intangible elements. Examples of intangible elements that should be emphasized would be sentimental value of belongings, loss of a place to live, economic implications of losing home and belongings, psychological trauma due to loss of a sense of place.
3. In Christmas Tree Fire video, the fire starts due to overheating of the christmas tree lights. Possible ways by which such fire can be prevented would include not leaving Christmas lights on for a extended period of time and using christmas lights with ICC or PS Certification. It should also be noted that Christmas tree was a pine tree that was combustible. The fire hazard could have been minimized by using a tree and decorations that are not combustible. The fire hazard could also have been minimized if the christmas tree was placed in an area away from from items like furniture and curtains that are also combustible and can easily catch fire.

5. After 20 minutes, learners share with the class their answers. Other learners should provide constructive comments regarding their answers.
6. As learners share their answers, synthesize and summarize answers of the class on the blackboard/ whiteboard.

EVALUATION (10 MINS)

1. Explain that the class will now apply what they have learned to another hazard. Explain that during an earthquake, one of the most common hazards is related to contents of home and buildings moving around or falling and injuring people. Explain that in this practice exercise, the class will apply what they learned for fires to falling hazards during earthquake.
2. Show the following videos:
   I. Earthquake – Kobe, Japan (superbogag, 2008)
   II. Earthquake Preparation: Potential Falling Hazards (CityofHillsboroOR, 2015)
3. Ask class to imagine that a similar earthquake occurs within the area where their house is located. Ask learners to answer the following questions:
   I. What are the specific elements exposed to strong ground shaking?
   II. Enumerate at least 3 specific measures can be undertaken to prevent or mitigate injury of people living within the house as well as damage to contents of the house?

ENRICHMENT (OUT OF CLASS)

1. Learners consult an architect or civil engineer to research what preventive, mitigative or adaptive measures they can add to their hazard exposure reduction action plan.
2. Learners review and revise their plan of Hazard exposure reduction action plan action for addressing falling hazards at home together with their parents.
3. Have learners view any of the prevention and preparedness videos enumerated above and formulate a hazard exposure reduction action plan for their home during the event of a flood or typhoon.

Teacher Tip:
You should also emphasize the falling hazards are also very common in homes with small children. (Fairview Health Services, n.d.)

Sample Answers are shown below:
Element exposed to shaking hazard: House itself, people living inside the house, family pets, furniture, belongings, personal records, sentimental value to possessions.

Prevention, Mitigation and Adaptation Strategies:

1. Secure to a nearby wall all large or tall appliances or pieces of furniture that may move around or topple over during a strong earthquake.
2. Move any large or tall appliances away from where it may fall on people (such as sofa or beds) or block an exit way during a strong earthquake.
3. Secure all lighting fixtures suspended from the ceiling or hanging from the walls which may fall on people or pets.
4. Secure (normally using velcro) breakable objects on shelves.
5. Put ties on cabinets that may suddenly open during an earthquake.

EVALUATION				
	EXCEEDS EXPECTATIONS	**MEETS EXPECTATIONS**	**NEEDS IMPROVEMENT**	**NOT VISIBLE**
Identify elements exposed and vulnerable to a specific hazard	Learner is able to identify all physical, social, economic and environmental hazards that are exposed and vulnerable to the specific hazard.	Learner is able to identify most physical hazards and some social, economic and environmental elements that are both exposed and vulnerable to the specific hazard.	Learner is able to identify some exposed elements to a specific hazard. Some exposed elements are not vulnerable to the specific hazard.	Learner is unable to identify any exposed elements to the specific hazard..
Formulate preventive, mitigative and adaptive strategies for reducing hazard exposure of exposed elements.	Learner is able to formulate preventive, mitigative and adaptive strategies for reducing hazard exposure of exposed elements. Strategies formulated demonstrate originality, innovative, and resourcefulness of learner.	Learner is able to formulate preventive, mitigative and adaptive strategies for reducing hazard exposure of exposed elements.	Learner is able to formulate strategies that are unrelated to reducing exposure to hazard.	Learner is unable to formulate any strategy to reducing hazard exposure of exposed elements.

Additional Resources:

1. Centers for Disease Control and Prevention. (2013). Floods|CDC. Retrieved from http://emergency.cdc.gov/disasters/floods/index.asp
2. Centers for Disease Control and Prevention. (2015). Key Facts About Flood Readiness|Floods. Retrieved from http://emergency.cdc.gov/disasters/floods/readiness.asp
3. Centers for Disease Control and Prevention. (2004). After a Flood|Floods. Retrieved from http://emergency.cdc.gov/disasters/floods/after.asp
4. Centers for Disease Control and Prevention. (2015). Hurricanes and Other Tropical Storms|CDC. Retrieved from http://emergency.cdc.gov/disasters/hurricanes/index.asp
5. United States Food and Drug Administration. (n.d.). Food and Water Safety During Power Outages and Floods. Retrieved from http://www.fda.gov/Food/ResourcesForYou/Consumers/ucm076881.htm
6. American Red Cross. (n.d.). Fire Prevention & Safety Tips | Red Cross. Retrieved from http://www.redcross.org/get-help/prepare-for-emergencies/types-of-emergencies/fire
7. National Fire Protection Association. (n.d.). Emergency Preparedness. Retrieved from http://www.nfpa.org/safety-information/for-consumers/emergency-preparedness
8. National Fire Protection Association. (2015, December 5). Christmas tree fires can turn devastating and deadly within seconds [Video file]. Retrieved from https://youtu.be/xr6b9b8FYKk
9. National Fire Protection Association. (2012, November 5). Fire Power (Original). Retrieved from https://youtu.be/_OEdL6mDluo
10. National Fire Protection Association. (2011, February 16). Fire Power - Revisited! Retrieved from https://youtu.be/9JU59Nsv2vg
11. RedDeerAdvocate. (2011, October 10). Demonstration underscores the danger of kitchen fires. Retrieved from https://youtu.be/AkbcPhtl9TE
12. Centers for Disease Control and Prevention. (2012). Preparing for a Volcanic Eruption|Volcanoes. Retrieved from http://emergency.cdc.gov/disasters/volcanoes/before.asp
13. Fairview Health Services. (n.d.). Retrieved from https://www.fairview.org/HealthLibrary/Article/40087
14. Superbogag. (2008, July 7). Earthquake - Kobe, Japan. Retrieved from https://youtu.be/MEfnCoqZWYY
15. City of Hillsboro OR. (2015, September 29). Earthquake Preparation: Potential Falling Hazards. Retrieved from https://youtu.be/IQc6vOG4yYQ

60 MINS

Identifying Specific Vulnerabilities

Content Standards
The learners shall be able to:

- demonstrate understanding of various elements that may be exposed to hazards including physical, social, economic, and environmental.
- demonstrate understanding of the vulnerability of each element.

Performance Standard
The learners shall be able to:

- conduct hazard hunts of exposed element and propose corresponding corrective actions of one's preparedness.

Learning Competency
The learners are able to:

- recognize vulnerabilities of different elements exposed to specific hazards **(DRR11/12 Id-12)**

Specific Learning Outcomes
At the end of the lesson, the learners will be able to:

1. apply concepts of exposure and vulnerability previously learned in recognizing vulnerability of different elements exposed to specific hazards;
2. analyze how the reducing the vulnerability of an exposed element to a specific hazard may result in increasing its vulnerability to other hazards and
3. synthesize practical strategies for reducing collective vulnerability of elements exposed to multiple hazards.

LESSON OUTLINE

Introduction	Introducing Learning Objectives	2
Motivation	News Article: Pampanga buried in Lahar	8
Instruction	Group Work	15
Practice	Worksheet	30
Evaluation	Inquiry	5
Enrichment		

Materials:
Pen and paper for classroom exercise

Suggested Resources

(1) Capacity Building in Asia using Information Technology Applications. (n.d.). *Module 5: Vulnerability of Physical Structures.* Retrieved from http://www.adpc.net/casita/course-materials/Mod-5-Physical-Vul.pdf
(2) Levy, M., and Salvadori, M. (1992). How buildings fall, how structures fail. New York, NY: W.W. Norton & Company
(3) White, J. (n.d.). *Five reasons buildings fail during earthquakes- and how to avoid them.* Retrieved from http://christnerinc.com/uploads/wysiwyg/hcd-five-reasons-buildings-fail-during-earthquakes-jeff-white.pdf
(4) Hawkesbury-Nepean Floodplain Management Steering Committee & Hawkesbury-Nepean Floodplain Management Steering Committee & New South Wales. Department of Natural Resources (2006). *Reducing vulnerability of buildings to flood damage: guidance on building in flood prone areas.* [Hawkesbury-Nepean Floodplain Management Steering Committee], Parramatta, N.S.W
(5) Federal Emergency Management Agency. (2005). FEMA 74: *Earthquake Hazard Mitigation for Nonstructural Elements.* Retrieved from http://mitigation.eeri.org/files/FEMA74_FieldManual.pdf

Additional Resources at the Back

INTRODUCTION (2 MINS)

Communicating Learning Objectives

1. Tell the class that the lesson will involve identifying exposed element for specific hazards and formulating strategies
2. Write the following Specific Learning Outcomes on the board or on an index card and asks learners to read them out aloud.

MOTIVATION (8 MINS)

Video Clip

1. Assign learner read-up Crittenden and Rodolfo on how the town of Bacolor, Pampanga was buried in 1995 by redeposited lahar derived from the eruption of Mt. Pinatubo in June 1991. Also have learners read the reference on the reference material on the Socio-Economic Profiles of Pampanga: Bacolor, Lubao and Mabalacat.
2. Show PowerPoint slides or show the videos from the recommended internet resources regarding the town of Bacolor, Pampanga. If needed, you can replay the videos so that learners can catch all the details.

INSTRUCTION (15 MINS)

Group Work

1. Subdivide the class into groups of 5 to 7 learners to a group. Have the group elect a scribe who responsibility is to synthesize and document the answers.
2. Based on the discussion of Crittenden and Rodolfo, ask learners to discuss among themselves the following questions:
    I. Identify the exposed elements affected by the lahar hazard, and why were these elements vulnerable? (Sample answers: people physically vulnerable to getting buried or trapped in structures particularly when lahar flow occurs suddenly and at night; the loss of loved one, possession, or loss of sense of place traumatize people both psychologically as well as socially; road and bridge can get eroded by lahar flows, houses with its contents can get buried, loss of livelihood, basic services like water, sewage, electricity due to burial by lahar can severely affect the normal way of life, loss of landmarks such as the burial of the church can erase cultural and historical monuments)

Teacher Tip:
If the June 1991 Eruption of Mt. Pinatubo was discussed in a previous class on volcanic and related hazards, you can ask the class what they remembered about the lesson.

Some internet resources that can be used for setting the motivation for the lesson include:

1. Natural Disasters and Cultural Change: Bacolor town and Pinatubo volcano, Philippines: coping with recurrent lahar disaster. (Crittenden and Rodolfo, 2002)
2. Lowe, D. (n.d.). Bacolor the town that got buried. Retrieved from http://www.thetravellingeditor.com/bacolor-buried-town/
3. Lakad Pilipinas. (n.d.). PAMPANGA: The Half-Buried Bacolor Church. Retrieved from http://www.lakadpilipinas.com/2014/02/pampanga-half-buried-bacolor-church.html
4. Danny Labung. (2011, June 22). Bacolor: Mt Pinatubo Devastation - 20th Anniv June 15, 2011 [Video file]. Retrieved from https://www.youtube.com/watch?v=t8dopMdq6Qk
5. Reden Dizon. (2011, April 27). San Antonio, Bacolor: Lahar. Retrieved from https://www.youtube.com/watch?v=iDTa4oNaX5Y

You can also assign learners to read or watch the videos recommended above.

Teacher Tip:
The main purpose of this exercise to enable the learner to obtain an idea of the socio-political dimensions people, communities and government respond to disasters, and the affects these actions have on increasing or decreasing vulnerability.

Specifically, this exercise aims to explain the social context in which the practice of raising houses on stilts came about in Bacolor as a result of the lahar disasters.

II. How did the residents' sense of attachment to place significantly contribute to the residents remaining or resettling back the town of Bacolor. (Sample answer: Because people did not want to leave the place, the invested their resources in remaning in and rebuilding the town of Bacolor).

III. What factors/circumstances led to the adoption of the traditional practice of house raising by residents of Bacolor to reclaim and protect their houses?

3. Have each group submit their answers after 15 minutes.

Teacher Tip:

An alternative case study that can be substituted for the case of Bacolor, Pampanga is the case of the province of Albay. In November 2006, Typhoon Reming resulted in lahar flows from Mayon burying towns in Albay. Unlike the lahars of Mt. Pinatubo that consisted generally soil, the lahars from Mayon Volcano contained large boulders mixed with soil. The large boulders hit and severely damaged structures (consisting mainly of houses) lying in the path of the lahar flow.

PRACTICE (30 MINS)

1. Show the picture of the house below and tells the class that this house is a typical raised house found in the Pampanga area affected by lahar. The frame of the house including the foundation is made from reinforced concrete, with hollow-blow in-fill walls. The roof system consists of a coco-lumber roof frame and galvanized iron roofing material. The partitions are constructed from wooden materials. The house was designed and constructed by a foreman with no formal engineering or architectural training.

Teacher Tip:

If learners have difficult time, it may be necessary to ask the following guide questions to give the learners clues to the answers:

1. Does house have any of the characteristic features such the presence of soft story, or the potential for resonance of the structure with the strong ground motions of the earthquake? Is there a possibility of the house pounding an adjacent house given that it is founded on stilts.
2. How does founding the house on stilts affect the ease by which the occupants can evacuate the house during a typhoon, fire, flood, or earthquake?
3. How does founding the house on stilts affect the ease by which the contents of the house, including the furniture and appliances, can be moved to a safer location.

2. There are 7 persons living inside the house which include:
   I. The owner of the house who is male and 34 years old.
   II. The wife of the owner of the house who is 32 years old.
   III. Three children aged 5-years, 3-years, and a 6-month old infant.
   IV. A 72-year old female.
   V. A 40 year old male who is wheelchair bound.
3. Most of the furnishing of the house is either wooden or plastic in construction.
4. Have learners write on a sheet of paper how founding the house on stilts affects the vulnerability of the house, its occupants and contents to the following hazards.
   I. Strong ground shaking due to an earthquake
   II. An fire starting from the stove in the kitchen
   III. Flood due to continuous and heavy rains
   IV. Strong winds from Signal 3 or stronger typhoon.
5. Have learners summarize their answers using the form as attached. A sample with the most common answers is given below. This can also be used as the basis for a solution key. Given learners 15 minutes to fill out the table.
6. At the end of 15 minute period have learners exchange papers and discuss the individual entries in each of the cells of the table having learners score the individual items. Use the example/solution key below as a guide for checking.

HAZARD	**EXPOSED ELEMENT**		
	HOUSE	**CONTENTS**	**OCCUPANTS**
Earthquake\Strong Ground Shaking	Putting the house on stilts will make it shake more during an earthquake resulting in larger earthquake forces acting on the house.(a)	Because of stronger shaking there is a greater chance that the contents of the house will be thrown around inside the house and get destroyed.	Putting the house on stilts will make it more difficult to evacuate during a strong earthquake. This is particularly true for the children, the PWD, and the elderly occupant. of the house. Because of the stronger shaking, there is greater chance that the contents of the house will be thrown around and will injure the occupants of the house.

HAZARD	EXPOSED ELEMENT		
	HOUSE	CONTENTS	OCCUPANTS
Fire	Putting the house on stilts results in reduced accessibility by fire fighters.	Putting the house on stilts will make it more difficult to evacuate the contents of the house during a fire making them more vulnerable.	Putting the house on stilts makes the house more difficult to evacuate during a fire.
Flood	The house will not be reached by flood waters because of its higher elevation.	Because the house is less likely to be reached by flood water, there is likely a chance that the contents will be damaged by flood waters.	Because the house is less likely to be reached by flood water, there is likely a chance that the contents occupants will be affected by the flood waters.
Typhoon	Putting the house on stilts makes it more vulnerable to strong winds and typhoons because the higher from the ground, the greater are the wind forces. In particular there is a greater possibility for the roof to be blown off because of the higher elevation and open windows.	The greater possibility of the roof being blown off during a typhoons results in a greater possibility that the contents will be affected by a typhoon.	The greater possibility of the roof being blown off during a typhoons results in a greater possibility that the occupants will be affected by a typhoon.

EVALUATION (5 MINS)

Have each learner answer the following two questions:

1. Does putting the raising the house together with its occupants and contents, make it overall more vulnerable considering it is exposed to earthquake, fire, flood and typhoon hazards? Why or why not?
2. Suggest a measure that can be done to reduce the vulnerability of the house, its occupants or its contents to each of the four hazards it is exposed to.

ENRICHMENT

1. Have learners formulate ways to minimize the majority of the vulnerabilities of the house, its occupants and contents can be minimized to earthquake, fire, flood and typhoon hazards. If necessary, have them consult an civil engineer or architect to address the physical/structural vulnerabilities of the house. Learners can be made to report on their plan of action in the following class period.

EVALUATION				
	EXCEEDS EXPECTATIONS	**MEETS EXPECTATIONS**	**NEEDS IMPROVEMENT**	**NOT VISIBLE**
Apply concepts of exposure and vulnerability previously learned in recognizing vulnerability of different elements exposed to specific hazards.	Learner is able to correctly answer at most all twelve items in the practice exercise.	Learner is able to correctly answer between 9 to 11 items in the practice exercise.	Learner is able to correctly answer between 3 to 9 items in the practice exercise.	Learner is able to correctly answer at most two out of twelve items in the practice exercise.
Evaluation question 1: Analyze how the reducing the vulnerability of an exposed element to a specific hazard may result in increasing its vulnerability to other hazards.	Learner knows that exposed elements are more vulnerable with a suitable explanation to support his answer. Explanation is both correct as well as original in that it is not included among the answers cited in the correction key, or based on the judgement of the teacher.	Learner knows that exposed elements are more vulnerable and can provide a suitable explanation to support his answer.	Learner knows that exposed elements are more vulnerable but cannot provide a suitable explanation to support his answer.	Learner cannot tell if raising the house has increased or decreased the vulnerability of the exposed elements to the four hazards considered. Learner answers that all exposed elements are less vulnerable to all four hazards as a result of raising the elevation of the house.
Evaluation question 2: Synthesize practical strategies for reducing collective vulnerability of elements exposed to multiple hazards.	Learner is able to provided at least one strategy that is correct and feasible/practice based on the judgement of the teacher. Learner accomplishes enrichment exercise.	Learner is able to provided at least one strategy that is correct and feasible/practice based on the judgement of the teacher.	Strategy provided by learner is either incorrect, not feasible, or impractical based on the judgement of the teacher.	Learner is unable to think of any strategy for addressing the vulnerability of exposed elements.

Additional Resources:

1. Agarwal, A. (2007). *Cyclone Resistant Building Architecture*. Retrieved from http://www.unisdr.org/files/11711_CycloneArchitecture1.pdf
2. Bukowski, R. (2001). *Fire as a Building Design Load*. Retrieved from http://fire.nist.gov/bfrlpubs/fire01/PDF/f01106.pdf
3. Federal Emergency Management Agency. (2006). *Designing for Earthquakes: A Manual for Architects*. Retrieved from http://www.fema.gov/media-library-data/20130726-1556-20490-5679/fema454_complete.pdf
4. CBM.Org. (n.d.). *Working Towards A Disability* Inclusive World. Retrieved from http://www.cbm.org/index.php
5. United Nations Office for Disaster Risk Reduction. (2014). Living with Disability and Disasters: UNISDR 2013 Survey on Living with Disabilities and Disasters - Key Findings. Retrieved from http://www.unisdr.org/2014/iddr/documents/2013DisabilitySurveryReport_030714.pdf
6. Crittenden, K. S. and Rodolfo, K. S. (2002). *Bacolor town and Pinatubo volcano, Philippines: coping with recurrent lahar disaster*. In R. Torrence and J. Grattan (eds.) Natural disasters and cultural change. Routledge, London, pp 43-65.
7. Lowe, D. (n.d.). *Bacolor the town that got buried*. Retrieved from http://www.thetravellingeditor.com/bacolor-buried-town/
8. Lakad Pilipinas. (n.d.). *PAMPANGA: The Half-Buried Bacolor Church*. Retrieved from http://www.lakadpilipinas.com/2014/02/pampanga-half-buried-bacolor-church.html
9. Danny Labung. (2011, June 22). *Bacolor: Mt Pinatubo Devastation - 20th Anniv June 15, 2011* [Video file]. Retrieved from https://www.youtube.com/watch?v=t8dopMdq6Qk
10. Reden Dizon. (2011, April 27). *San Antonio, Bacolor: Lahar*. Retrieved from https://www.youtube.com/watch?v=iDTa4oNaX5Y

120 MINS

Case Studies

Content Standards
The learners shall be able to:

- demonstrate understanding of various elements that may be exposed to hazards including physical, social, economic, and environmental.
- demonstrate understanding of the vulnerability of each element.

Performance Standard
The learners shall be able to:

- conduct hazard hunts of exposed element and propose corresponding corrective actions of one's preparedness.

Learning Competency
The learners are able to:

- differentiate among hazards, exposure, and vulnerabilities and give examples from actual situations. **(DRR11/12 Id-13)**

Specific Learning Outcomes
At the end of the lesson, the learners will be able to:

1. given a particular situation, differentiate between hazards, exposed elements and their vulnerabilities;
2. give examples of hazard, exposed elements and their vulnerabilities from historical events within the Philippines; and
3. suggests mitigation, adaptation and preparedness strategies for managing disaster risk based on experiences from previous disasters whenever possible.

