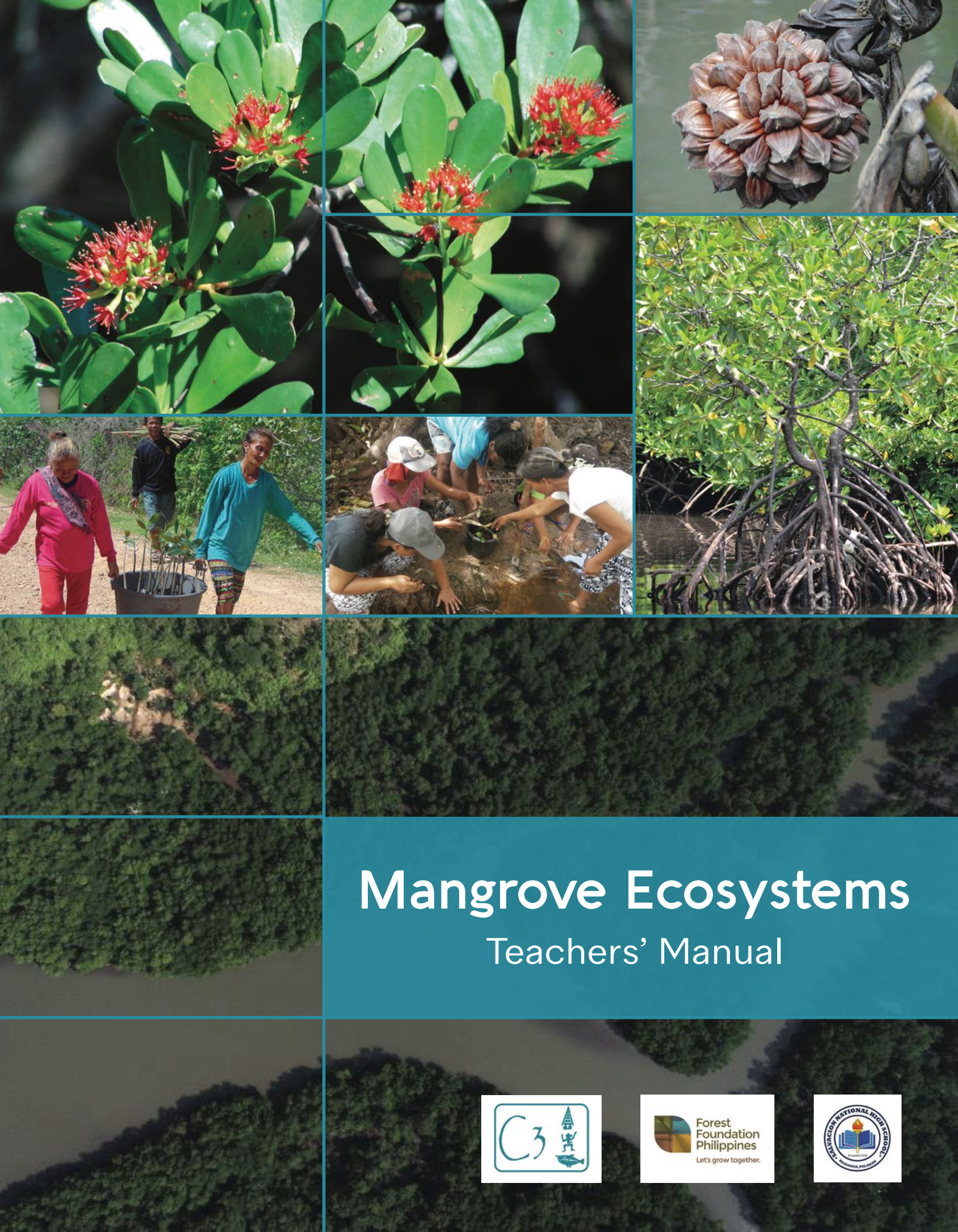

Mangrove Ecosystems

Teachers' Manual

Forest Foundation Philippines
Let's grow together.

Mangrove Ecosystems

Teachers' Manual

Forest Foundation Philippines
Let's grow together.

Forest Foundation Philippines

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Makati, Philippines

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@forestfoundationph

Founded in 2002, under two bilateral agreements between the governments of the United States of America and the Philippines, the Forest Foundation Philippines is a nonprofit organization that provides grants to organizations that empower the people to protect the forests.

Community Centered Conservation (C3) Philippines, Inc.

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C3 Philippines was registered in 2011 in Busuanga, Palawan as a local non-profit organization striving to develop conservation efforts worldwide by building the capacity of local individuals and institutions through grass-roots research and training initiatives.

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Foreword

Busuanga is one of the best diversed ecosystem in the world. It is now tagged as the last shade of paradise because of its preserved ecosystem. Aside from the tourism industry, fishing is the primary source of food and income of the locals.

Salvacion National High School, as the biggest central high school in the town, is catering learners from all Barangays within Busuanga, and from Coron municipality. As educators in a learning institution, it has been our felt responsibility to look into the situation and instill in the youth the principle of environmental responsibility, to ensure its sustainability for present and future generations.

C3 Philippines, a Non-Government Organization, works on community centred conservation of local species. It established its first field station in the Calamianes islands in 2011, particularly in Busuanga. It pioneered the first dugong conservation program, protecting one of the last strongholds of the endangered dugong in the Philippines, and is recognized as the national lead agency for research and management of the species. Today, C3 Philippines continues to organize various seminar workshops for Science teachers and learners in line with ecosystem conservation.

Drawing from decades of conservation work and instilling the value of lifelong learning, two different organizations with different structures have united to a common purpose: to educate the youth of Busuanga on sustainable development and responsible stewardship of their natural fishing grounds through Mangrove Education.

With C3 Philippines's technical know-how, and our teachers's knowledge of mangrove conservation in the Depatment of Education's Curriculum Guide, this Teacher's Manual on Mangrove Conservation has been crafted.

This Teacher's Manual is intended for different grade levels in Science, from Grade 7 to Grade 12.

The dream of localizing some of the competencies in Science is realized in this craftsmanship.

Evelyn B. Nadado

Preface

Through this developed Teachers Manual on mangrove and beach forests, the knowledge and understanding will spread outwards from the schools into the rest of the community. Furthermore, students will learn about the mangrove and beach forest ecosystems within their locality, which includes general information of the environment. The scientific concepts and field learning activities included in the manual can also help students to further understand and appreciate the value of these ecosystems.

Through the Busuanga Coastal Forest Project funded by Forest Foundation Philippines, Community Centered Conservation Philippines and Salvacion National High School Teachers have developed this Manual as a tool to aid teachers and students about the importance of mangrove forests.

Each lesson in this manual contains a backgrounder and extra information for students and teachers, questions for students to answer, and a list of suggested activities (such as conducting local research, puzzles, and more). These activities are designed to enhance students' understanding and appreciation of mangroves.

Acknowledgment

The development and production of this manual was made possible through the dedication, perseverance, and collective effort of various organizations and institutions who shared their expertise, ideas, precious time, and resources. We extend our sincerest gratitude for their valuable contributions:

Forest Foundation Philippines, for giving us the opportunity to develop and produce this manual with their provided funds and technical assistance;

Palawan Council for Sustainable Development (PCSD-Coron) and the Department of Environment and Natural Resources–Community Environment and Natural Resource Office (DENR-CENRO, Coron), for their continuing support and provision of information necessary for development of this manual;

Local Government Unit (LGUs) of Busuanga (Mayors Office, SB Office, MPDC, MAO, and MTO), for continued work coordination and untiring support for this project;

Salvacion National High School Science Teachers (SNHS), for sharing their technical expertise and valuable time for the formulation of content, editing, and finalization of the manual;

And to all local community partners of Busuanga municipality, who shared their efforts and participated to make this manual possible.