LESSON OUTLINE

Introduction	Introducing Learning Objectives	2
Motivation	Definition of Terms	8
Instruction	Reading of Articles and Group Work	50
Practice	Presentation of Research	50
Evaluation	Inquiry	10
Enrichment	Assessment of Hazards at Home	
Materials	Pen and paper for classroom exercise	

Suggested Resources

1. 1990 Luzon earthquake. (n.d.). Retrieved **DATE** from Wikipedia: https://en.wikipedia.org/wiki/1990_Luzon_earthquake
2. Philippine Institute of Volcanology and Seismology. (2001). The July 16, 1990 Luzon Earthquake - A Technical Monograph [Monograph]. Retrieved from http://www.phivolcs.dost.gov.ph/html/update_SOEPD/1990LuzonEQ_Monograph/foreword.html
3. The July 16, 1990 Luzon Earthquake. (n.d.). Retrieved from https://ds.iris.edu/data/reports/1990/90-014/LuzorPHI.July90.eq.pdf
4. EQE Engineering. (1990). The July 16, 1990 Philippines Earthquake: August 1990. (n.p.): Author
5. Acacio, A. A. (1992, May 27). Retrofitting lifeline facilities on liquefied deposits. Paper presented at Proceedings from the 4th Japan-U.S. Workshop on Earthquake Resistant Design of Lifeline Facilities and Countermeasures for Soil Liquefaction, Tokai University Pacific Center. Honolulu, Hawaii: National Center for Earthquake Engineering Research

Additional Resources at the End of this Lesson

INTRODUCTION (2 MINS)

1. Tell the class that the lesson will synthesize the concepts on exposed elements and their vulnerabilities and apply these to actual situations.
2. Write the following specific learning outcomes on the board or on an index card and asks learners to read them out aloud.

MOTIVATION (8 MINS)

1. Ask learners within the class to explain the following terms in their own words: Disaster Risk, Hazard, Exposure, Vulnerability and Capacity.
2. Ask learners to explain how hazard, exposure, vulnerability and capacity are related to disaster risk.

INSTRUCTION (50 MINS)

Reading of Articles

1. Prior the lesson, download and print materials on the following four historical disasters.
   I. 16 July 1990 Luzon Earthquake
   II. Typhoon Yolanda (Haiyan)
   III. 1990 Eruption of Mt. Pinatubo
   IV. Typhoon Ondoy and Pepeng
2. Divide the class into four groups. This can be done by lottery so that groups are roughly the same size. The groups will be given the following names to help in identification and be assigned the following historical disaster.
   I. EARTH: 16 July 1990 Luzon Earthquake
   II. WIND: Typhoon Yolanda (Haiyan)
   III. FIRE: 1990 Eruption of Mt. Pinatubo
   IV. WATER: Typhoon Ondoy and Pepeng
3. Each group studies the materials and answers the following questions (Sample answers are shown in Table 2 below).
   I. Research damages with regards to total deaths, total number of persons affected and total economic damage. (See *Country Profile*. (n.d.). Retrieved from http://www.emdat.be/country_profile/index.html)

Teacher Tip:
To save time and resources, teacher can subdivide class into four groups prior to the class session, and assign members of each group to research the assigned historical disaster.

II. What specific areas where affected by the disaster?

III. For each specific area, identify the major hazards.

IV. What were the major categories of exposed elements? For each category, give specific examples based on facts gathered through research.

V. What were the most common factors contributing the vulnerability of each of these elements. Ask learners to describe the effects of hazards on the exposed elements.

4. Ask each group to explain based on what they researched why this event ended up in a disaster (see sample answers in Table 3). Also ask each group to suggest prevention, mitigation or adaptation strategies whenever possible. If no measures can be done, have the group explain why. (see sample answers Table 4)

DISASTER	DEATHS	AFFECTED	ECONOMIC LOSS (Million US $)
Earth	2,412	1,597,553	640
Wind	7,354	16,106,870	10,000
Fire	847	1,036,065	211
Water	789	4,901,763	585

Table 1: Country Profile (University of Louvain-Belgium, n.d.)

TABLE 2

DISASTER	AREA AFFECTED	HAZARD	EXPOSED ELEMENTS	VULNERABILITY / POTENTIAL EFFECTS
Luzon Earthquake	Baguio	Earthquake-induced landslides	Roads (e.g. Kennon Road, Marcos Highway) Access to Baguio City	• Steep cuts made into slopes, as part of road construction, are susceptible to slope failure during an earthquake, resulting in debris that can block roads resulting in loss of access that can hampered rescue operations and relief goods.
Yolanda	Tacloban	Strong Winds Storm Surge	People, Homes and Contents	• Light structures and roofs of structures are susceptible to damage when subjected to loads induced by strong winds. • People are susceptible to injury when exposed to flying debris made airborne by strong winds. • People are susceptible to drowning or injury when carried away by turbulent flood waters. • Structures or the individuals elements (eg walls and doors) are susceptible to damage when exposed to hydrodynamic or buoyant forces due to flood waters. • Wooden elements of structures and contents are susceptible to damage due to prolonged saturation. Certain contents are also prone to damage to mold and mildew due to excessive moisture.

DISASTER	AREA AFFECTED	HAZARD	EXPOSED ELEMENTS	VULNERABILITY / POTENTIAL EFFECTS
Pinatubo Eruption	Angeles City	Tephra (Ash) Fall	Structures	• Roof systems are prone to collapse due to weight of tephra accumulating on roofs.
Ondoy	Metro Manila	Flash flooding	People, Homes, Contents	• People are susceptible to drowning in flash floods due to limited evacuation time. • Survivors of floods are susceptible to psycho-social trauma. • Persons with chronic illness as well as physical and psychological disabilities are significantly greater difficulty in evacuating compared to able persons making them more vulnerable to injury or death during a flood. • Structures or specific elements are susceptible to damaged when exposed to hydrodynamic or buoyancy forces during a flood. • Structure and its contents are susceptible to damage due to prolonged exposure to water.

TABLE 3

DISASTER	AREA AFFECTED
1990 Luzon Earthquake	Extensive loss of life, damage to infrastructure and critical facilities. Extensive environmental impact due to numerous earthquake induced landslides.
Typhoon Yolanda	Extensive loss of life, damage to infrastructure and critical facilities. Extensive environmental impact due to large amount of debris generated. Death, injury and economic losses resulted in psychological trauma to survivors.
Mt. Pinatubo	Extensive environmental impact due to large amount of volcanic debris deposited. Extensive damage to infrastructure within surrounding areas.
Typhoon Ondoy	Area affected by flood was a highly developed and highly populated area.

TABLE 4

DISASTER	AREA AFFECTED
Injury due to falling debris resulting from earthquake induced landslides	Difficult to avoid if earthquake occurs while travelling in a mountainous area. Best option would be to stop the car, get out and find an area away from steep slopes.
Flood risk due to storm surges	Research if your area is prone to storm surges and potentially how high waters can rise. Prepare an evacuation plan and emergency kit which you can easily take should a flood occur.
Collapse of structures due to tephra fall	Check if you live near a potentially active volcano. When constructing a house, consult a licensed civil engineer or architect and discuss how volcanic hazards can be taken into consideration into the design of the house. Explore the possibility of including risk from volcanic eruption in home insurance. Familiarize yourself with the volcano alert leaves. Have an evacuation plan for a volcanic eruption. Prepare an evacuation kit.
Hazard of flash flooding	Research if you Live in a potentially flood prone area and determine how high the flood water can rise. Prepare an evacuation plan and emergency kit which you can easily take should a flood occur.

PRACTICE (50 MINS)

1. Each group presents the information they researched and answers to the guide questions on the first day (or previous class meeting) regarding the four(4) historical disaster to the class explaining the background of the event, the specific hazards, exposed elements and factors that made these elements vulnerable to the hazard. The group summarizes how these factors lead to the disaster. Also, the group presents their suggestions regarding what lessons were learned from the disaster and what strategies can the group recommend minimizing the risk of such a disaster occurring in the future.
2. Comment and make suggestions regarding their assessment of the risk factors (hazard, exposure and vulnerability), the assessment of the group as to what factors lead to the disaster, and the recommended strategies from minimizing the occurrence of the same disaster in the future.
3. After the lesson, the group revises their case study report taking into consideration the comments and suggestions and submits this in the succeeding class meeting.

EVALUATION (10 MINS)

1. Select a disaster event that the learners in the class are familiar with. Explain the background of this event. Ask learners to individually answer the following questions.
   I. Identify the specific hazard(s) involved in this disaster.
   II. Enumerate the exposed elements affected by the hazard.
   III. Explain why the exposed elements were vulnerable to the hazard.
   IV. Recommend strategies that could have been taken to minimize the possibility of a similar disaster occurring in the future.

   Example: Guinsaugon Landslide

   I. Rainfall induced rockslide, avalanche and debris flow.
   II. More than 1000 people killed, entire barangay of Guinsaugon including more than 200 houses, barangay hall and element school building. Psychological trauma to survivors and relatives of those killed.
   III. Debris from rock slide and avalanche travelled at speeds greater than 100 kph that prevented residents of barangay Guinsaugon from evacuating. Landslide debris was highly erosive and abrasive destroying structure within the flow path. Large volume of landslide debris buried the town destroying all structures. People buried or trapped in houses suffocated under the weight of the debris.
   IV. More careful selection of site for establishing communities away from landslide prone areas. Installation of early warning systems. Conducting information seminars on landslide hazards for affected communities.

ENRICHMENT

1. Learner develops assess the hazards his/her house is exposed to. Hazards should generally include earthquake, typhoon and fire, and possibly flooding, volcanic eruption and landslide related hazards. The learner then makes an inventory of all exposed elements and identifies the specific vulnerabilities of each of the exposed elements. Learner then formulates an action plan to address these vulnerabilities. Learner can discuss the plan with his/her parents.

2. Group consults experts to solicit comments regarding their case study report and obtain suggestions how to improve the report. Groups should particularly ask expert help on possible strategies for dealing with the risk posed by different hazards, particularly those which do not seem to have possible prevention, mitigation or adaptation measures.

EVALUATION				
	EXCEEDS EXPECTATIONS	**MEETS EXPECTATIONS**	**NEEDS IMPROVEMENT**	**NOT VISIBLE**
Differentiate the between hazards, exposed elements and their vulnerabilities for a specific situation.	Learner is able to distinguish between hazard, exposure and vulnerability in all situations. Whenever appropriate learner is able to distinguish between physical, social, economic and environmental exposed element and vulnerabilities.	Learner is able to distinguish between hazard, exposure and vulnerability for most situations. Most of the exposed elements and vulnerabilities identified are physical.	Learner is unable to suggest any mitigation, adaptation and preparedness strategies.	Learner is unable to differentiate between hazard, exposure and vulnerability for the specific situation.
Give examples of hazard, exposed elements and their vulnerabilities from historical events within the Philippines.	Learner is able to give examples of hazards, exposed elements and their corresponding vulnerabilities based on Philippine historical events. Exposed elements and vulnerabilities are from varied categories including physical, social, economic and environmental.	Learner is able to give examples of hazards, exposed elements and their corresponding vulnerabilities based on Philippine historical events. Exposed elements and vulnerabilities are generally of the physical types.	Learner is able to give examples of hazards and exposed elements based on Philippine historical events, but is unable to identify the vulnerabilities of the exposed elements.	Learner is unable to give examples of hazard, exposure and vulnerability based on historical events in the Philippines.
Suggests mitigation, adaptation and preparedness strategies for managing disaster risk based on experiences from previous disasters whenever possible.	Learner is able to suggest mitigation, adaptation and preparedness strategies that are appropriate for the hazard they are intended to address. Strategies suggested show originality, innovation and resourcefulness of the learner.	Learner is able to suggest some mitigation, adaptation and preparedness strategies that are appropriate for the hazard they are intended to address.	Learner is able to suggest some mitigation, adaptation and preparedness strategies; however these are inappropriate for the hazard they are intended to address.	Learner is unable to suggest any mitigation, adaptation and preparedness strategies.

Additional Resources:

1. *Mount Pinatubo*. (n.d.). Retrieved DATE from Wikipedia: https://en.wikipedia.org/wiki/Mount_Pinatubo
2. Diggles, M. (ed.). (2005). The Cataclysmic 1991 Eruption of Mount Pinatubo, Philippines, Fact Sheet 113-97. Retrieved from http://pubs.usgs.gov/fs/1997/fs113-97/
3. VolcanoDiscovery. (n.d.). *Chronology of the 1991 Pinatubo eruption, Philippines*. Retrieved from http://www.volcanodiscovery.com/pinatubo/chronology-1991-eruption.html
4. *Typhoon Ketsana*. (n.d.). Retrieved DATE from Wikipedia: https://en.wikipedia.org/wiki/Typhoon_Ketsana
5. *Typhoon Parma*. (n.d.). Retrieved DATE from Wikipedia: https://en.wikipedia.org/wiki/Typhoon_Parma
6. National Disaster Risk Reduction and Management Council. (n.d.). *Final Report on Tropical Storm Ondoy(Ketsana) and Typhoon Pepeng (Parma)*. Retrieved from http://www.ndrrmc.gov.ph/attachments/article/92/Narrative_Report_re_Tropical_Storm_Ondoy_(KETSANA)_and_Typhoon_Pepeng_(PARMA)_2009.pdf
7. *Typhoon Haiyan*. (n.d.). Retrieved DATE from Wikipedia: https://en.wikipedia.org/wiki/Typhoon_Haiyan
8. National Disaster Risk Reduction and Management Council. (n.d.). *Situational Report re Effects of Typhoon YOLANDA (HAIYAN)*. Retrieved from http://www.ndrrmc.gov.ph/index.php/21-disaster-events/1329-situational-report-re-effects-of-typhoon-yolanda-haiyan
9. Paciente, R. B. (2014, March 11). *Response and Lessons Learned from Typhoon "HAIYAN" (YOLANDA)*. Paper presented at JMA/WMO Workshop On Effective Tropical Cyclone Warning in Southeast Asia, Japan. Tokyo, Japan: (n.p.).
10. Country Profile. (n.d.). Retrieved from
11. http://www.emdat.be/country_profile/index.html

60 MINS

Concept, Principles, and Relevance of Disaster Risk Reduction

Content Standard
The learners demonstrate understanding of disaster risk reduction.

Performance Standard
The learners shall be able to:

- develop a community emergency preparedness plan and community disaster preparedness plan to minimize vulnerability and disaster risk in the community and avoid or limit adverse impacts of hazards.

Learning Competencies
The learners are able to:

- discuss the key concepts, principles and elements of DRRR. **(DRR11/12-IIg-h-42)**; and
- recognize the importance of DRRR on one's life. **(DRR11/12-IIg-h-43)**

Specific Learning Outcomes
At the end of the lesson, the learners will be able to:

1. understand the principles of disaster risk reduction and management; and
2. apply these principles in their everyday lives

LESSON OUTLINE

Introduction	Communicating Learning Objectives	10
Instruction	Lecture on Disaster Risk Reduction	40
Evaluation	Quiz	10
Enrichment	Research on Past Disasters	

Suggested Resources

(1) UNISDR Terminology on DRR, http://www.unisdr.org/

(2) Disaster risk reduction and climate change adaptation in the Pacific, http://www.unisdr.org/
Introduction to disaster risk reduction, http://www.preventionweb.net/files/26081_kp1concepdisasterrisk1.pdf

(3) DepEd Disaster Risk Reduction Resource Manual

(4) Corporate social responsibility and disaster reduction: a global overview by Twigg, J. (2001) http://www.dfid.gov.uk/r4d/PDF/Outputs/Mis_SPC/R7893CSROverview.pdf

INTRODUCTION (10 MINS)

Communicating Learning Objectives

Introduce the following learning objectives using any of the suggested protocols.

1. I can identify the elements of disaster risks
2. I can enumerate and apply the key principles of disaster risk reduction in my daily life

Pre-test

1. Ask learners to enumerate/briefly define the types of hydrometeorological hazards discussed in class:
    I. Prevention
    II. Mitigation
    III. Adaptation
    IV. Preparedness
    V. Response
    VI. Recovery

2. Ask the class to discuss
    I. What is disaster risk?
    II. How can we reduce disaster risk?
    III. How can a community benefit from a disaster risk reduction plan?

INSTRUCTION (40 MINUTES)

Lecture

Disaster risk reduction (DRR) is a term used for reducing and preventing disaster risks. It is founded on the principle that while hazards are inevitable, its adverse effects like lost lives and/or destruction of property are not. There are steps that we can do to ensure reduction of risks. DRR actions can be political, technical, social and economic.

Before we proceed to the principles to DRR, it is essential that we first understand what a "***disaster***" actually entails.

Defining the concepts of Disaster Risk

I. Disaster
II. Risk
III. Hazard
IV. Vulnerability
V. Capacity

Disaster - a serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources.

Disasters are often described as a result of the combination of several things: the exposure to a *hazard*; the conditions of *vulnerability* that are present; and insufficient *capacity* or measures to reduce or cope with the potential negative consequences. Disaster impacts may include loss of life, injury, disease and other negative effects on human, physical, mental and social well-being, together with damage to property, destruction of assets, loss of services, social and economic disruption and environmental degradation.

RISK	HAZARD	VULNERABILITY	CAPACITY
The word "risk" has two connotations: in general usage the emphasis is usually placed on the concept of chance or possibility on an event and its negative consequence, such as in "the risk of an accident"; whereas in technical settings the emphasis is usually placed on the consequences, in terms of "potential losses" for some particular cause, place and period.	Defined as a "dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage".	Defined as the characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard.	Defined as the combination of all the strengths, attributes and resources available within a community, society or organization that can be used to achieve agreed goals.

RISK	HAZARD	VULNERABILITY	CAPACITY
The term disaster risk therefore refers to the potential (not actual) disaster losses, in lives, health status, livelihoods, assets and services, which could occur in a particular community or society over some specified future time period.	Hazards can be single, sequential or combined in their origin and effects. Each hazard is characterized by its location, intensity, probability and likely frequency. The hazards of concern to disaster risk reduction are hazards that arise from a variety of geological, meteorological, hydrological, oceanic, biological, and technological sources, sometimes acting in combination.	Vulnerability is a set of prevailing or consequential conditions arising from various physical, social, economic and environmental factors which increase the susceptibility of a community to the impact of hazards Vulnerability also comprise various physical, social, economic, political and environmental factors that affect the ability of communities to respond to events.	Capacity may include infrastructure and physical means, institutions, societal coping abilities, as well as human knowledge, skills and collective attributes such as social relationships, leadership and management.

It is important to differentiate hazard from disaster. The phrase "natural disaster" which is widely used often causes confusion and has been the subject of debates.

"Strictly speaking there are no such things as natural disasters, but there are natural hazards. A disaster is the result of a hazard's impact on society. So the effects of a disaster are determined by the extent of a community's vulnerability to the hazard (conversely, its ability, or capacity to cope with it). This vulnerability is not natural, but the result of an entire range of constantly changing physical, social, economic, cultural, political and even psychological factors that shape people's lives and create the environments in which they live." Twigg (2001).

Interaction between Risk, Hazard, Vulnerability and Capacity

Hazards do not necessarily constitute disaster. Disasters are usually described in terms of the effects which a hazard has on lives, property, environment and the cost of recovery or rehabilitation.

$$\text{Risk (R)} = \frac{Hazard\ (H) \times Vulnerability(V)}{Capacity\ (C)}$$

Disaster Risk or ***Risk*** can be mathematically described as the product of the combination of three elements that were discussed: hazard, vulnerability and capacity, and it given by the formula.

Hazards will always be present, therefore, disaster reduction strategies primarily include vulnerability and risk assessment. The following are some factors that can affect the vulnerability of a community:

1. Political factors
    I. A community's vulnerability can be linked to political will and commitment to developmental concerns
    II. Lack of access to resources, infrastructure, basic services and information can increase vulnerability
2. Economic factors
    I. Poverty has the single most important influence to vulnerability
    II. Economic status also relates to the capacity of a community to cope and recover from adverse effects
    III. Poverty eradication and creation of sustainable livelihoods are essential part of disaster risk reduction
3. Physical factors
    I. Access to suitable land, proper housing design, building materials and accessibility of emergency services
    II. Poor physical environment exposes people to hazards such as landslides, floods, fires, wind, disease and epidemics.
4. Social factors
    I. Level of education, training, safety and security, information and awareness, cultural beliefs, traditional values contribute to social well-being
    II. Lack of awareness and access to information can result in increase of vulnerability
5. Environmental factors
    I. Scarcity of resources in a community can reduce the coping solutions and recovery from a disaster

Disaster Risk Reduction

Disaster Risk Reduction (DRR) is the concept and practice of reducing disaster risks through analysis and management of the causal factors of disasters. It leads to reduced exposure to hazards, lessening of vulnerability of people and assets, effective management of land and the environment and improved preparedness for adverse events.

Disaster risk reduction usually requires long-term planning across sectors and must be integrated into general national and regional development strategies. DRR strategies usually begin with plans for assessing (a) the hazards and risks that threaten the target area, (b) the

extent of harm that would occur to communities and infrastructure, and (c) the vulnerable people's capacities to cope with and recover from possible disasters.