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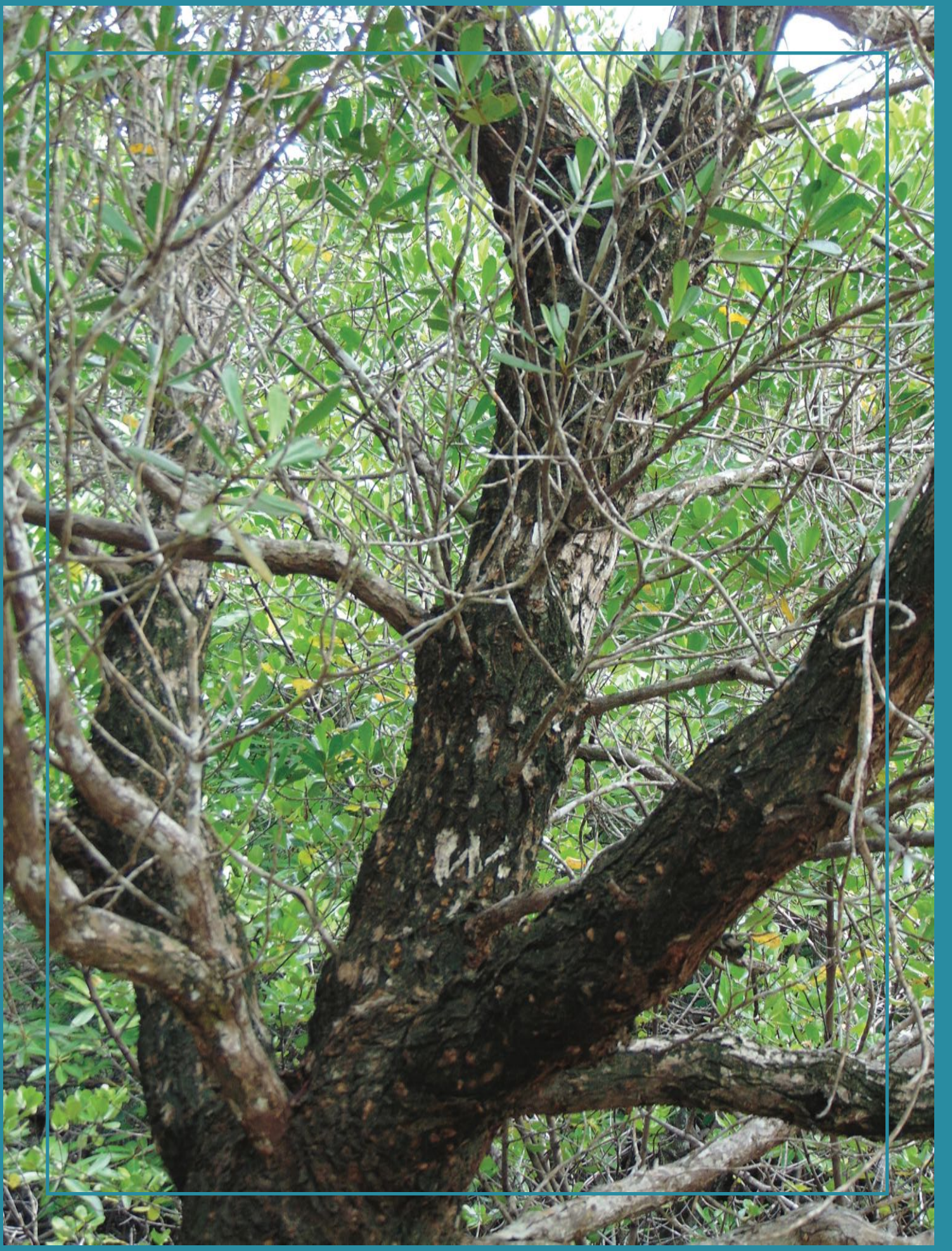