Figure 1: Shows the key components of DRRR and Management

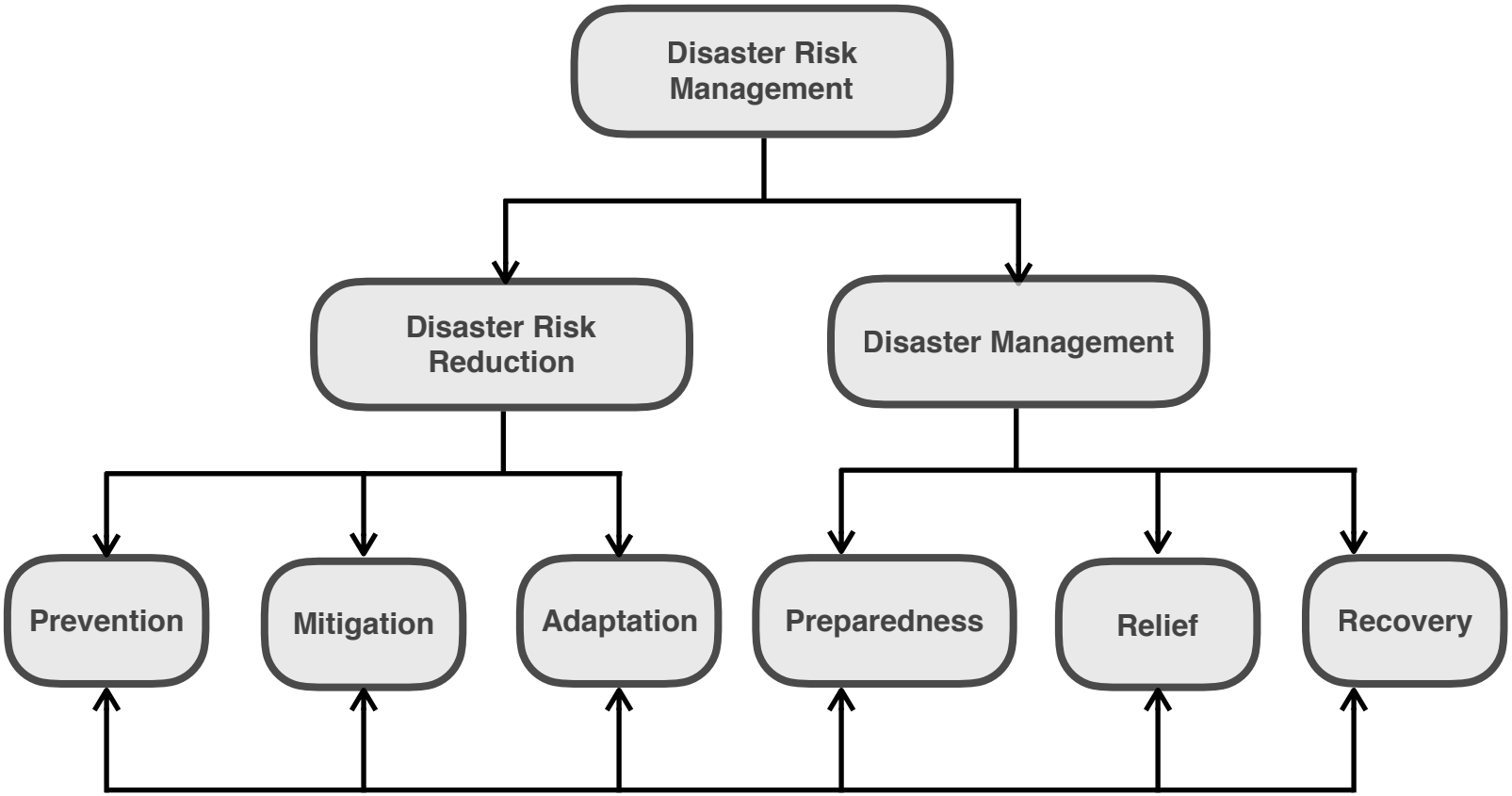


FIGURE 1: DISASTER RISK REDUCTION AND MANAGEMENT AND ITS COMPONENTS

PRE-EVENT	
Prevention	The outright avoidance of adverse impacts of hazards and related disasters. Prevention expresses the concept and intention to completely avoid potential adverse impacts through action taken in advance. Can be in the form of proper land use or using suitable engineering design. (However, oftentimes complete avoidance of losses is not feasible and the task transforms to that of mitigation)
Mitigation	The lessening or limitation of the adverse impacts of hazards and related disasters. While the adverse impacts of hazards often cannot be prevented fully, their scale or severity can be substantially lessened by various strategies and actions. Mitigation measures involve a wide range of elements from engineering techniques to environmental policies and even public awareness.
Adaptation	The adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. This definition addresses the concerns of climate change and is sourced from the secretariat of the United Nations Framework Convention on Climate Change (UNFCCC).
Preparedness	The knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current hazard events or conditions. Preparedness action is carried out within the context of disaster risk management and aims to build the capacities needed to efficiently manage all types of emergencies and achieve orderly transitions from response through to sustained recovery.

POST EVENT	
Response	The provision of emergency services and public assistance during or immediately after a disaster in order to save lives, reduce health impacts, ensure public safety and meet the basic subsistence needs of the people affected. Disaster response is predominantly focused on immediate and short-term needs and is sometimes called “disaster relief”.
Recovery	The restoration, and improvement where appropriate, of facilities, livelihoods and living conditions of disaster-affected communities, including efforts to reduce disaster risk factors. The recovery task of rehabilitation and reconstruction begins soon after the emergency phase has ended, and should be based on pre-existing strategies and policies that facilitate clear institutional responsibilities for recovery action and enable public participation.

The concept of disaster has changed over time. In early human civilization, many cultures viewed disasters as a sign of bad luck or an act of God. However, the development of science started changing this perception of disasters. Some of the factors that contributed to this change are:

1. Social science
    I. Treat hazards as external agents that communities can identify and react to
    II. See disasters as expression of social vulnerability
2. Natural science
    I. Emphasis on the hazard component – hydrometeorological, geodynamic and/or technological
    II. Understanding the dynamics of hazards
    III. Quantifying the impacts of hazards
3. Recent studies on disaster risk
    I. Understanding of disaster in both social and natural science perspective

The key components of DRR and how it is applied to different communities is not complete. It, however, provide us with very good starting point for DRR.

EVALUATION (10 MINS)

1. Natural phenomena like typhoons or earthquake are considered as
    A. Risks
    B. Emergency
    C. Hazard
    D. Vulnerability

2. Among the components of DRR, where does the concept of "*building back better*" belong?
    A. Preparedness
    B. Mitigation

C. Response
D. Recovery

3. For the same number of people exposed to tropical cyclones, mortality risk in low-income countries is approximately
   A. The same as in high-income countries
   B. Lower than risks in high-income countries
   C. Higher than high-income countries
   D. Dependent on the population of children

4. Appropriate environmental management can reduce the risk of disasters occurring by
   A. Improving coastal management and flood risk reduction
   B. Reducing risk of drought, sand storm and hazardous fires
   C. Regulating flood waters
   D. All of the above

5. The ability to face and manage adverse conditions using available resources and skills is
   A. Responsiveness
   B. Capacity
   C. Risk Management
   D. Awareness

ENRICHMENT

1. Ask the learners to research on past disasters that happened in the Philippines
2. By applying any of the key principles/components of DRR, discuss how we can reduce future occurrence of similar events.
3. Ask learners to write an essay/reflection paper as an assignment.

60 MINS

Community-based Disaster Risk Reduction and Management

Content Standard
The learners demonstrate understanding of disaster risk reduction.

Performance Standard
The learners shall be able to:

- develop a community emergency preparedness plan and community disaster preparedness plan to minimize vulnerability and disaster risk in the community and avoid or limit adverse impacts of hazards.

Learning Competency
The learners are able to:

- discuss different community-based practices for managing disaster risk to specific hazards **(DRR11/12-IIg-h-44)**

Specific Learning Outcome
At the end of the lesson, the learners will be able to:

1. know different practices for disaster management

LESSON OUTLINE

Introduction	Communicating Learning Objectives	10
Instruction	Good Practices for DRR	40
Enrichment	Research on Past Disasters	10

Suggested Resources

(1) International Strategy for Disaster Reduction. (2007). *Towards a Culture of Prevention: Disaster Risk Reduction Begins at School*. Retrieved from http://www.unisdr.org/files/761_education-good-practices.pdf

(2) United Nations Office for Disaster Risk Reduction. (n.d.). *Terminlogy - unisdr*. Retrieved from https://www.unisdr.org/we/inform/terminology

INTRODUCTION (10 MINS)

Communicating Learning Objectives

Introduce the following learning objectives using any of the suggested protocols.

1. I can learn about the good / best practices in disaster risk reduction management

Pre-test

1. What are the best practices in disaster risk reduction management in your community?

INSTRUCTION (40 MINUTES)

Good Practices for DRR

In this lecture, Four (4) initiatives done in different parts of the world are presented. These are considered *good practices,* they provide an indication of the successes achieved so far and an idea of what could be achieved in the future

By the end of this module, the learners will be asked to identify the key points why the following are considered best practices, and will be asked to come up with their own plan to develop a community based practice for managing a particular hazard.

Two projects are about raising awareness, namely:

1. School Children as Disaster Risk Reduction Catalysts and Initiators (Thailand)
2. Teaching Guide and Quiz Competitions Help Enhance Preparedness (Grenada)

And another two in promoting prevention

1. Children Assess their Own Vulnerabilities, Plan Risk Reduction (Philippines)
2. Annual "Earthquake and Safety" Drills in all Schools across the Country

SCHOOL CHILDREN AS DISASTER RISK REDUCTION CATALYSTS AND INITIATORS (THAILAND)

Only after the December 2004 Asian Tsunami disaster that disaster risk reduction has been a focus of interest in Thailand . In 2006, a project called "Child-Led Disaster Risk Reduction (CLDRR) in Thailand Project" was initiated. The basic principle of the project was *"children and youth can play an active role in community affairs that are relevant to them, especially if they are appropriately trained and supported by adults "*

This is done by:

(1) building children's knowledge of disaster risk reduction (DRR) and community risk;

(2) building the capacity of children for DRR actions within their communities through educational campaigns; and (3) sensitizing adults (schools and communities) on the importance of involving children in DRR and other issues relevant to them.

The role of the project is to:

1. Promote the idea of "child-led DRR among tsunami-affected communities" among its local partners by means of material, presentations and visits;

2. Build the CLDRR capacity of local partners' staff and volunteers through training workshops on key DRR concepts, how to develop community risk and resource maps, how to conduct an educational campaign for DRR in a community setting, and other refresher training as needed by local partners; and

3. Provide technical and other support for the Project design and implementation process, including developing a training toolkit/manual on CLDRR, on-the-job training for partners, and regular monitoring visits to Project locations.

IMPACTS	LESSONS LEARNED
• Children and teachers have received information and instruction on how to cope better with disasters. • Teachers have been exposed to new alternative approaches to child-centered learning, new issues on disaster risk reduction and a starting point for including DRR into their school curricula. • Targeted communities have benefited from learning from the children and are making use of the children's outputs such as risk and resource maps and educational campaigns	• Support from adults, especially from teachers, community members and project staff, is a key success factor • Children can and are willing to participate • Children participatory projects must involve both children and adults

TEACHING GUIDE AND QUIZ COMPETITIONS HELP ENHANCE PREPAREDNESS (GRENADA)

Grenada is a Caribbean state that gets affected by tropical cyclones. Poor preparedness and response during Hurricane Ivan in 2004 indicated that the awareness and understanding of risk were insufficient in all sectors of their society. A teaching guide intended for Grade 3 to 5 learners on disaster preparedness was developed under the joint coordination of the Ministry of Education and UNICEF in Grenada. Training sessions were also conducted to train teachers on how to prevent disasters. The teaching guide helped the teachers organize the annual "National Disaster Awareness Week Primary School Quiz" competition and prepare their learners for the event.

IMPACTS	LESSONS LEARNED
• An increase in the participation and level of knowledge of Grade 5 learners in the "National Disaster Awareness Week Primary School Quiz". • As a result of the training, disaster-related discussions began in school, where teachers and school administrators shared their experiences of Hurricane Ivan and stressed the importance of psychological first aid resources. • Subsequently, disaster managers learned to incorporate psychological first aid into their presentations to schools and school groups.	• A single teaching guide can make a difference in increasing awareness and knowledge of disaster reduction among school learners, teachers and the public at large • Organizers had to be sensitive with regard to the competing schools' workload at that time of year, which includes school activities and commitments • School quiz requires a coordinator with excellent organization skills to manage the scope of preparations necessary for a national-level activity. Also, the support from the body which has control over primary schools (i.e. DepEd)

CHILDREN ASSESS THEIR OWN VULNERABILITIES, PLAN RISK REDUCTION (PHILIPPINES)

More than half of the population at risk in the Philippines is children, yet their specific vulnerabilities, needs and capacities have not been addressed, nor has their potential role in disaster risk reduction (DRR) been recognized. To address this, a project called "Child-Oriented Participatory Risk Assessment and Planning" (COPRAP) was implemented. The project promoted disaster planning for children through development of tools that help children identify their own needs, vulnerabilities and capacities. Subsequently, the community adopted DRR measures that benefited both the children and the rest of the community. More importantly, the Project paved the way for local-level initiatives towards an integrated and sustainable approach to development

IMPACTS	LESSONS LEARNED
• The project was sustainable and it paved the way for local level initiatives toward an integrated and sustainable approach to development. • It debunked the notion that disaster management is solely the responsibility of adults	• Children can play specific roles before, during and after a disaster such as preparation of supplies or other basic needs • In addition to food and clothing, children have a primary need for educational material such as books, bags, pencils and notebooks. • Questionnaires and activities help understand the needs of a community before, during and after a disaster.

ANNUAL "EARTHQUAKE AND SAFETY" DRILLS IN ALL SCHOOLS ACROSS THE COUNTRY

Iran has sought to educate children and youngsters on disaster preparedness at all school levels on a national scale, in both urban and rural areas. "Earthquake and Safety" programs have been carried out in the country since 1991 by the Iran-based International Institute of Earthquake Engineering and Seismology (IIEES), and school safety programs have been under way since 1996.

The Initiative, called "Earthquake and Safety Drills in Schools", is part of a series of activities aimed at protecting people, especially children, from the impacts of future earthquakes. The Initiative also involves developing and implementing a comprehensive program that addresses all groups in society.

IMPACTS	LESSONS LEARNED
• The drills have helped expand a seismic safety culture, spread the "drill" experience to non-school areas, and make "Earthquake and Safety" a national activity. • Promotes a culture of safety at all levels of society • Increase children's knowledge, and share this knowledge with their families, friends and community	• Education plays a key role in promoting safety measures against earthquakes and spreading them in the society. • A major challenge initially was to secure the cooperation of many institutions and organizations such as mass media . This was overcome through persistent advocacy and continuous follow-up to secure cooperation of many institutions.

ENRICHMENT (10 MINS)

1. Ask the learners to research on other best-practices in Disaster Risk Reduction management
2. Ask the learners to choose a particular hazard, what practices can they institute in your own school or community similar to those described above.

60 MINS

Community Preparedness Plan

Content Standard
The learners demonstrate understanding of disaster risk reduction.

Performance Standard
The learners shall be able to:

- develop a community emergency preparedness plan and community disaster preparedness plan to minimize vulnerability and disaster risk in the community and avoid or limit adverse impacts of hazards.

Learning Competency
The learners are able to:

- develop a community preparedness plan **(DRR11/12-IIg-h-45)**

Specific Learning Outcome:
At the end of the lesson, the learners will be able to:

1. know the four themes in disaster risk reduction management framework that will help them in creating their own community preparedness plans

LESSON OUTLINE

Introduction	Communicating Learning Objectives	5
Instruction	Lecture: Themes of Disaster Risk Reduction Management Framework	45
Evaluation	Thematic Areas	10

Suggested Resources

(1) National Disaster Risk Reduction and Management Council. (2011). National Disaster Risk Reduction and Management Plan 2011-2028. Retrieved from http://www.ndrrmc.gov.ph/attachments/article/41/NDRRM_Plan_2011-2028.pdf

(2) United Nations Office for Disaster Risk Reduction. (n.d.). *Terminlogy - unisdr*. Retrieved from https://www.unisdr.org/we/inform/terminology

INTRODUCTION (5 MINS)

Communicating Learning Objectives

Introduce the following learning objectives using any of the suggested protocols.

1. I can identify the elements of a disaster plan.

Pre-test

1. What is a disaster risk reduction plan?

INSTRUCTION (45 MINUTES)

Good Practices for DRR

The National Disaster Risk Reduction and Management Plan aims to provide policies, plans and programs to deal with disasters in the Philippines. It also serves as "the principal guide to disaster risk reduction and management (DRRM) efforts to the country…." The Framework envisions a country of "safer, adaptive and disaster resilient Filipino communities toward sustainable development."

Four (4) themes in disaster risk reduction management framework

1. Disaster prevention and mitigation
2. Disaster preparedness
3. Disaster response
4. Disaster rehabilitation and recovery

Definition of Terms:

Disaster prevention – the outright avoidance of adverse impacts of hazards and related disasters. It expresses the concept and intention to completely avoid potential adverse impacts through action taken in advance such as construction of infrastructure to eliminate certain risks, land use regulation that do not permit any settlement in high-risk zones and seismic engineering designs that ensure the integrity of building in an earthquake.

Disaster mitigation – the lessening or limitation of the adverse impacts of hazards and related disasters. Mitigation measures encompass engineering techniques and hazard-resilient construction as well as improved environmental policies and public awareness.

Disaster preparedness – the knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate respond to, and recover from, the impacts of likely, imminent or current hazard events or conditions

Disaster response - The provision of emergency services and public assistance during or immediately after a disaster in order to save lives, reduce health impacts, ensure public safety and meet the basic subsistence needs of the people affected.

Disaster rehabilitation and recovery - The restoration, and improvement where appropriate, of facilities, livelihoods and living conditions of disaster-affected communities, including efforts to reduce disaster risk factors, in accordance with the principle of "build back better".

Rehabilitation – measures that ensure the ability of affected communities and/or areas to restore their normal level of function by rebuilding livelihood and damaged infrastructure and increasing the communities' organizational capacity.

The concepts of the thematic areas discussed above are not mutually exclusive, their concepts and activities involved overlap, with no clear distinction over time.

(1) They mutually reinforce each other - Activities under each of the areas may affect each other. For instance, appropriate prevention and mitigation can complement the level of preparedness in a community.

(2) They do not, should not and cannot stand alone - Equal attention should be given to all areas.

(3) They have no clear starting or ending points - Activities can be under several priority areas.

Note: Reduce people's vulnerabilities and increase their capacities.

The outcomes of the activities could be focused on a specific area but should be considered as a part of the whole plan. The table below lists the activities involved and illustrates the overlap between the different thematic areas.

EVALUATION				
PREVENTION AND MITIGATION	**PREPAREDNESS**	**RESPONSE**	**REHABILITATION AND RECOVERY**	**PREVENTION AND MITIGATION**
Disaster risk reduction in national and local plans and programs. Hazard and risk mapping.				
	Activities related to ensuring the (a) people are prepared and (b) response will be carried out efficiently and effectively			
		Restoration of life lines and basic infrastructure. Early recovery		
			Long term recovery and prevention and mitigation – "building back better	

To better understand how this applies to disaster planning, the following are the roles and overall goals of some government agencies in the context of the 4 thematic areas.

DISASTER PREVENTION AND MITIGATION	
DEPARTMENT OF SCIENCE AND TECHNOLOGY	**GOAL:** Avoid hazards and mitigate their potential impacts by reducing vulnerabilities and exposure and enhancing capacities of communities • Reduce vulnerabilities and exposure of communities to health hazards • Enhance capacities of communities to reduce their own risks and cope with the impacts of all hazards

DISASTER PREPAREDNESS

DEPARTMENT OF THE INTERIOR AND LOCAL GOVERNMENT	**GOAL:** Establish and strengthen capacities of communities to anticipate, cope and recover from the negative impacts of emergency occurrences and disasters • Increase level of awareness of the community to threats and impacts of all hazards • Equip the community with necessary skills to cope with the negative impacts of a disaster • Increase the capacity of a community • Develop and implement disaster preparedness policies and plans • Strengthen partnership among all key stakeholders

DISASTER RESPONSE

DEPARTMENT OF SOCIAL WELFARE AND DEVELOPMENT	**GOAL:** Provide life preservation and meet the basic subsistence needs of affected population based in acceptable standards during or immediately after a disaster 1. Decrease the number of preventable deaths and injuries 2. Provide basic subsistence needs of affected population 3. Immediately restore basic social services

DISASTER REHABILITATION AND RECOVERY

NATIONAL ECONOMIC AND DEVELOPMENT AUTHORITY	**GOAL:** Restore and improve facilities, livelihood and living conditions and organization capacities of affected communities, and reduce disaster risks in accordance with the "*build back better*" principle 1. Restore people's means of livelihood and continuity of economic activities 2. Restore shelter and other installations 3. Reconstruct infrastructure and other public utilities 4. Assist in the physical and psychological rehabilitation of persons who suffered from the effects of disaster

EVALUATION (10 MINS)

Identify which thematic area a particular activity falls under

1. Risk and hazard maps
2. Strengthen rescue operations
3. Disaster Risk Reduction in school curricula
4. Design and construction of resilient school buildings
5. More efficient insurance system
6. Increase community capacities

ENRICHMENT

1. With the thematic areas in mind, ask the learners to formulate a disaster plan in your community by thinking of at least 2 activities in each area that can be locally done for a common hazard.

Teacher Tips:

Following answer key is just a guide, the activities can cover more than 1 thematic area.

Answer

1. Prevention and mitigation / preparedness
2. Response
3. Preparedness
4. Preparedness / rehabilitation and recovery
5. Mitigation / preparedness / recovery / response
6. Mitigation / preparedness

60 MINS

Survival Kit

Content Standard
The learners demonstrate understanding of disaster risk reduction.

Performance Standard
The learners shall be able to:

- develop a community emergency preparedness plan and community disaster preparedness plan to minimize vulnerability and disaster risk in the community and avoid or limit adverse impacts of hazards.

Learning Competency
The learners are able to:

- prepare survival kits and materials for one's family and for public information and advocacy **(DRR11/12-IIg-h-46)**

Specific Learning Outcome:
At the end of the lesson, the learners will be able to:

1. prepare their own disaster kit

LESSON OUTLINE

Introduction	Communicating Learning Objectives	10
Instruction	Lecture: Themes of Disaster Risk Reduction Management Framework	40
Practice	Preparation of Disaster Kits	10

Suggested Resources

(1) Centers for Disease Control and Prevention. (2014). *Emergency supplies for earthquake preparedness.* Retrieved from http://emergency.cdc.gov/disasters/earthquakes/supplies.asp

(2) Department of Homeland Security. (n.d.). *Basic disaster supplies kit*. Retrieved from http://www.ready.gov/kit

(3) Philippine Red Cross. (n.d.). *Red cross lifeline kit: Be ready all the time!* Retrieved from http://www.redcross.org.ph/get-involved/volunteer/item/837-red-cross-lifeline-kit-be-ready-all-the-time

(4) United Nations Office for Disaster Risk Reduction. (n.d.). *United Nations Office for Disaster Risk Reduction*. Retrieved from http://www.unisdr.org/

INTRODUCTION (10 MINS)

Communicating Learning Objectives

Introduce the following learning objectives using any of the suggested protocols.

1. I can prepare essential items needed for a disaster kit

Pre-test

Emergency / disaster supply kit is bag that contains supplies that one would require to survive when evacuating from disaster.

1. For how long should supplies in a disaster kit last?
2. What items are vital to a disaster kit?
3. Would disaster kits depend on the type of hazard?

INSTRUCTION (40 MINUTES)

The first 72 hours after a disaster is critical. Supply of water, food, electricity, communication lines may not be available. In addition, access to public safety services, rescue, clinics or hospitals may not be possible. Hence, individuals should be prepared to be self-reliant and be able to survive for at least 3 days or 72 hours.