Introduction

The Philippines is regarded as one of the top 17 mega-biodiversity countries in the world owing to its geographical isolation, diverse habitats, and high rates of endemism. Its coastline is one of the longest in the world, extending up to 36,289 km. Based on the global rankings of mangroves area in terms of area cover, the Philippines ranked number 15th with an area of 263,137 ha or 1.9% global contribution (Long and Giri, 2011). This is 50% of mangrove species of the world (Primavera, et al., 2004; Garcia et al., 2013).

The government of the Philippines adopts the Food and Agriculture Organization (FAO) definition of forest as "an area of more than 0.5 ha and tree crown cover (or equivalent stocking level) of more than 10% which includes natural and plantation and production forests" (Lasco et al. 2012). A mangrove forest is defined as a type of forest on tidal mudflats along the sea coast, extending along the streams where the water is brackish. The term *mangrove* refers to a group of tropical and subtropical trees and shrubs that grow in the intertidal zone (Feller and Sitnik, 2006). These trees or shrubs have physiological and morphological adaptations to environmental stresses such as high salinity, low oxygen, poor nutrient availability, and substrate mobility (Elisson et al., 2012).

Mangroves provide tremendous value to mankind and marine organisms alike, and have ecological and economic benefits (Alongi, 2002). They are vital to coastal communities as they help protect against damage caused by tsunami waves, erosion, and storms; and serve as a nursery for fish and other species that support coastal livelihoods. They are a source of plant products such as food and traditional herbal medicine. In addition, mangroves have an incredible ability to seize carbon from the atmosphere, and serve as both source and storage for nutrients for inshore marine habitats such as seagrass beds and coral reefs. Coastal forests also provide erosion control, flood regulation, sediment trapping, nutrient recycling, wildlife habitat, and nurseries (J.H. Primavera et.al., 2008). This ecosystem also helps to promote clear water, and the growth of adjacent ecosystems like seagrass and corals (Melana et al., 2000).

Despite the significance of mangroves, they remain under constant threat from direct and indirect anthropogenic pressures. For the past two decades, the mangrove forest cover has declined worldwide and lost roughly 35% of the global area. More than 1 in 6 (17%) mangrove species worldwide are in danger of extinction, largely due to coastal development, climate change, logging, and agriculture, according to the first-ever global assessment on the conservation status of mangroves for the IUCN Red List of Threatened Species. FAO assessment (2007) shows that 11 out of 70 (16%) mangrove species have been placed on the IUCN Red List.

In Palawan, surveys and assessments conducted by C3 Philippines, Inc. in eight coastal barangays of Busuanga and Coron Municipalities have found that the dominant mangrove species are *Rhizophora spp*. Other frequently observed species are *Ceriops spp*., *Bruguiera spp*., *Lumnitzera spp*., *Xylocarpus spp*., *Sonneratia spp*., *Avicennia spp*., *Nypa fruticans*, *Excoecaria agallocha*, *Scyphiphora hydrophyllacea*, *Heritiera littoralis*, and *Osbornia octodonta*. Mangrove-associated species include insects, birds, crustaceans, mollusks, and fishes. Commonly, the mangrove forest is considered for gleaning areas of the communities.

Busuanga Island, being a small island ecosystem, is vulnerable to climate change. One alarming manifestation was the devastation of super typhoon Yolanda (Haiyan) as it exited the Philippine area of responsibility in November 2013. In an effort to rebuild coastal communities and protect the ecosystems and biodiversity, C3 has tremendously engaged local communities to be at the forefront of its conservation strategy.

Given the importance of mangroves to both the environment and to people's livelihoods, it is essential that students learn about mangroves—what they are, how they function in an ecosystem, and how to protect them.