Basic emergency / disaster kit items are commonly found in households already like flashlight, battery or crank operated radio. Food, water and blanket. The kit must be organized, easy to find and easy to carry, and should be checked every 6 months to make sure the items are in good condition. The following are the items essential in a disaster kit:

1. Water
2. Food
3. Tools
    A. Personal effects and hygiene kit
    B. Important family documents and money
    C. First aid kit

WATER

- A person can survive without food intake for 5 days as long as there is water intake. Prepare clean water in clean airtight containers for washing, drinking and cooking:
- 4 liters per person per day (1 liter for drinking and 3 liters for sanitation)

FOOD

- Store only non-perishable food such as canned foods (easy-to-open), crackers, dried fruit, dry cereal
- Juice (canned, tetra-pack)
- Food should be sufficient for three days consumption of every family member.
- Disposable plates and utensils.

TOOLS

- Maps with indication of evacuation sites and routes
- Whistle
- Flashlight with extra batteries (or self-powered flashlight)
- List of Emergency numbers to call
- Multi-purpose knife
- Matches or lighter and candles
- AM radio transistor with extra batteries or self-powered
- Blankets
- Sleeping bag

IMPORTANT FAMILY DOCUMENTS AND MONEY

- Keep these in a plastic envelope or any waterproof container
- Money should be in the form of cash and loose change (atm machines may not be working)
- Prepaid cards
- List of important information (security insurance number, driver's license, passport number, bank account details, insurance policy, etc.)
- Important documents: Birth certificates, passport, marriage contract, diploma, insurance certificates, land titles, etc.

PERSONAL EFFECTS AND HYGIENE KIT

- Extra Clothing (Short and long sleeved shirts, pants, jackets, socks, etc.)
- Undergarments
- Antibacterial soap
- Toothbrushes
- Toothpaste
- Comb/ hair brush
- Tissue paper

FIRST AID KIT

- Disposable Gloves
- Adhesive Strips
- Sterile medical tap
- Thermometer
- Adhesive Bandage
- First aid manual
- Pain reliever and antibiotics
- Anti-diarrhea medication
- Prescription medication (if needed)

THINGS THAT ARE GOOD TO HAVE

- Scissors
- Hard closed shoe (you may need to walk through debris)
- Toys, books, puzzle, other activities for children

AVOID

- Salty or sugary food as this will make you thirsty
- Food cans opened for more than 2 hours
- Milk and fruit juice as they easily spoil
- Opening your refrigerator constantly (when power is out)

ENRICHMENT (10 MINS)

1. Ask the learners to think of other essential items for a disaster kit
2. Ask the learners to prepare a disaster kit in their household and/or
3. Ask the learners to make a poster conveying the importance of a disaster kit, and present them in their home, school and/or community.

180 MINS

The Philippine Disaster Risk Reduction and Management Law

Content Standard
The learners develop a community emergency preparedness plan and community disaster preparedness plan to minimize vulnerability and disaster risk in the community and avoid or limit adverse impacts of hazards.

Performance Standard
The learners shall be able to:

- able to develop a community disaster preparedness plan to minimize vulnerability and disaster risk in the community and avoid or limit adverse impacts of hazards.

Learning Competencies
The learners are able to:

- explain DRR-related laws and policies. **(DRR11/12-IIi-j-47);**
- avail of existing DRR-related services, programs, and projects. **(DRR11/12-IIi-j-48);** and
- abide by public policies on DRRM. **(DRR11/12-IIi-j-49)**

Specific Learning Outcomes:
At the end of the lesson, the learners will be able to:

1. understand and explain Republic Act 10121: Philippine Disaster Risk Reduction Management Act of 2010 and its Implementing Rules and Regulations;
2. avail of existing DRR-related services programs and projects;
3. have access on information resources from the government in terms of projects and programs of DRRM; and
4. abide by public policies on DRRM

LESSON OUTLINE

Introduction	Review	5
Motivation	Role Playing	40
Instruction	Discussion of RA 10121 and its IRR	60
Evaluation	Situational Reports	40
Evaluation	Quiz	35
Enrichment	Group Work	

Materials:
Cartolina or Manila paper, permanent markers

Suggested Resources

(1) National Disaster Risk Reduction and Management Council website. http://www.ndrrmc.gov.ph
(2) Philippine National Disaster Response Pillar. http://www.reponseops.ph
(3) Policy and Procedures Writing Guide. Boise State University. http://policy.boisestate.edu/policy-writing-guide/
(4) Republic Act No. 10121. Official Gazette . http://www.gov.ph/2010/05/27/republic-act-no-10121/
(5) Republic Act No. 10121 Implementing Rules and Regulations. http://www.ndrrmc.gov.ph/attachments/article/95/Implementing_Rules_and_Regulartion_RA_10121.pdf

Additional Resources at the End of this Lesson

INTRODUCTION (10 MINS)

Review

1. Ask the learners what they remember about Disaster Risk Reduction (DRR) and Disaster Risk Reduction Management (DRRM).
2. Reiterate the community emergency preparedness plan and community disaster preparedness plan that they have developed.

Teacher Tip:
You may opt to make a conceptual map of disaster risk reduction for the learners to supply associated terms and let them explain.

Communicating Learning Objectives

1. Introduce learner objectives:
   I. I will understand the Philippine Disaster Risk Reduction Law of 2010 (RA 10121).
   II. I will learn about the implementing rules and regulations of RA 10121.
   III. I will be able to avail of existing DRR-related services programs and projects.
   IV. I will have access to the information and resources from the government in terms of projects and programs with regards to DRR.
   V. I will be able to abide by public policies on DRRM.

MOTIVATION (40 MINUTES)

Role Playing

1. Tell the learners that they would be part of the LGU and stakeholders and would make their own laws/rules/policies when a disaster strikes.
2. Divide the class into five groups. Each group will be given a scenario and a set of roles that they will play.
3. Hypothetically, all of the groups are living in the same area but will be dealing with different hazards and possible disasters.
4. The learners are tasked to make policies regarding their specific scenario. Using the disaster preparedness plan that they have come up with, they need to make concrete procedures or steps of how to deal with the possible disasters that they are assigned to. They also need to take note of the do's and don'ts before, during, and after a disaster.
5. Learners will be given time to read their roles and discuss the policies that they want to implement in regards to the possible disasters. Ideally, 15 minutes is given.

Teacher Tip:
Policy definition: (Merriam-Webster dictionary)

- A definite course or method of action selected from among alternatives and in light of given conditions to guide and determine present and future decisions.
- A high-level overall plan embracing the general goals and acceptable procedures especially of a government body.

6. They will be given cartolinas/manila papers and permanent markers to write their policies.
7. After which, groups will be given a maximum of 5 minutes each to report their policies.
8. The class will then compare the policies for the different hazards.
9. Similarities and differences will be pointed out for each of the policies.
10. Impose the following question to the learners: Which policy should be used if there are multiple disasters that occur, e.g. a storm is passing through as a volcano erupts (in the case of the 1991 Pinatubo eruption), fire has occurred due to an earthquake, etc.?

INSTRUCTION (30 MINS)

Discussion of RA 10121

1. There should only be one policy which governs all disaster risk reduction management in the Philippines.
2. The teacher will discuss RA 10121 or the Philippine Disaster Risk Reduction Management (DRRM) Act of 2010.
3. Learners will be tasked to take note the similarities and differences with their drafted policy.

Important details of the law:

1. RA 10121: An Act Strengthening the Philippine Disaster Risk Reduction and Management System, providing for the National Disaster Risk Reduction and Management Framework and institutionalizing the National Disaster Risk Reduction and Management Plan, appropriating funds therefor and for other purposes.
2. Title: Philippine Disaster Risk Reduction and Management Act of 2010
3. Road Map of RA 10121: 21 years in the making, 7 congress, 4 administrations
4. Framework of National Disaster Risk Reduction Management
   I. Serves as conceptual guide to all local and national efforts concerning DRRM
   II. Shifts country's paradigm and approach from reactive disaster management to proactive disaster risk reduction.
   III. Goal: Safer, adaptive and disaster-resilient Filipino communities towards sustainable development.

Teacher Tip:

There are six (6) roles that learners may be put into. If the group consists of more than 6 learners, you may opt to repeat certain roles- ordinary residents, farmers, etc. You may also add roles that you think are appropriate in your area, e.g. cattle raisers, religious leaders, etc.

The roles represent the different sectors in a community:

A. Politicians - government
B. Businesspeople – business sector
C. Stay-at-home residents – ordinary resident
D. Social worker
E. Farmer – agricultural sector
F. Doctor/nurse – health sector

The format of how to write a policy is also included at the Role Playing kit.

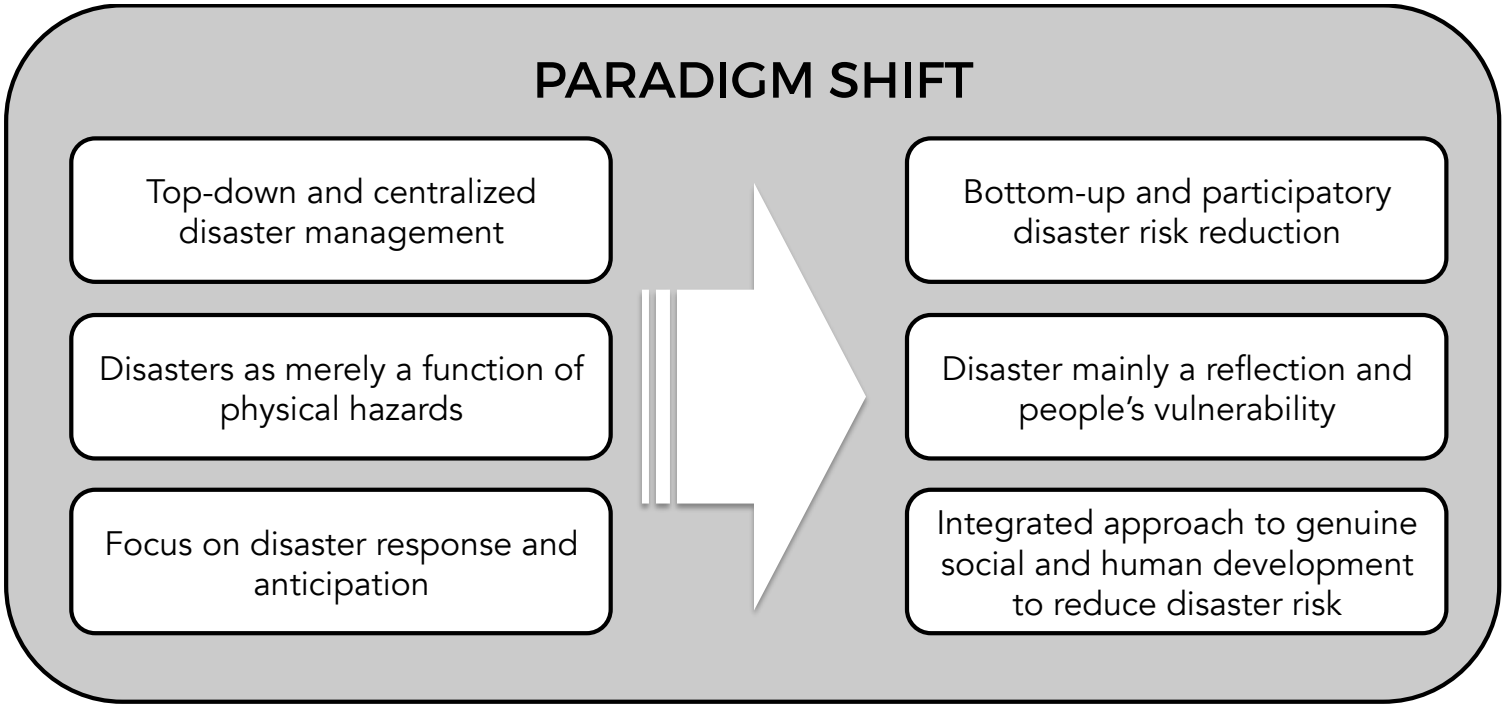


Image from Primer on the Disaster Risk Reduction and Management (DRRM) Act of 2010 by DRRNetPhils.

SUMMARY OF THE LAW

I. Declaration of Policy and Definition of Terms (Sections 2 and 3)
II. Declaration of Scope (Section 4)
III. Creation of Institutions:
  A. National Disaster Risk Reduction and Management Council (Sections 5, 6, 7)
  B. Office of the Civil Defense (Sections 8, 9)
  C. Regional and local DRRM Organization (Sections 10, 11, 12)
  D. Mechanism for Disaster Volunteers (Section 13)
IV. Education and Training in DRR (Section 14)
IV. Operational procedures
  A. Coordination during emergencies (Section 15)
  B. Declaration of state of calamity (Section 16)
  C. Remedial measures (Section 17)
  D. Humanitarian assistance (Section 18)
V. Prohibited acts and Penal Clause (Sections 19, 20)
VI. Funding schemes (Sections 21, 22, 23)
VII. Annual report, IRR, Oversight committee, Sunset review (Sections 24, 25, 26, 27)
VIII. Repealing Clause, Separability Clause, Effectivity Clause (Sections 28, 29,30)

POLICIES OF THE LAW (SECTION 2)

A. Uphold the people's constitutional rights to life and property by addressing the root causes of vulnerabilities to disasters, strengthening the country's institutional capacity for disaster risk reduction and management and building the resilience of local communities to disasters including climate change impacts.

B. Adhere to and adopt the universal norms, principles and standards of humanitarian assistance and the global effort on risk reduction as concrete expression of the country's commitment to overcome human sufferings due to recurring disasters

C. Incorporate internationally accepted principles of disaster risk management in the creation and implementation of national, regional, and local sustainable development and poverty reduction strategies, policies, plans and budgets

D. Adopt a disaster risk reduction and management approach that is holistic, comprehensive, integrated, and proactive in lessening the socioeconomic and environmental impacts of disasters including climate change, and promote the involvement and participation of all sectors and all stakeholders concerned, at all levels especially the local community

E. Develop, promote, and implement a comprehensive National Disaster Risk Reduction and Management Plan (NDRRMP) that aims to strengthen the capacity of the national government and the local government units (LGUs), together with partner stakeholders, to build the disaster resilience of communities, and' to institutionalize arrangements and measures for reducing disaster risks, including projected climate risks, and enhancing disaster preparedness and response capabilities at all levels

F. Adopt and implement a coherent, comprehensive, integrated, efficient and responsive disaster risk reduction program incorporated in the development plan at various levels of government adhering to the principles of good governance such as transparency and accountability within the context of poverty alleviation and environmental protection

G. Mainstream disaster risk reduction and climate change in development processes such as policy formulation, socioeconomic development planning, budgeting, and governance, particularly in the areas of environment, agriculture, water, energy, health, education, poverty reduction, land-use and urban planning, and public infrastructure and housing, among others

H. Institutionalize the policies, structures, coordination mechanisms and programs with continuing budget appropriation on disaster risk reduction from national down to local levels towards building a disaster-resilient nation and communities.

I. Mainstream disaster risk reduction into the peace process and conflict resolution approaches in order to minimize loss of lives and damage to property, and ensure that communities in conflict zones can immediately go back to their normal lives during periods of intermittent conflicts

J. Ensure that disaster risk reduction and climate change measures are gender responsive, sensitive to indigenous know ledge systems, and respectful of human rights

POLICIES OF THE LAW (SECTION 2)

K. Recognize the local risk patterns across the country and strengthen the capacity of LGUs for disaster risk reduction and management through decentralized powers, responsibilities, and resources at the regional and local levels

L. Recognize and strengthen the capacities of LGUs and communities in mitigating and preparing for, responding to, and recovering from the impact of disasters

M. Engage the participation of civil society organizations (CSOs), the private sector and volunteers in the government's disaster risk reduction programs towards complementation of resources and effective delivery of services to the Citizenry

N. Develop and strengthen the capacities of vulnerable and marginalized groups to mitigate, prepare for, respond to, and recover from the effects of disasters

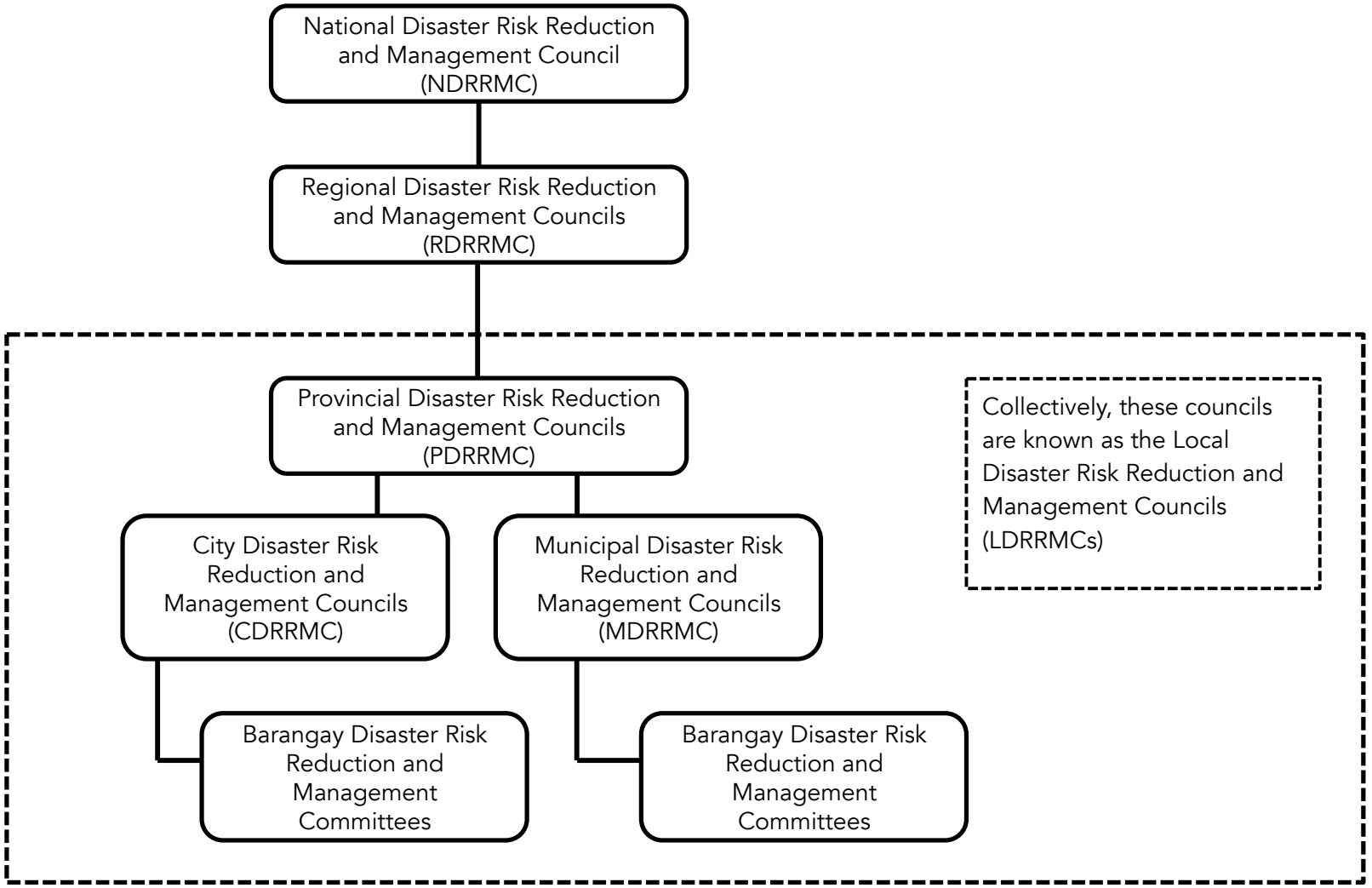
O. Enhance and implement a program where humanitarian aid workers, communities, health professionals, government aid agencies, donors, and the media are educated and trained on how they can actively support breastfeeding before and during a disaster and/or an emergency

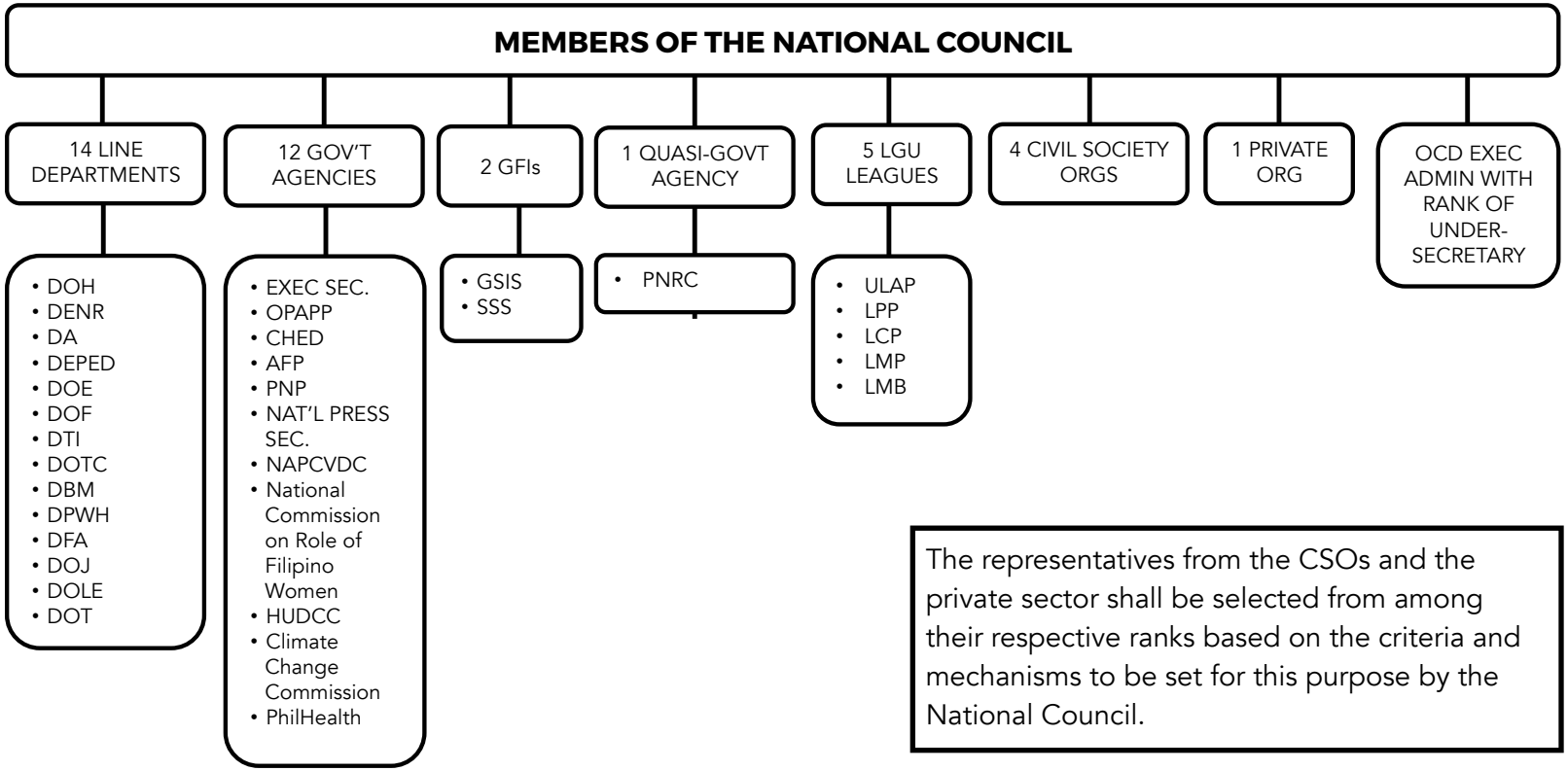
P. Provide maximum care, assistance and services to individuals and families affected by disaster, implement emergency rehabilitation projects to lessen the impact of disaster, and facilitate resumption of normal social and economic activities.

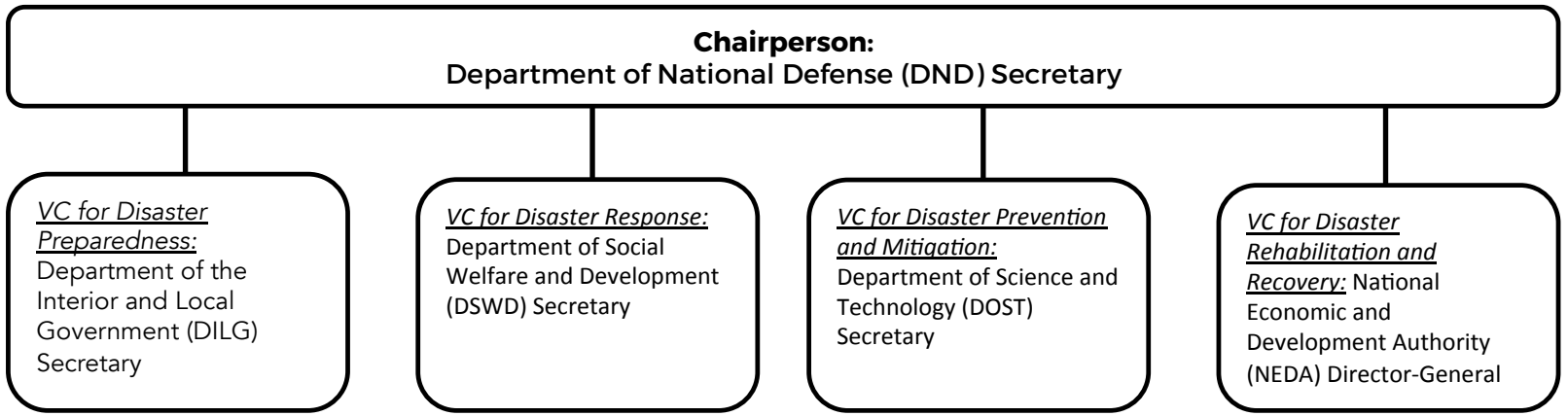
DISCUSSION of RA 10121 IRR (30 mins)

1. Discussion on the structure and functions of the National Disaster Risk Reduction and Management Council NDRRMC.
2. Disaster Risk Reduction and Management Council Organizational Network

Teacher Tip:
You may opt to prepare the discussion ahead of time. In some parts which has many details, you may give examples or ask the learners to give examples based on what they have learned about DRR.


National Disaster Risk Reduction and Management Council (NDRRMC)
Regional Disaster Risk Reduction and Management Councils (RDRRMC)
Provincial Disaster Risk Reduction and Management Councils (PDRRMC)
City Disaster Risk Reduction and Management Councils (CDRRMC)
Municipal Disaster Risk Reduction and Management Councils (MDRRMC)
Barangay Disaster Risk Reduction and Management Committees
Barangay Disaster Risk Reduction and Management Committees
Collectively, these councils are known as the Local Disaster Risk Reduction and Management Councils (LDRRMCs)


MEMBERS OF THE NATIONAL COUNCIL
14 LINE DEPARTMENTS
12 GOV'T AGENCIES
2 GFIs
1 QUASI-GOVT AGENCY
5 LGU LEAGUES
4 CIVIL SOCIETY ORGS
1 PRIVATE ORG
OCD EXEC ADMIN WITH RANK OF UNDER-SECRETARY
• DOH
• DENR
• DA
• DEPED
• DOE
• DOF
• DTI
• DOTC
• DBM
• DPWH
• DFA
• DOJ
• DOLE
• DOT
• EXEC SEC.
• OPAPP
• CHED
• AFP
• PNP
• NAT'L PRESS SEC.
• NAPCVDC
• National Commission on Role of Filipino Women
• HUDCC
• Climate Change Commission
• PhilHealth
• GSIS
• SSS
• PNRC
• ULAP
• LPP
• LCP
• LMP
• LMB
The representatives from the CSOs and the private sector shall be selected from among their respective ranks based on the criteria and mechanisms to be set for this purpose by the National Council.


Chairperson:
Department of National Defense (DND) Secretary
VC for Disaster Preparedness: Department of the Interior and Local Government (DILG) Secretary
VC for Disaster Response: Department of Social Welfare and Development (DSWD) Secretary
VC for Disaster Prevention and Mitigation: Department of Science and Technology (DOST) Secretary
VC for Disaster Rehabilitation and Recovery: National Economic and Development Authority (NEDA) Director-General

ABBREVIATIONS

DOH	Department of Health	OPAPP	Office of the Presidential Adviser on the Peace Process
DENR	Department of Environment and Natural Resources	CHED	Commission on Higher Education
DA	Department of Agriculture	AFP	Armed Forces of the Philippines
DEPED	Department of Education	PNP	Philippine National Police
DOE	Department of Energy	NAPCVDC	National Anti Poverty Commission - Victims of Disasters and Calamities
DOF	Department of Finance	HUDCC	Housing and Urban Development Coordinating Council
DTI	Department of Trade and Industry	PhilHealth	Philippine Health Insurance Corporation
DOTC	Department of Transportation and Communications	GSIS	Government Service Insurance System
DBM	Department of Budget and Management	SSS	Social Security System
DPWH	Department of Public Works and Highways	PNRC	Philippine National Red Cross
DFA	Department of Foreign Affairs	ULAP	Union of Local Authorities of the Philippines
DOJ	Department of Justice	LPP	League of Provinces of the Philippines
DOLE	Department of Labor and Employment	LCP	League of Cities of the Philippines
DOT	Department of Tourism	LMP	League of Municipalities of the Philippines
GFIs	Government Financial Institutions	LMB	Liga ng mga Barangay
LGU	Local Government Unit	OCD	Office of Civil Defense
VC	Vice Chair		

FUNCTIONS OF THE NDRRMC

A. Develop a NDRRM Framework (NDRRMF) which shall provide for a comprehensive, all-hazards, multi-sectoral, inter-agency and community-based approach to disaster risk reduction and management. The Framework shall serve as the principal guide to disaster risk reduction and management efforts in the country and shall be reviewed on a five (5)-year interval, or as may be deemed necessary, in order to ensure its relevance to the times.

B. Ensure that the NDRRM Plan (NDRRMP) is consistent with the NDRRMF.

C. Advise the President on the status of disaster preparedness, prevention, mitigation, response and rehabilitation operations being undertaken by the government, CSOs, private sector, and volunteers; recommend to the President the declaration of a state of calamity in areas extensively damaged; and submit proposals to restore normalcy in the affected areas, to include calamity fund allocation.

D. Ensure a multi-stakeholder participation in the development, updating, and sharing of a Disaster Risk Reduction and Management Information System and Geographic Information System-based national risk map as policy, planning and decision-making tools.

E. Establish a national early warning and emergency alert system to provide accurate and timely advice to national or local emergency response organizations and to the general public through diverse mass media to include digital and analog broadcast, cable, satellite television and radio, wireless communications, and landline communications.

F. Develop appropriate risk transfer mechanisms that shall guarantee social and economic protection and increase resiliency in the face of disaster.

G. Monitor the development and enforcement by agencies and organizations of the various laws, guidelines, codes or technical standards required by this Act.

H. Manage and mobilize resources for disaster risk reduction and management including the National Disaster Risk Reduction and Management Fund.

I. Monitor and provide the necessary guidelines and procedures. on the Local Disaster Risk Reduction and Management Fund (LDRRMF) releases as well as utilization, accounting and auditing thereof.

J. Develop assessment tools on the existing and potential hazards and risks brought about by climate change to vulnerable areas and ecosystems in coordination with the Climate Change Commission.

K. Develop vertical and horizontal coordination mechanisms for a more coherent implementation of disaster risk reduction and management policies and programs by sectoral agencies and LGUs.

L. Formulate a national institutional capability building program for disaster risk reduction and management to address the specific' weaknesses of various government agencies and LGUs, based on the results of a biennial baseline assessment and studies.

M. Formulate, harmonize, and translate into policies a national agenda for research and technology development on disaster risk reduction and management.

N. In coordination with the Climate Change Commission, formulate and implement a framework for climate change adaptation and disaster risk reduction and management from which all policies, programs, and projects shall be based.

FUNCTIONS OF THE NDRRMC

O. Constitute a technical management group composed of representatives of the abovementioned departments, offices, and organizations, that shall coordinate and meet as often as necessary to effectively manage and sustain national efforts on disaster risk reduction and management.

P. Task the OCD to conduct periodic assessment and performance monitoring of the member-agencies of the NDRRMC, and the Regional Disaster Risk Reduction and Management Councils (RDRRMCs), as defined in the NDRRMP.

Q. Coordinate or oversee the Implementation of the country's obligations with disaster management treaties to which it IS a party and see to It that the country's disaster management treaty obligations be incorporated in its disaster risk reduction and management frameworks, policies, plans, programs and projects.

FUNCTIONS OF THE RDRRMC

A. Coordinate, integrate, supervise, and evaluate the activities of the local disaster risk reduction and management councils

B. Responsible in ensuring disaster sensitive regional development plans, and in case of emergencies shall convene the different regional line agencies and concerned institutions and authorities.

C. Establish an operating facility to be known as the Regional Disaster Risk Reduction and Management Operations Center (RDRRMC) whenever necessary

FUNCTIONS OF THE LDRRMCS

A. Approve, monitor and evaluate the implementation of the LDRRMPs and regularly review and test the plan consistent with other national and local planning programs.

B. Ensure the integration of disaster risk reduction and climate change adaptation into local development plans, programs and budgets as a strategy in sustainable development and poverty reduction.

C. Recommend the implementation of forced or preemptive evacuation of local residents, if necessary.

D. Convene the local council once every three (3) months or as necessary.

DISASTER VOLUNTEERS

A. Mobilization of volunteers may be undertaken by government agencies, civil service organizations, private sector, and local government units.

B. Enhancement, welfare, and protection of the volunteers will be the responsibility of the agencies, civil service organizations, private sector, or local government unit which assembled them.

C. Accreditation and inclusion in the database of community disaster volunteers are done at municipal or city level.

D. Volunteers will follow guidelines set by the NDRRMC.

E. Volunteers are entitled to compensatory benefits and insurance under the guidelines.

EDUCATION AND TRAINING

A. DRR education is integrated into the school curricula of secondary and tertiary level of education including formal and nonformal, technical-vocational, indigenous learning, and out-of-school youth courses and programs.

EDUCATION AND TRAINING

B. SK councils together with the DRRMCs shall encourage the youth to participate in DRRM activities, e.g. quick response groups. DRRM shall be part of SK programs and projects.

C. Mandatory training of public sector employees in emergency response and preparedness shall be undertaken.

COORDINATION DURING EMERGENCIES

A. LDRRMCs shall take the lead in preparing for, responding to, and recovering from the effects of any disaster

B. BDC, if barangay is affected

C. City/municipal DRRMC, if two or more barangays are affected

D. Provincial DRRMC, if two or more cities/municipalities are affected

E. Regional DRRMC, if two or more provinces are affected

F. NDRRMC, if two or more regions are affected

G. NDRRMC and LDRRMCs support LGUs which have primary responsibility as first disaster responders.

STATE OF CALAMITY

A. National Council shall recommend to the President of the Philippines the declaration and lifting of state of calamity in an area.

B. Scope of state of calamity can be a cluster of barangays, municipalities, cities, provinces, and regions.

C. International humanitarian assistance may be necessary.

D. Local sanggunian may also declare and lift the state of calamity upon the recommendation of the LDRRMC.

REMEDIAL MEASURES (MANDATORY IMMEDIATE UNDERTAKING OF THE MEASURES WHEN STATE OF CALAMITY IS DECLARED)

A. Imposition of price ceiling on basic necessities and prime commodities by the President upon the recommendation of the implementing agency.

B. Monitoring, prevention and control by the Local Price Coordination Council of overpricing/profiteering and hoarding of prime commodities, medicines and petroleum products.

C. Programming/reprogramming of funds for the repair and safety upgrading of public infrastructures and facilities.

D. Granting of no-interest loans by government financing or lending institutions to the most affected section of the population through their cooperatives or people's organizations.

INTERNATIONAL HUMANITARIAN ASSISTANCE

A. Importation and donation of food, clothing, medicine and equipment for relief and recovery and other disaster management and recovery-related supplies

B. Importations and donations shall be considered as importation and/or donation to the NDRRMC, subject to the approval of the Office of the President.

PROHIBITED ACTS

A. Dereliction of duties which leads to destruction, loss of lives, critical damage of facilities and misuse of funds.

B. Preventing the entry and distribution of relief goods in disaster-stricken areas, including appropriate technology, tools, equipment, accessories, disaster teams/experts.

C. Buying, for consumption or resale, from disaster relief agencies any relief goods, equipment or other and commodities which are intended for distribution to disaster affected communities.

PROHIBITED ACTS

D. Buying, for consumption or resale, from the recipient disaster affected persons any relief goods, equipment or other aid commodities received by them.

E. Selling of relief goods, equipment or other aid commodities which are intended for distribution to disaster victims.

F. Forcibly seizing relief goods, equipment or other aid commodities intended for or consigned to a specific group of victims or relief agency.

G. Diverting or misdelivery of relief goods, equipment or other aid commodities to persons other than the rightful recipient or consignee.

H. Accepting, possessing, using or disposing relief goods, equipment or other aid commodities not intended for nor consigned to him/her.

I. Misrepresenting the source of relief goods, equipment or other aid commodities by:

   (1) Either covering, replacing or defacing the labels of the containers to make it appear that the goods, equipment or other aid commodities came from another agency or persons.

   (2) Repacking the! goods, equipment or other aid commodities into containers with different markings to make it appear that the goods came from another agency or persons or was released upon the instance of a particular agency or persons.

   (3) Making false verbal claim that the goods, equipment or other and commodity m its untampered original containers actually came from another agency or persons or was released upon the instance of a particular agency or persons.

J. Substituting or replacing relief goods, equipment or other aid commodities with the same items or inferior/cheaper quality.

K. Illegal solicitations by persons or organizations representing others as defined in the standards and guidelines set by the NDRRMC.

L. Deliberate use of false at inflated data in support of the request for funding, relief goods, equipment or other aid commodities for emergency assistance or livelihood projects.

M. Tampering with or stealing hazard monitoring and disaster preparedness equipment and paraphernalia.

FUNDING

A. LDRRM Fund

   (1) Not less than 5% of estimated revenue from regular sources shall be set aside to support disaster risk management activities such as, but not limited to, pre-disaster preparedness programs (training, purchasing life-saving rescue equipment, supplies and medicines) and post-disaster activities (e.g. payment of premiums on calamity insurance)

   (2) LDRRMC shall monitor and evaluate the use and disbursement of the LDRRMF.

   (3) LDRRMC may transfer the said fund to support disaster risk reduction work of other LDRRMCs which are declared under state of calamity upon the recommendation of the LDRRMO and approval of sanggunian concerned.

   (4) Thirty percent (30%) shall be allocated as Quick Response Fund (QRF) or stand-by fund for relief and recovery programs in order that situation and living conditions of people in communities or areas stricken by disasters, calamities, epidemics, or complex emergencies, may be normalized as quickly as possible.

FUNDING

B. NDRRM Fund

(1) NDRRM Fund shall be used for disaster risk reduction or mitigation, prevention and preparedness activities such as but not limited to training of personnel, procurement of equipment, and capital expenditures. It can also be utilized for relief, recovery, reconstruction and other work or services in connection with natural or human induced calamities which may occur during the budget year or those that occurred in the past two (2) years from the budget year.

(2) The specific amount of the NDRRM Fund and the appropriate recipient agencies and/or LGUs shall be determined upon approval of the President of the Philippines in accordance with the favorable recommendation of the NDRRMC.

(3) Of the amount appropriated for the NDRRM Fund, thirty percent (30%) shall be allocated as Quick Response Fund (QRF) or stand-by fund for relief and recovery programs in order that situation and living conditions of people in communities or areas stricken by disasters, calamities, epidemics, or complex emergencies, may be normalized as quickly as possible.

(4) All departments/agencies and LGUs that are allocated with DRRM fund shall submit to the NDRRMC their monthly statements on the utilization of DRRM funds and make an accounting thereof in accordance with existing accounting and auditing rules.

(5) All departments, bureaus, offices and agencies of the government are hereby authorized to use a portion of their appropriations to implement projects designed to address DRRM activities in accordance with the guidelines to be issued by the NDRRMC in coordination with the DBM.

C. Funding of the OCD

(1) OCD shall be allocated a budget of one billion pesos (Php 1,000,000,000.00) revolving fund.

ASSESSMENT (40 MINS)

1. After the discussion of the policies and IRR of RA 10121, learners will be given a situational report on a recent disaster.
2. The situational reports will consist of the situation overview, incidents monitored, casualties, affected population, and damages.
3. They will be given 20 minutes to identify or assess the following:
   A. Which DRRMC should be at the forefront of the situation?
   B. Should a state of calamity be declared? Why or why not?
   C. What concrete steps should be taken by the DRRMC given the situation?
4. The learners will submit a written report consisting of their answers to questions.

Teacher Tip:
Situational reports on disasters could be downloaded from the NDRRMC website: http://www.ndrrmc.gov.ph/index.php/21-disaster-events.

You may want to vary the types of disasters given to learners. They may get disasters related to earthquakes, volcanoes, landslides and sinkholes, hydrometeorological, or fire.

5. Afterwards, the learners will be given a copy of the full report in which they will know what the actual DRRMCs have done.
6. On a separate sheet of paper, the learners will critique if the disaster response of the DRRMCs were adequate and appropriate based on RA 10121.

EVALUATION (35 MINS)

On the projects and programs of the government on DRR

1. Learners will be asked to research about the projects and programs of the government regarding DRR.
2. They will be assigned government institutions that they will research on (basing on the NDRRMC structure).
3. Their task is to find out about recent projects and programs of the government.
4. They will write a report regarding the projects and programs. The report will consist of the following details:
   A. What is the project or program all about?
   B. What institution is/was responsible for the project?
   C. Who was/are affected by the project or who can avail of the project?
   D. What is/was the duration of the project?
   E. How does/did the project address DRRM?
   F. Is/Was the project successful in its goals?
   G. Are there any suggestions or comments that you have about the project?
5. If the projects/programs are currently happening, the learners will be asked to participate in the project, in an aspect to be agreed upon with the designated coordinator in each DRRR agency.

Additional activity:

1. The teacher may opt to use some of the website resources and as a hands-on activity wherein learners will discover/know the current status or monitoring of these agencies concerning DRR.

These are some of the resources for the projects and programs of the government concerning DRR:

1. Earthquake and volcanic hazards – PHIVOLCS website (http://phivolcs.dost.gov.ph)
2. Landslides and other hazards – MGB website (http://mgb.gov.ph)
3. Hydrometeorological hazards – PAGASA website (http://pagaasa.dost.gov.ph), Project NOAH (http://noah.dost.gov.ph) and Philippine Microsatellite Project (Diwata-1)
4. Fire Hazards – BFP website (http://bfp.gov.ph)
5. Quasigovernment organization on DRR: Philippine Red Cross website (http://www.redcross.org.ph)

Teacher Tip:
This is an open-ended activity wherein the learners will conduct research, interview their local disaster risk reduction and management office, and possibly start a collaborative project with their LDRRMC

ENRICHMENT

1. Divide the learners into groups and ask them to research on the most recent disaster in their community.
2. Using the information that they have gathered, they need to determine the following details:
   A. Under which hazard could the disaster be classified?
   B. How many were affected by the disaster? Who were affected by the disaster?
   C. How much damage was caused by the disaster?
   D. What concrete steps should have been taken by the local authorities in response to the disaster as stipulated in RA 10121? Give detailed steps.
3. Afterwards, they will go and interview their LDRRMC regarding the response conducted for the disaster. They will determine if the steps taken by the LDRRMC were in accordance to RA 10121. They will also compare the steps that they have formulated to those of LDRRMC's.
4. From there, the learners will also ask about the services, programs, and projects that their LDRRMCs are conducting.
5. The learners are encouraged or required to be involved in at least a single project conducted by the LDRRMC.