Part I: Grade 7 Competencies

Components of Ecosystem
(Intertidal and Subtidal Areas)

I. OBJECTIVES

A. Content Standards

The learner demonstrates an understanding of organisms interacting with each other and with their environment to survive.

B. Performance Standards

The learner conducts a collaborative action to preserve the ecosystem in the locality.

C. Learning Competency

Code: S7LT-IIh-9

Objective: Differentiate the biotic and abiotic components of an ecosystem.

Specific Objectives: Characterize and identify the biotic and abiotic components in the intertidal and subtidal areas along the coastline.

II. SUBJECT MATTER

A. Topic: Components of Ecosystem (Intertidal and Subtidal Areas)

B. Reference: Mangrove Education Series for Secondary Schools Students' Module, DepEd Curriculum Guide

C. Materials: Learner's Materials

III. LEARNING ACTIVITIES

A. Review

Jumbled Letters (Finding Magic Words)

- Ecosystem, Abiotic, Biotic

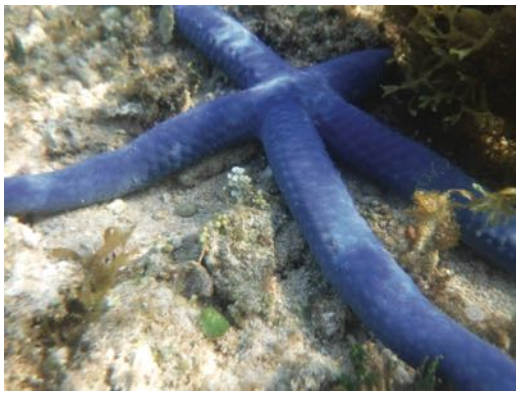
B. Motivation

Jigsaw Puzzle about different marine ecosystems

C. Presentation of the Lesson

Display/post several pictures of organisms commonly found in the intertidal zone (sea stars, crabs, oysters, clams).

Example:



Sea star *(Linckia laevigata)*

Oysters

Crabs

Clams *(Anodontia edentula)*

Photos by C3 Philippines, Inc.

1. Ask the students if they have ever encountered an organism like this. If so, where?
2. Have students volunteer to describe his/her experience.

Play a video clip about the intertidal and subtidal zone.

3. Unlocking Terms (Literacy)

- Intertidal Areas
- Subtidal Areas

D. Activity

(Integration to MAPEH, English, and Filipino)

WEIRDO I BELONG?

Use differentiated instruction. The students will be divided into 5 groups: Group 1 (*Tide Pools*), Group 2 (*Sandy Beach*), Group 3 (*Coral Reefs*), Group 4 (*Seagrass Beds*), and Group 5 (*Mangrove Swamps*). Each student is free to choose the group they want to join. Let them identify the different intertidal and subtidal areas through poem recital, storytelling, spoken poetry, and drawing. Students shall perform their activity in 5 minutes, then let them present to the class. (With Rubrics)

E. Analysis/ Discussion

Discuss the following:

1. How will you differentiate intertidal from subtidal areas?
2. In your barangay, what kind of intertidal and subtidal areas found along your coastline? Describe it.
3. Does your coastline have healthy or degraded habitat? Why?

F. Abstraction

Intertidal areas are areas along the beach which are covered with water during high tide and are partially or completely exposed during low tide. ***Subtidal areas*** are found in the deeper zone and remain underwater even during low tide. The different intertidal and subtidal areas along the coastline are:

Tide Pools are areas on rocks and sand on the beach that are sometimes filled with seawater. It can be small, in a shallow puddle, found high up on the shore, deep holes nearer the sea. Tide pools form when the ocean covers the beach once or twice a day. Some of the plants and animals that live close to the sea are covered when the tide washes over them. They have to survive in both wet and exposed conditions. The tides bring fresh oxygen and food. Between tides, some of the smaller pools become too warm and begin to dry up. Many of the animals (e.g., crustaceans, sea slugs, gastropods, and other mollusks) hide under cool, damp rocks and moist seaweeds so that their bodies do not dry out before the

tide comes in again. Because the water level of the pools depends on the tide, tide pools are not permanent habitats.