Teacher TIp:
This is an open-ended activity wherein the learners will conduct research, interview their local disaster risk reduction and management office, and possibly start a collaborative project with their LDRRMC

EVALUATION	MEETS EXPECTATIONS	NEEDS IMPROVEMENT	NOT VISIBLE
ASSESSMENT ON POLICIES AND IRR	Learner was able to give concrete steps to be taken by the DRRMCs in accordance with RA 10121.	Learner was only able to give some details involving the disaster but was unable to give concrete steps taken DRRMCs in accordance with RA 10121.	Learner was unable to give details on concrete steps taken DRRMCs in accordance with RA 10121.
ASSESSMENT ON PROJECTS AND PROGRAMS ON DRR	Learner was able to research and fully explain on a project or program concerning DRR.	Learner was able to research on a project or program concerning DRR. However, the learner was unable to explain the project or program properly.	Learner was unable to research any project or program of the government concerning DRR.
ASSESSMENT ON THE LEVEL OF OBEDIENCE ON DRRR POLICIES	Learner was able to show full obedience to DRRR policies	Learner was able to show partial obedience to DRRR policies	Given a particular disaster scenario, learner did not show any indication of obedience to DRRR policies

ROLE PLAYING KIT

Scenario: You live in an area which is prone to disasters. Unfortunately, your area does not have a set of procedures/protocol to follow when a disaster strikes. This lack of policy has resulted into chaos and confusion at the time of the disaster causing a lot of injuries, casualties, and damages. In order to address this problem, a meeting of community stakeholders was called to come up with policies and procedures. Each group will be assigned a specific hazard that they need to focus on. Each member of the group will pick a role that they will embody during the discussions. The learners will have to come up with policies taking into considerations the roles that they play.

HAZARDS	ROLES
1. Earthquake Hazards	1. Politician/local government official
2. Volcano Hazards	2. Businessperson
3. Rainfall-induced landslide and sinkhole	3. Stay-at-home resident
4. Hydrometeorological hazards	4. Police/Firefighter (Social worker)
5. Fire Hazard	5. Doctor/nurse
	6. Farmer

HOW TO WRITE A POLICY: POLICY FORMAT

A. Policy Number
B. Effective and Revised Dates – to be determined by the policy group
C. Policy Title – should capture the content of the policy; does not include the word "policy"
D. Purpose – brief statement of the purpose of the policy which many include a basic explanation for the policy if not apparent on its face.
E. Additional Authority – list of statute, regulation, State Board policy, Executive Order, or other relevant authority governing the policy.
F. Scope – to who or what does the policy apply
G. Responsible Party – list unit, department, college or other pertinent area responsible for administering or enforcing policy.
H. Definitions – uncommon words or words with meanings unique to higher education should be defined and listed in alphabetical order.
   I. Policy Statement – provides a rationale for the policy, including underlying philosophy of the policy and what the policy hopes to accomplish. Section may include a statement of how the policy is related to the institution's core mission and values.
   II. Procedure – includes the steps necessary to comply with the policy, with sufficient detail that end users will readily understand how to comply with the policy mandates. Procedures should be consistent with the policy section. Forms associated with the procedure should be linked in the document.

Sample of the policy:

This sample goes directly to the policy statement and the procedures needed.

(Source: http://www.biztree.com/doc/general-safety-policy-D715)

GENERAL SAFETY POLICY

1. Safety – General Policy

   Providing safe working conditions and maintaining continuity of employment is of continual concern. In this regard, it is important that adequate policies and procedures be developed and adhered to in order to ensure safe, efficient operating conditions, thereby safeguarding employees and facilities.

   The Company will not knowingly permit unsafe conditions to exist, nor will it permit employees to indulge in unsafe acts. Violations of Company rules and regulations will result in disciplinary action.

   The Company believes that the safety of employees and physical property can best be ensured by a meaningful program.

   A. Employee

      Since the employee on the job is frequently more aware of unsafe conditions than anyone else, employees are encouraged to make recommendations, suggestions, and criticisms of unsafe conditions to their immediate supervisor so that they may be corrected.

   B. Supervisors

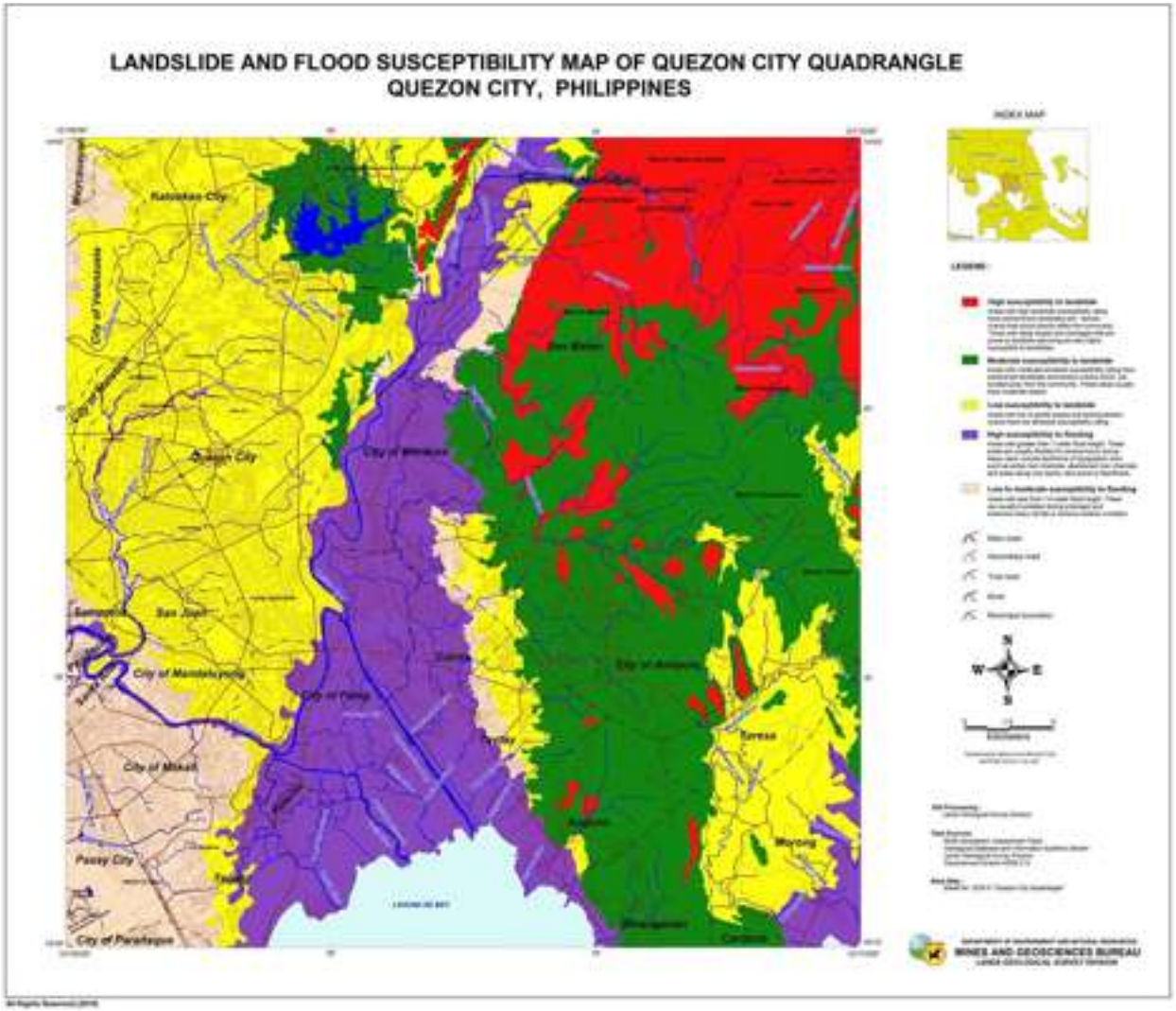
      Supervisors are responsible for the working conditions within the department and the plant generally. A supervisor should remain alert at all times to dangerous and unsafe conditions, so that he/she may recommend corrective action, discipline employees who habitually create or indulge in unsafe practices, assess new or changed situations for inherent dangers, and follow up on employee suggestions for corrective action so that unsafe conditions are not instituted or permitted to exist.

2. Safety Committee Meetings

   Company operates in accordance with guidelines and as such encourages the employee's involvement in company-wide safety committee meetings to be held quarterly. The committee will specify procedures and actions to be taken in the event of fires, security, and other emergencies. Decisions and recommendations will be communicated via the department team meetings.

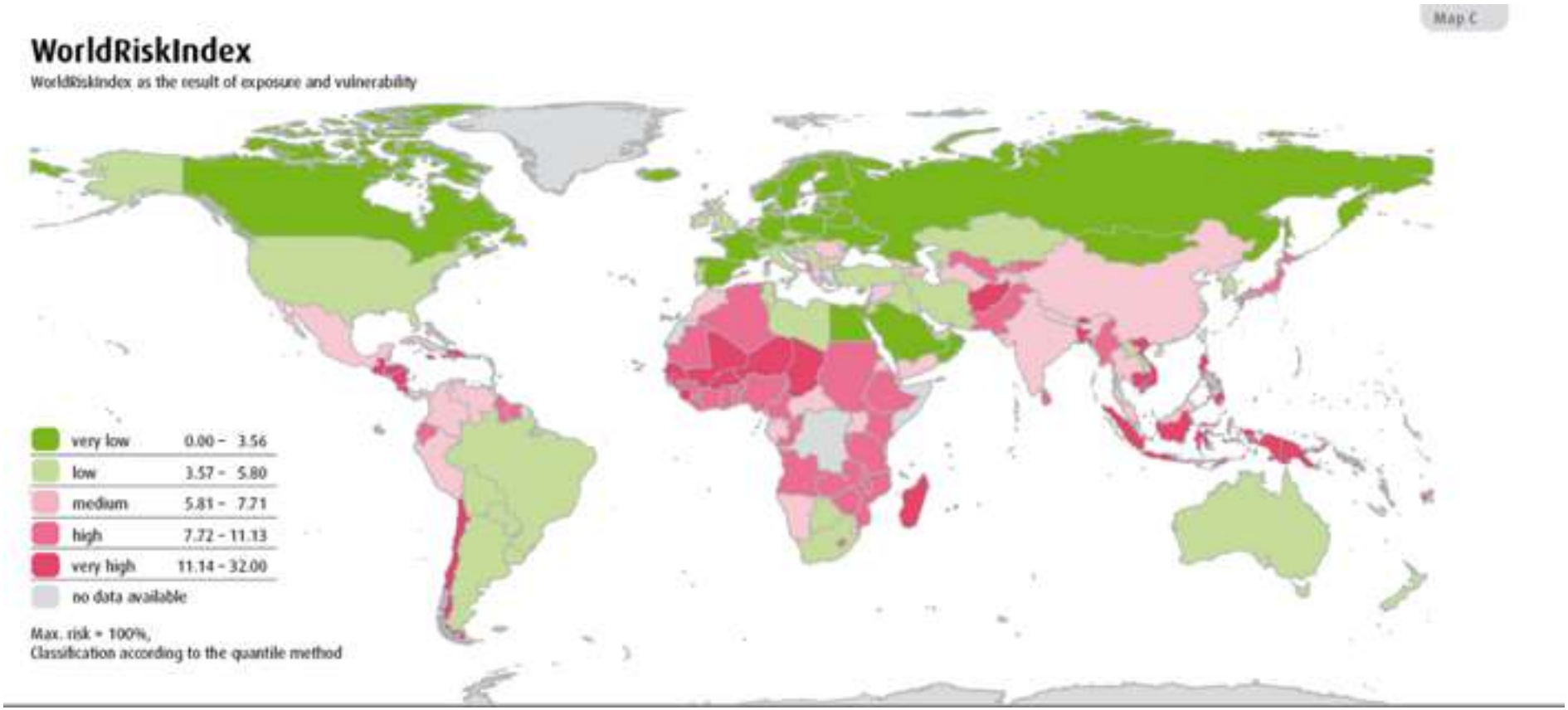
3. Injuries

   All employees are required to immediately report all occupational illnesses or injuries to your supervisor, no matter how minor, and complete an occupational illness or injury form.



Other Related Geological Hazards, DRR11/12 IIa-b-30, Landslide and Flood Susceptibility Map of QC Quadrangle

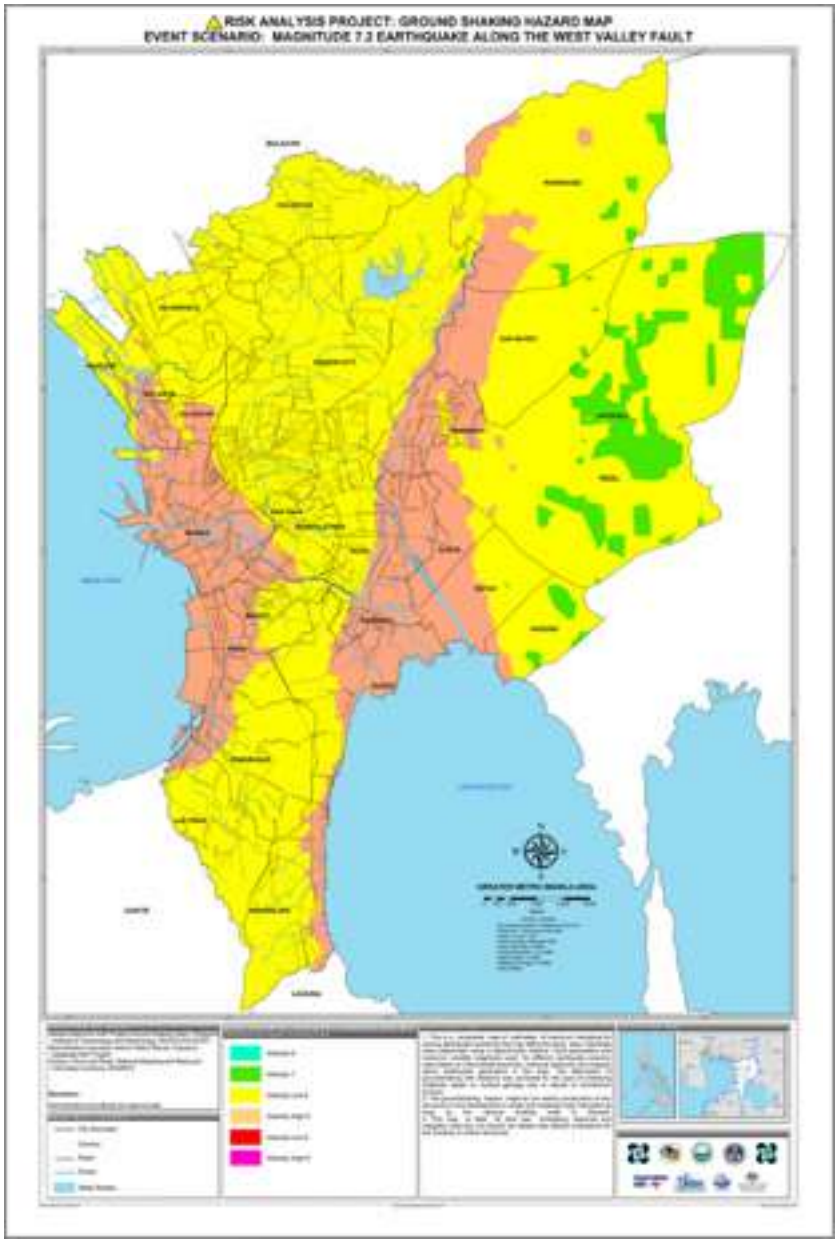
Hydrometeorological Hazards, DRR11/12-IIc-d-34, Hydrometeorological Events



Other Related Geological Hazards

DRR11/12 IIa-b-30

Landslide and Flood Susceptibility Map of QC Quadrangle



Earthquake Hazards

DRR11/12-If-g-20

Quezon City Ground Shaking Hazard Map

A school building in Cabanatuan City collapsed after intense ground shaking, trapping hundreds of students, 16 July 1990 Luzon Earthquake (Source: PHIVOLCS)

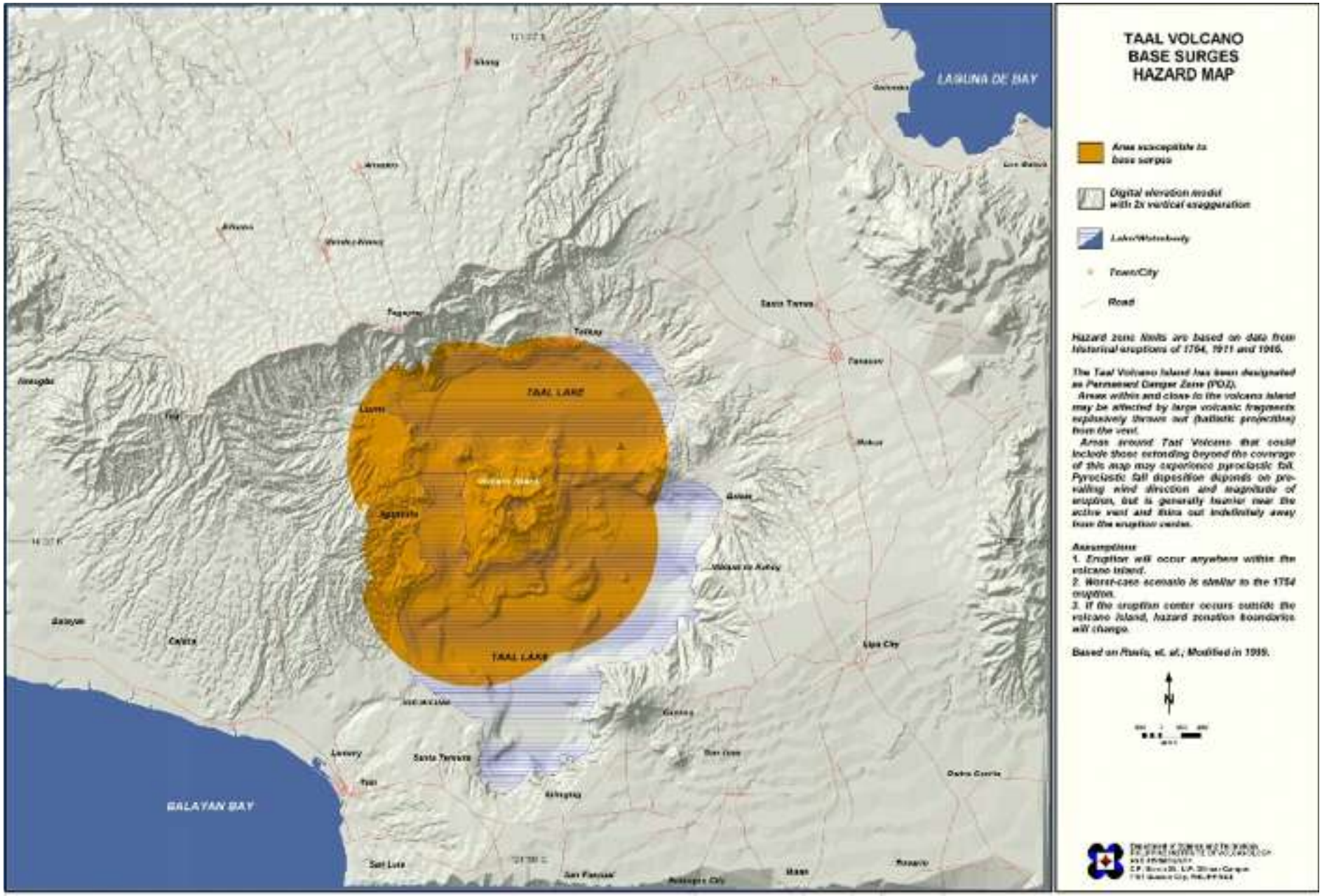
Kobe, Japan. 1995 earthquake. Source: Creative Commons, Wikimedia

Nepal. 2015 earthquake. Source: Creative Commons, SIM Central

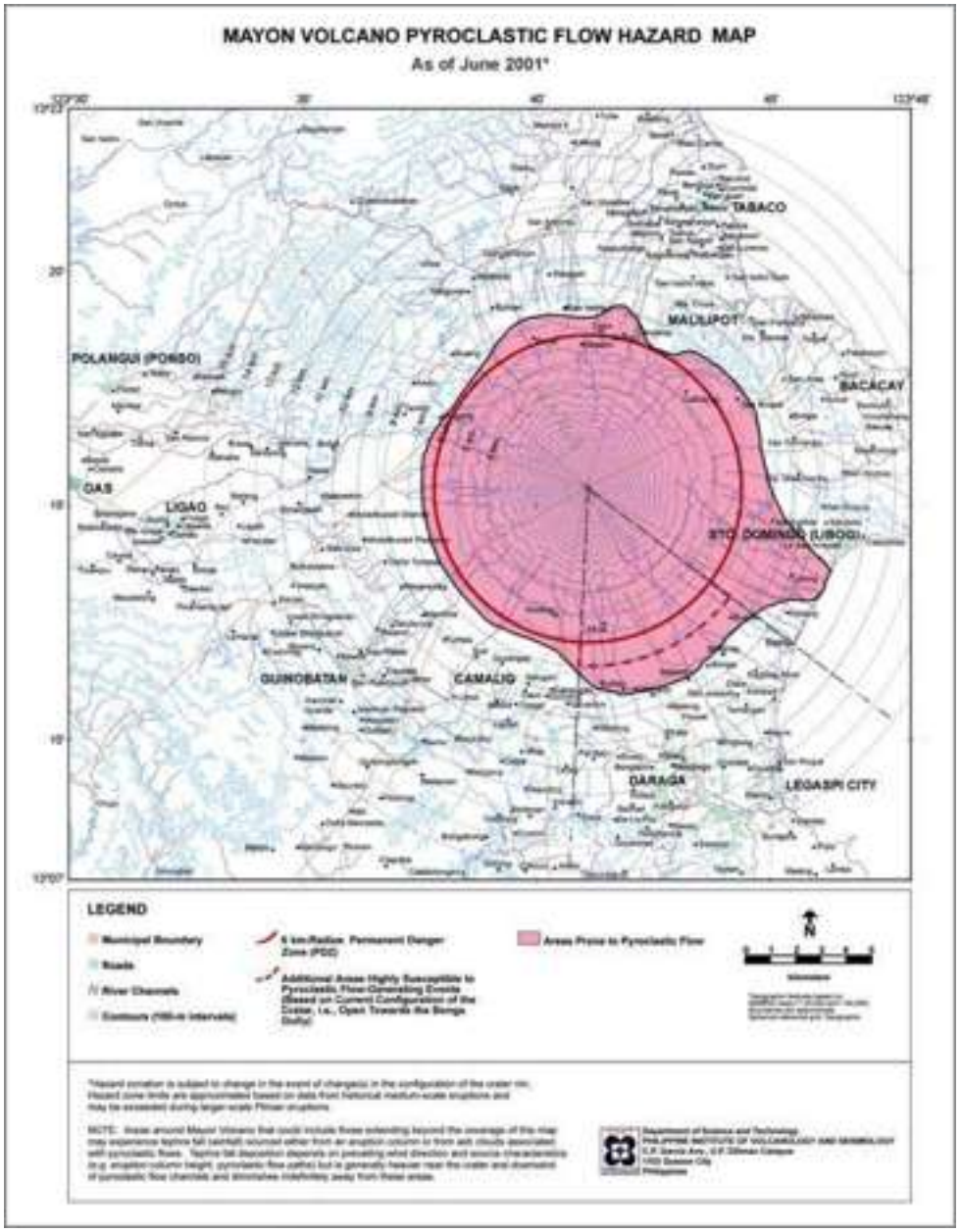
Pyroclastic flow from Pinatubo Volcano eruption

Mayon Volcano eruption, 1984. An example of pyroclastic flow event. *Photo from PHIVOLCS.*

Mayon Volcano eruption, 1984. An example of lava flow event *Photo from PHIVOLCS.*



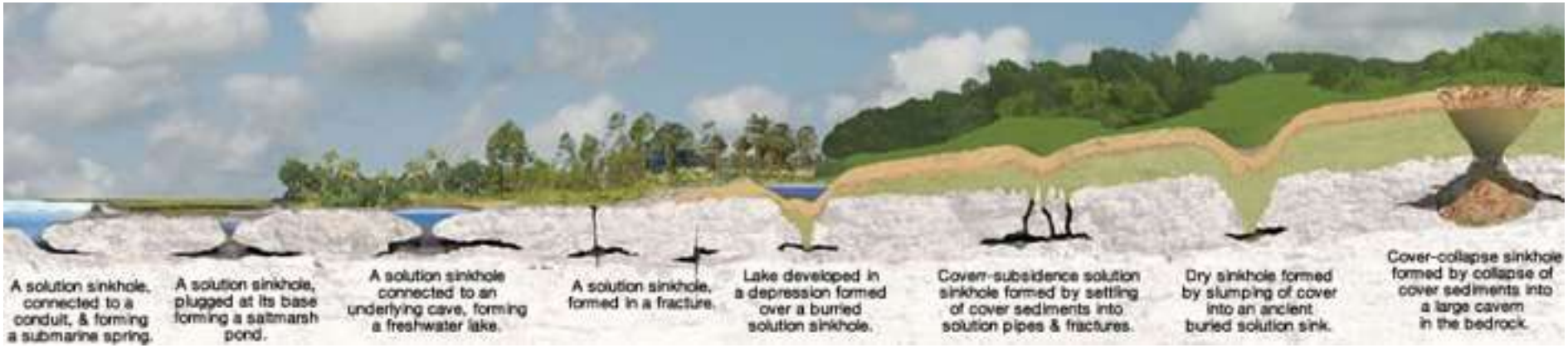
Volcano Hazards, DRR11/12-Ih-i-25, Taal Volcano Base Surges Hazard Map



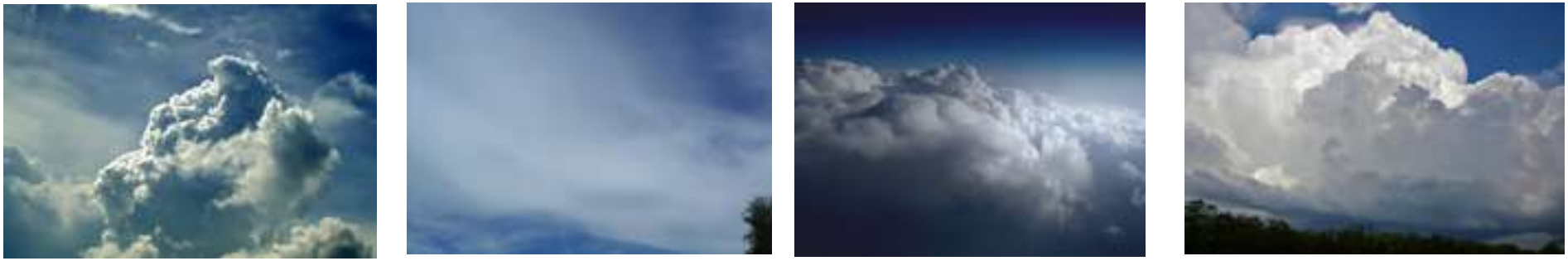
Volcano Hazards, DRR11/12-Ih-i-25,
Mayon Volcano Pyroclastic Flow Hazard Map

Other Related Geological Hazards, DRR11/12 IIa-b-27,
DRR11/12 IIa-b-28, Types of Sinkholes

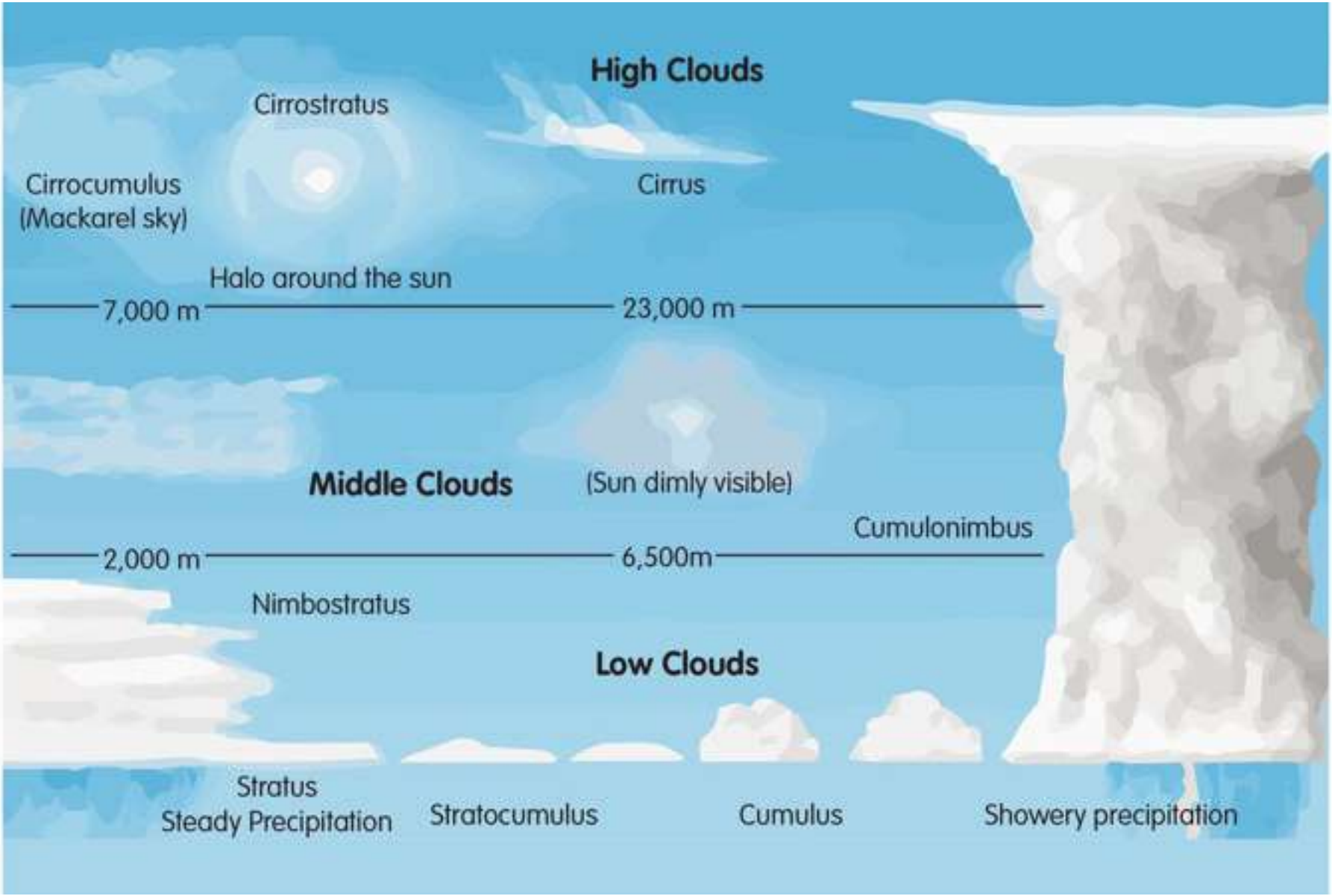
Hydrometeorological Hazards, DRR11/12-IIc-d-32,
Types of Clouds



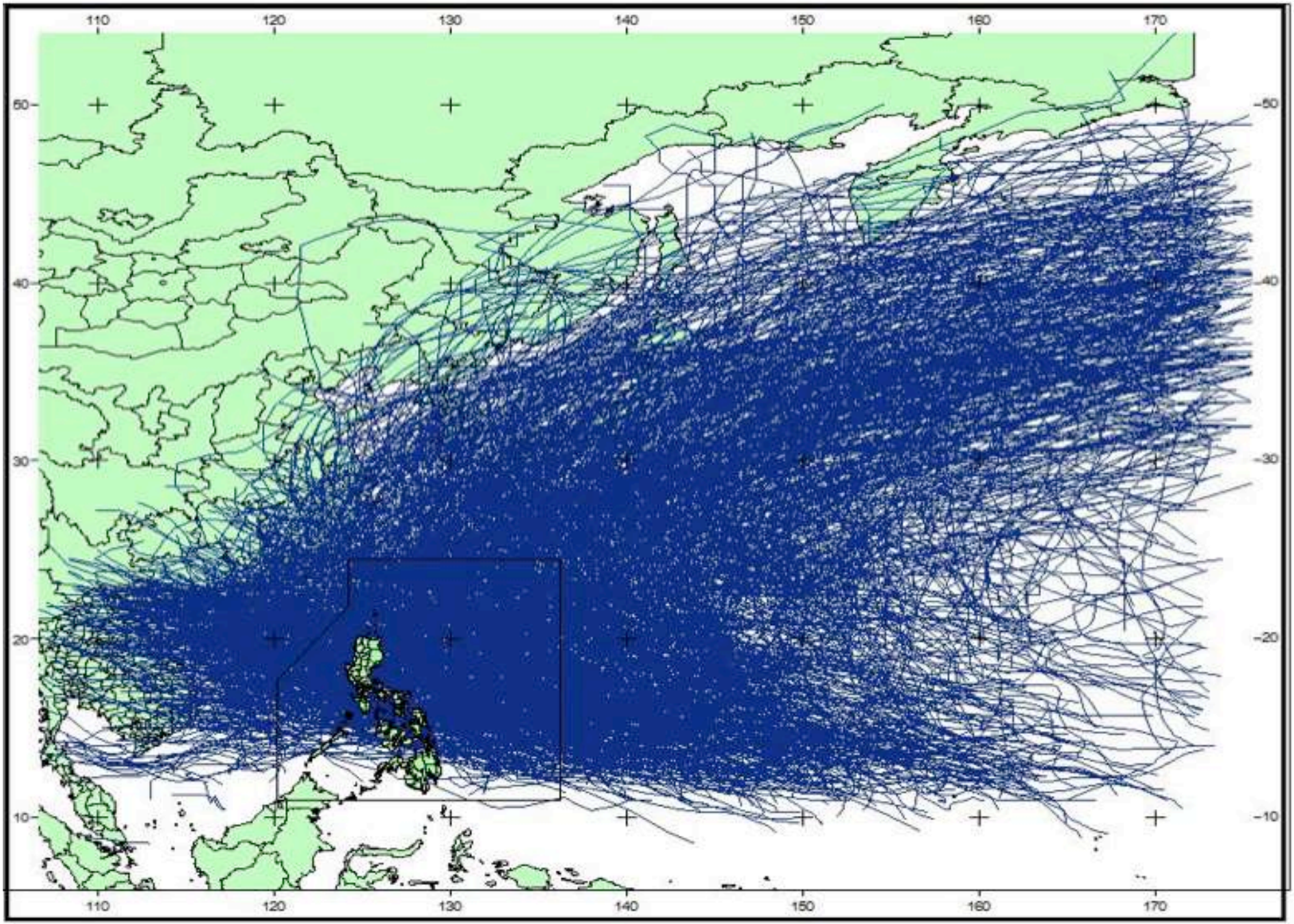
Other Related Geological Hazards, DRR11/12 IIa-b-27, DRR11/12 IIa-b-28, Types of Sinkholes



Hydrometeorological Hazards, DRR11/12-IIc-d-32, Types of Clouds



Hydrometeorological Hazards, DRR11/12-IIc-d-32, Types of Clouds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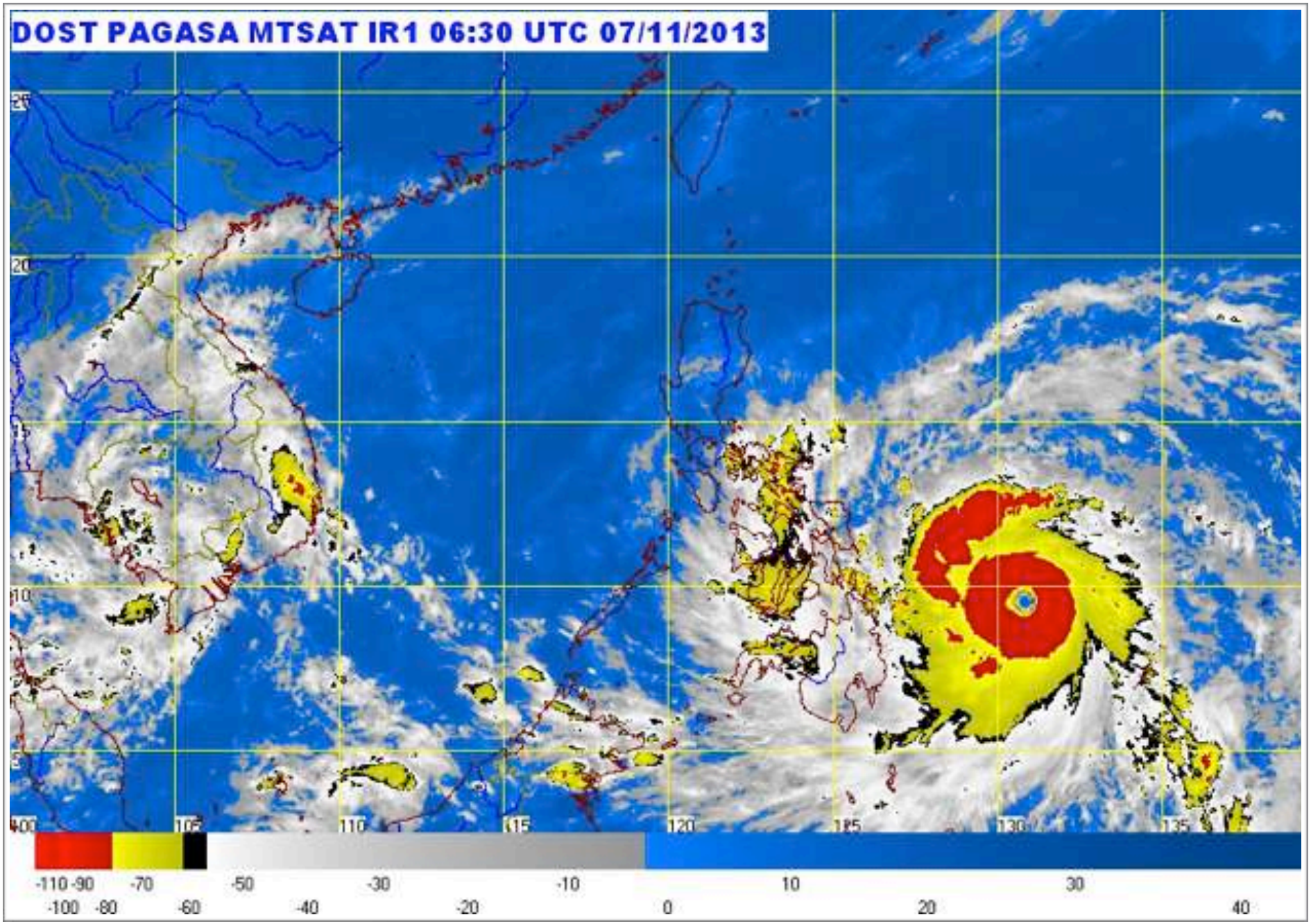
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-110 -90 -70 -50 -30 -10 10 30
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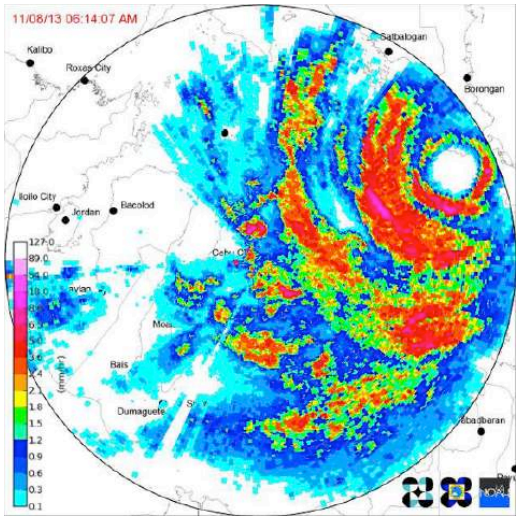
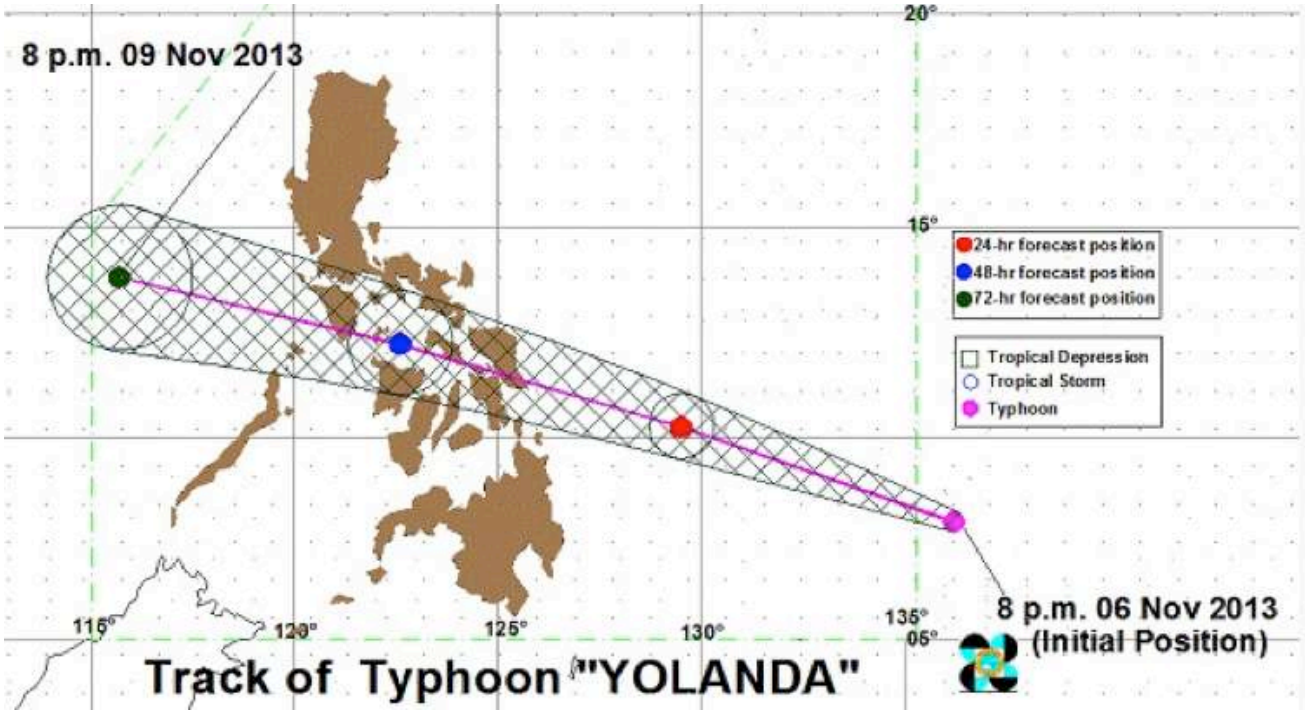
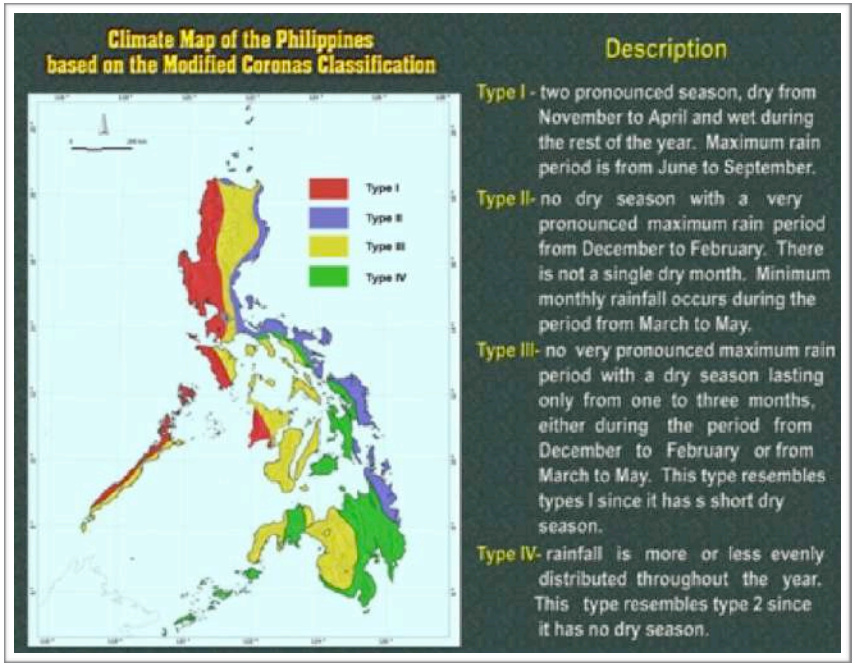
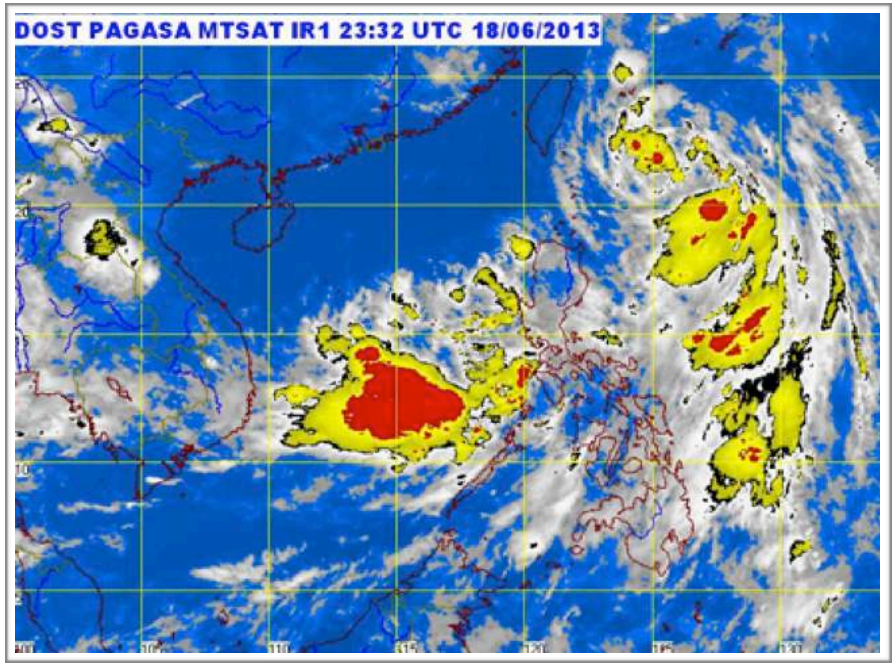