Sandy Beach is where land meets water. Beaches are formed when sea cliffs near shorelines have eroded away. Sand left on the beach by ocean waves or by rivers flowing to the sea can also form beaches. Many kinds of plants and animals make their homes on the beach. They must adjust to life in a salty environment. Generally, there are two kinds of beaches. A beach which is mostly composed of sand is termed a *sandy beach*, while a beach with many rocks is termed a *rocky beach*.

Coral Reef is an underwater ecosystem characterized by ***reef***-building ***corals***. ***Reefs*** are formed of colonies of coral polyps held together by calcium carbonate. The coral reef provides shelter to many animals.

Seagrasses are marine plants with the same basic structure as terrestrial (land) plants. The have tiny flowers and mostly elongated leaves, although a few may have oval leaves. They form meadows in estuaries and shallow coastal waters with sandy or muddy bottoms. Most closely related to lilies, they are quite different from seaweeds which are algae.

Mangrove ecosystem is located exclusively or almost exclusively in intertidal habitats, therefore salinity is brackish (a mixture of fresh and seawater) to marine ranging from 10-35 Parts per Thousand (ppt). They are some of the most biologically productive areas on earth and serve as nurseries for aquatic wildlife. Mangrove branches and roots provide a habitat for birds, crustaceans, and fish. Mangrove ecosystem improves water quality by filtering pollutants, stabilizing the soil and protecting the shoreline from erosion. One advantage of mangrove species is that they have less competition because very few plants can thrive in salty water. The Philippines has only about 35 species of mangroves, whereas a rainforest has hudreds to thousands of plant species.

Trivia

In protected coastlines, the progression of the marine ecosystem is as follows: areas toward the deeper ends are usual locations of coral reefs. In nearshore areas, which are shallow and generally covered with water, are typical seagrass beds. Areas closest to the beach are the usual locations for mangroves. Coral reefs and seagrasses are subtidal while mangroves are intertidal.