Hydrometeorological Hazards,
DRR11/12-IIc-d-33,
Hydrometeorological Events



Hydrometeorological Hazards, DRR11/12-IIc-d-34, Hydrometeorological Events


Climate Map of the Philippines
based on the Modified Coronas Classification
Type I
Type II
Type III
Type IV
Description
Type I - two pronounced season, dry from November to April and wet during the rest of the year. Maximum rain period is from June to September.
Type II- no dry season with a very pronounced maximum rain period from December to February. There is not a single dry month. Minimum monthly rainfall occurs during the period from March to May.
Type III- no very pronounced maximum rain period with a dry season lasting only from one to three months, either during the period from December to February or from March to May. This type resembles types I since it has s short dry season.
Type IV- rainfall is more or less evenly distributed throughout the year. This type resembles type 2 since it has no dry season.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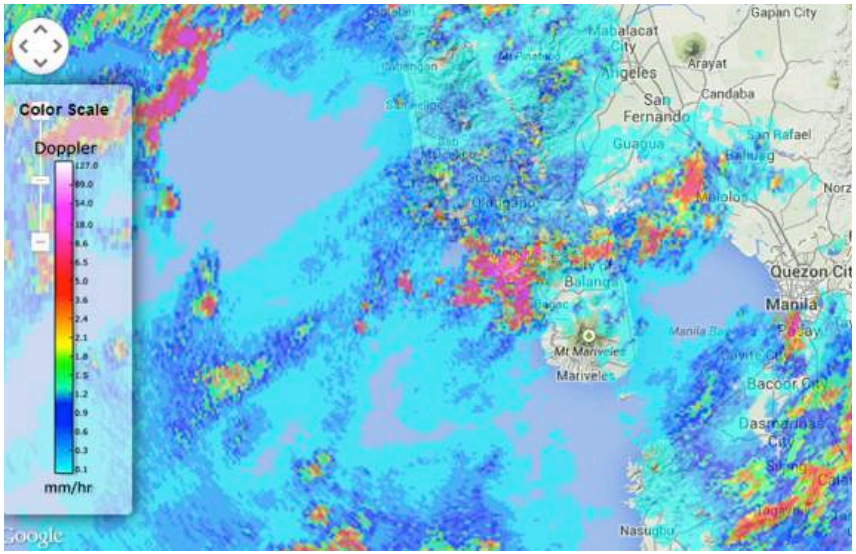
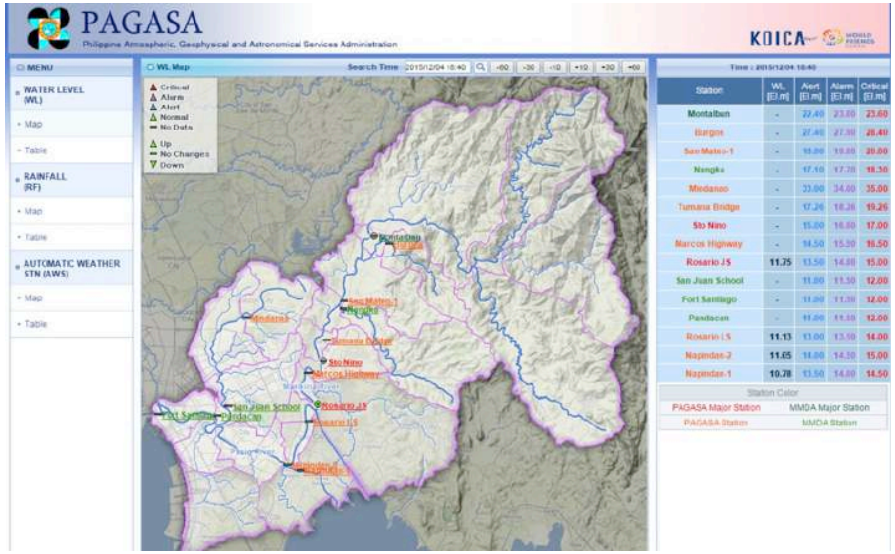
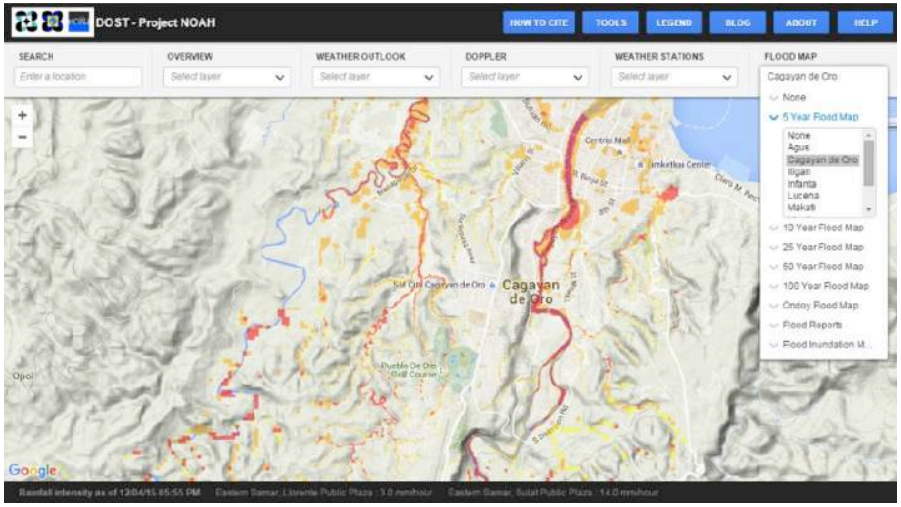

Color Scale
Doppler
mm/hr
Gapan City
Mabalacat City
Angeles
Arayat
San Fernando
Candaba
Guagua
San Rafael
Malolos
Quezon City
Manila
Mt Mariveles
Mariveles
Bacoor City
Dasmariñas City
Nasugbu
Google


PAGASA
Philippine Atmospheric, Geophysical and Astronomical Services Administration
KOICA
MENU
WATER LEVEL (WL)
RAINFALL (RF)
AUTOMATIC WEATHER STN (AWS)
Map
Table
Station
Montalban
Rosario JS
San Juan School
Fort Santiago
Pandacan
Rosario I S
Napindan-2
Napindan-1
PAGASA Major Station
MMDA Major Station



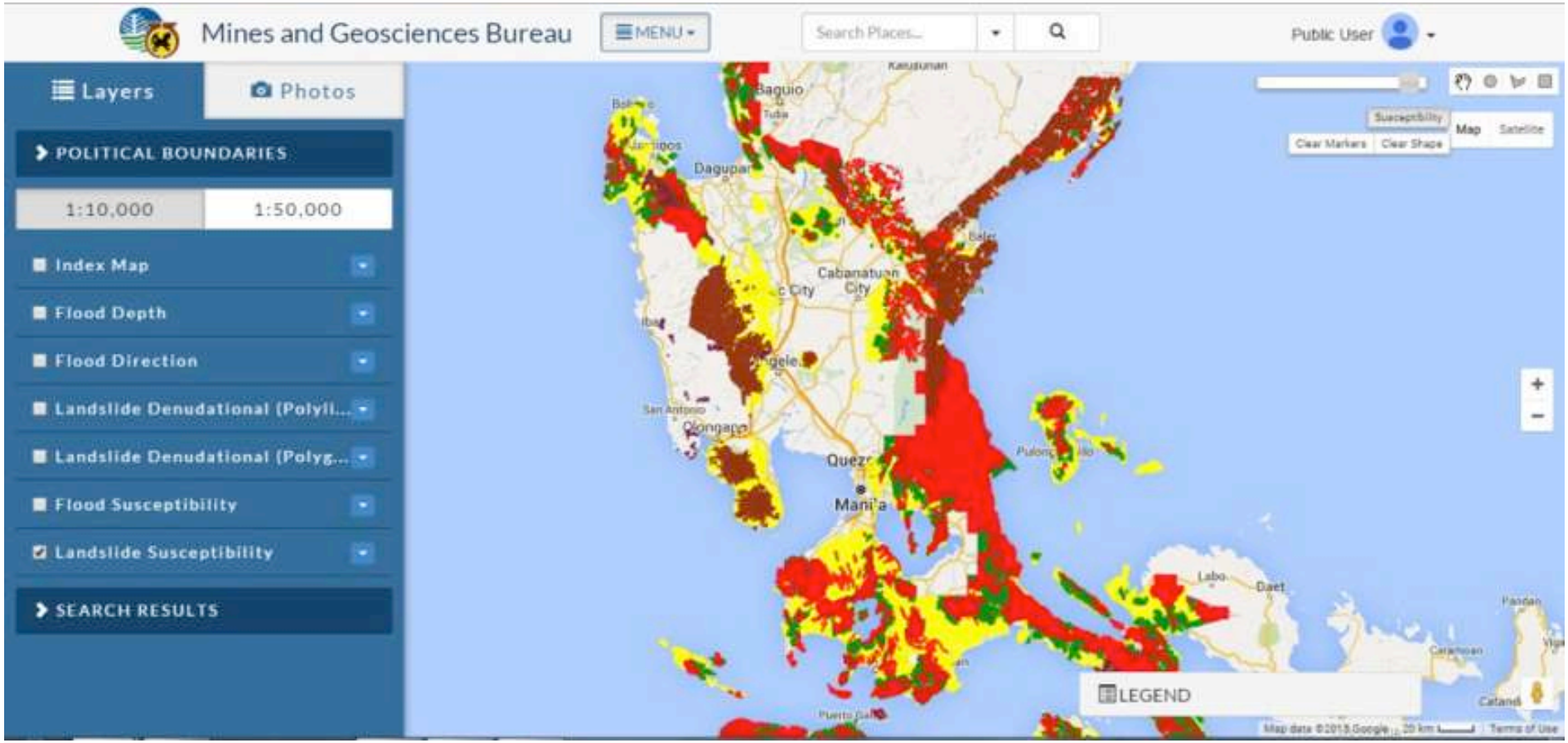
Project Noah Flood Maps

5-year	25-year	100-year

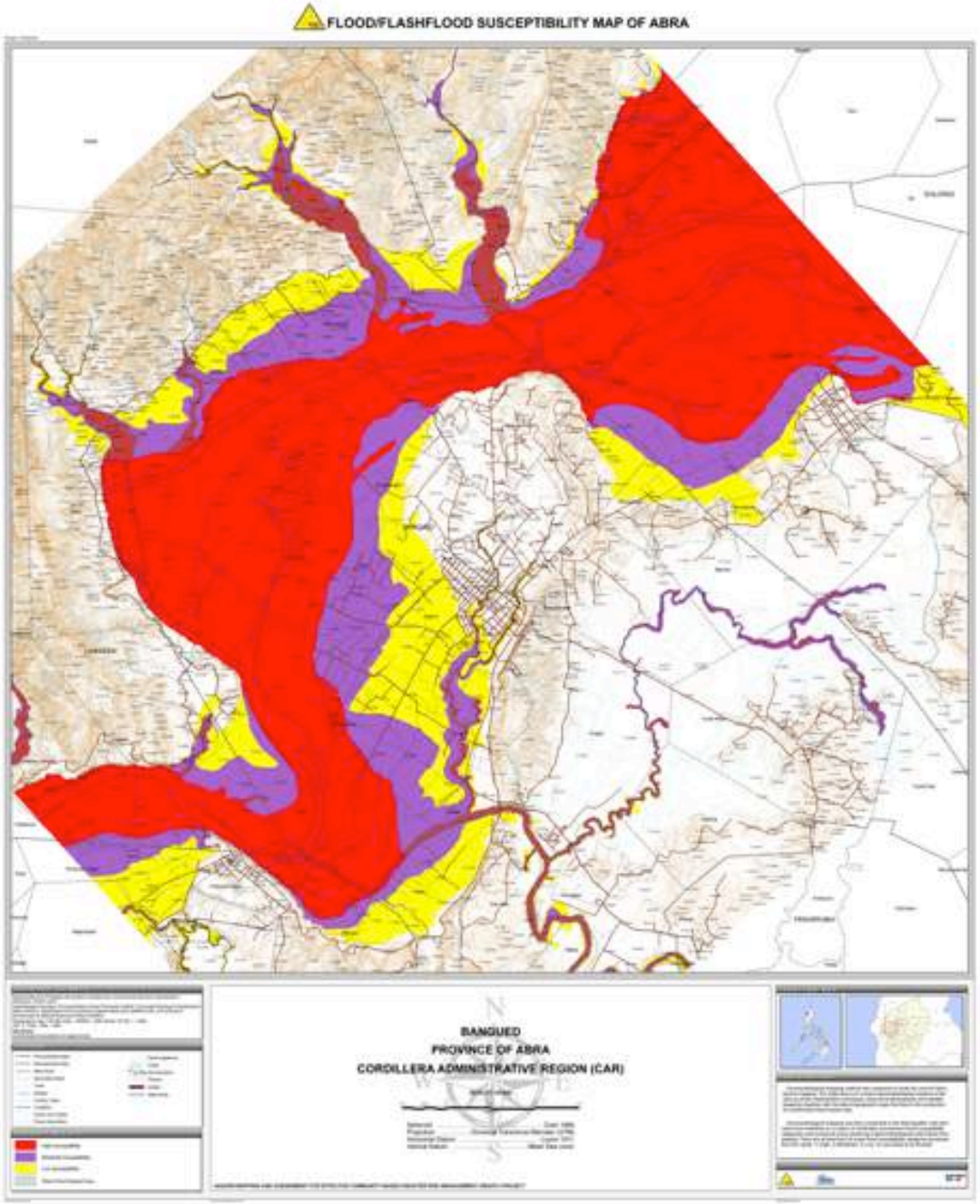
Project Noah Flood Maps

5-year	25-year	100-year

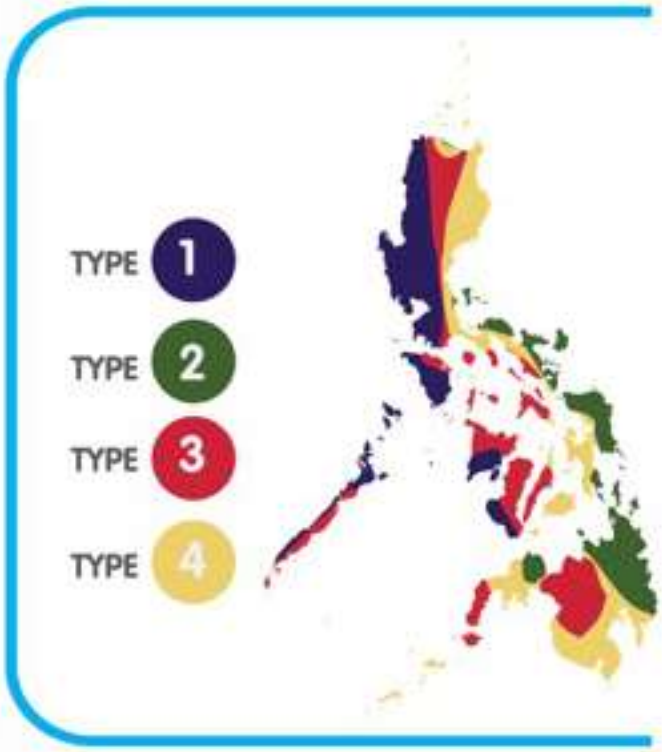
Hydrometeorological Hazards, DRR11/12-IIc-d-35 and 36, Rainfall Observations



Hydrometeorological Hazards, DRR11/12-IIc-d-35 and 36, Mines and Geosciences Bureau GeoHazard Visualization Portal



Hydrometeorological Hazards, DRR11/12-IIc-d-35 and 36, *Flood/ Flashflood susceptibility map*



Hydrometeorological Hazards, DRR11/12-IIc-d-33, PAGASA Regional Flood Advisory

Biographical Notes

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Dr. Mario A. Aurelio is currently the Director of the National Institute of Geological Sciences, University of the Philippines (UP-NIGS). He obtained his Bachelor's degree in Geology from the University of the Philippines, where he was also given the Leopoldo Faustino Award for garnering the 1st Place in the Geology Licensure Exam in the same year. He went on to obtain an M.Sc. in Geodynamics of Oceans and Continents, and a Ph.D. in Structural Geology and Tectonics, both from *Université Pierre et Marie Curie in Paris, France*.

In his pursuit of excellence in research and teaching, Dr. Aurelio has written over 175 international and local scientific publications and technical reports and has presented over 150 papers in conferences, seminars, and workshops in over 20 countries. He has co-edited and co-written a book entitled: "Geology of the Philippines, 2nd Edition," and is the co-author of the International Geological Map of Asia 1:5M (IGMA5000) published in 2013 by the Sub-Commission for Asia of the Commission on Geological Map of the World under the United Nations.

His works cover areas in Southeast Asia, Africa, and Europe. Prior joining the academe, Dr. Aurelio worked for 20 years as a geologist at the Mines and Geosciences Bureau, allowing him to gain extensive experience in mineral exploration and development. He continues to actively engage in mineral resource studies through his research in the university. Furthermore, he holds the rank as Lieutenant Commander in the Philippine Coast Guard Auxiliary.

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Dr. Gerry Bagtasa is an Associate Professor at the University of the Philippines Diliman. He obtained his Bachelor's degree in Physics, with a specialization in Computer Application from the De La Salle University Manila. He then finished his Master's degree in Physics from the De La Salle University Manila, and his doctorate degree in Science, focusing on Artificial Systems, Optics and Electronics, and Atmospheric Physics from Chiba University, Japan. One of his goals is to look at the air pollution present in Metro Manila and how it affects local weather. He has published papers and presented in conferences locally and internationally, has created a crowd-sourcing weather application, and runs a website that forecasts weather for different cities in the Philippines.

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Mr. John Dale B. Dianala is currently a researcher at the University of the Philippines, and is pursuing a Master of Science degree in Geology that focuses in Structural Geology and Tectonics, particularly in active faults and earthquake occurrence. He finished his Bachelor's degree in Geology, Cum Laude, from the University of the Philippines, as a Merit Scholar from the Department of Science and Technology. He also taught laboratory courses in Structural Geology, Petrology, Mineralogy, and Field Geology in the same university.

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Dr. Mark Albert H. Zarco is a Professor 12, and the Group Head of the Geotechnical Engineering Group, Institute of Civil Engineering, College of Engineering, University of the Philippines Diliman. He finished his Doctor of Philosophy, Civil Engineering major in Geotechnical Engineering from Virginia Polytechnic Institute and State University. He finished his Master's Degree and his Bachelor of Science in Civil Engineering (Cum Laude) from the University of the Philippines DIliman. He has also published academic papers on Soil Structure Analysis, Generalised Hyperbolic Stress-Strain Relationships for Nonlinear Deformation Analysis of Soils, and in Computational Aspects of Consolidation Settlement Calculations. He received the Fulbright Hayes Grant, and three UPERDFI Awards as an Outstanding researcher. He was also the Chairman of the Committee on Foundations and Geomaterials, NSCP-ASEP in 2010.

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Ms. Sandra M. Tabinas is an Information Technology Officer II at the Information Management Bureau, Department of Social Welfare and Development where she heads the Geographic Information Systems Unit. She also served as a Planning Officer and Geographic Information Systems Officer at DSWD from 2013-2016, where she created ICT policies, guidelines, and project proposals; and updates evacuation maps for DSWD service management during disaster operations. She was also a member of the Typhoon Yolanda Disaster Augmentation Response Team. She finished her Bachelor of Science in Metallurgical Engineering from the University of the Philippines Diliman.

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He finished his Bachelor's Degree in Geology at the University of the Philippines, his *Diplôme d'études Approfondies* from the *Universite de Paris VI (Université Pierre et Marie Curie),* and his Doctor of Philosophy in Geology from the *Universite de Paris VI (Université Pierre et Marie Curie).*

He was also a Visiting Scientist at the Research Centre for Volcanology, Seismology, and Disaster Mitigation at Nagoya University; and a Post-doctoral fellow at Academia Sinica, Institute of Earth Sciences, Taiwan.

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GATO B. BORRERO

Illustrator

Mr. Gato B. Borrero is the Creative Direction Consultant at D11B Graphic Design Studio, an Art Director at Quorum Holdings Corporation, an Illustration and Graphic Design Consultant at the Management Sciences for Health, and served as a Design Consultant for the Manila Observatory, the Philippine Red Cross, the End Child Prostitution, Child Pornography and Trafficking of Children for Sexual Purposes, Greenpeace Southeast Asia, and the Oxford Committee on Famine Relief. He finished his Bachelor of Fine Arts from Kalayaan College, and is currently taking up his Master of Development Communication at the University of the Philippines.