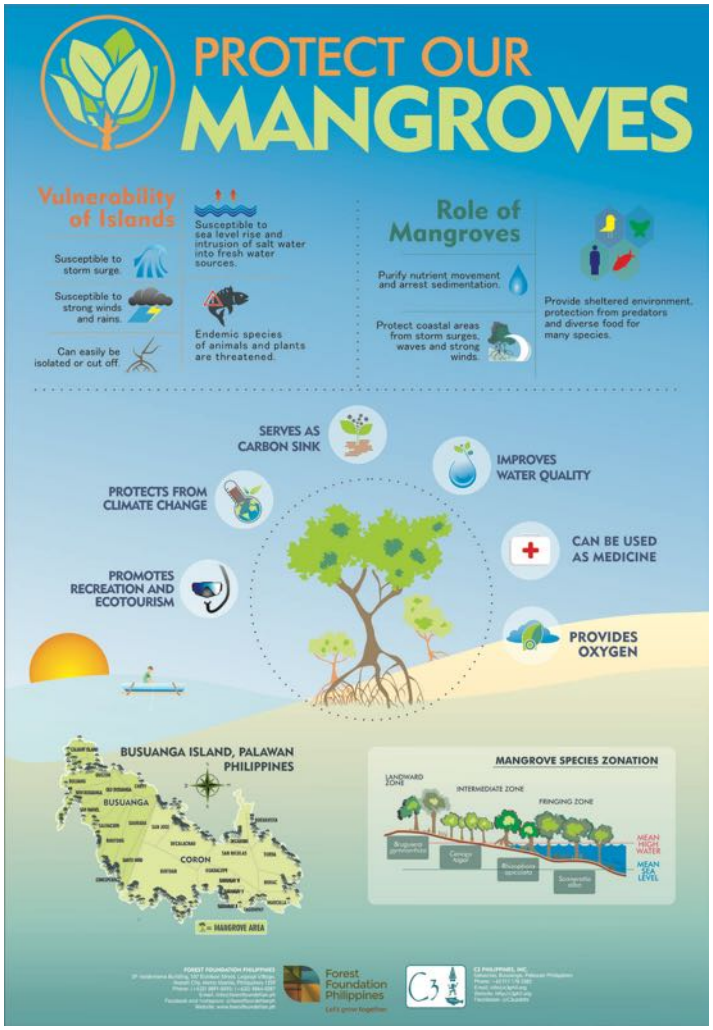
G. Application

(Integration to Arts)

Poster Making

Design/make a poster of the example of intertidal or subtidal areas in your locality.

Example:



Poster by C3 Philippines, Inc.

H. Generalization

What are the different intertidal and subtidal areas along the coastline?

IV. EVALUATION

Objective type of test

5 items about intertidal and subtidal areas.

Test Yourself

1. Which of the following is NOT a permanent habitat?
   a. Coral reef
   b. Tide pool
   c. Seagrass bed
   d. Sandy beach
   e. Mangroves

2. Which of the following is formed by deposits of non-living materials of animal colonies or groups?
   a. Coral reef
   b. Tide pool
   c. Seagrass bed
   d. Sandy beach
   e. Mangroves

3. Which of the following areas has a highly anaerobic substrate?
   a. Coral reef
   b. Tide pool
   c. Seagrass bed
   d. Sandy beach
   e. Mangroves

4. Are there examples of intertidal areas not covered in the module? If there are, what are they?

5. Give examples of places in Busuanga, in the Philippines, and in the world, which are best known for the different intertidal and subtidal habitats.

Answer Key:

1. *b*
2. *d*
3. *e*
4. _____
5. _____

Ecological Relationships
(Who Eats Who in the Mangroves)

I. OBJECTIVES

A. Contents Standards

The learner demonstrates an understanding of organisms interacting with each other and with their environment to survive.

B. Performance Standards

The learner conducts a collaborative to preserve the ecosystem in the locality.

C. Learning Competency

Code: S7LT-IIg-12

Objective: Predict the effect of change in abiotic factors on the ecosystem.

Specific Objectives:

1. Identify examples of the food chain in a mangrove forest;
2. Discuss the energy flow in a mangrove; and
3. Compare the food chain and food web.

II. SUBJECT MATTER

A. Topic: Ecological Relationships

B. Reference: Mangrove Education Series for Secondary Education *Students' Module*, DepEd Curriculum Guide

C. Materials: Learner's Materials

III. LEARNING ACTIVITIES

A. Motivation

Localization

Which Eats What?

Let students go outside their classrooms to observe the different kinds of organisms that they found. The learners will identify from what kind of organism they belong to. (Producer, Consumer, Decomposer)

B. Preliminary Activity

(Using Differentiated Instruction)

The class is divided into 4 groups: Group 1 and 2 (*Food Chain*), and Group 3 and 4 (*Food Web*). Using the pictures of different mangrove ecosystems students will make their food chain and food web. Each group is given the freedom to choose which group they want to join. The group can present their output through drawing, diagram or concept mapping. Then let them explain their food chain and food web. Students also identify the first-order consumer up to last order consumer.

C. Analysis/ Discussion

1. Which organism belongs to the producer? Belong to the consumer?
2. Which organisms belong to the first-order consumers, second-order consumers, and third-order consumers?
3. Assuming that algae are found in your study area, what might happen to the other organism if you remove algae from the chain? (you may base your answer on the food web that you formed with your group)
4. Are there any animals listed in your diagram that eat several items of food? Name them.
5. Mud crabs feed on decomposing leaf litter. If humans harvest and eat them, what will happen to other organisms that feed on young mud crabs?
6. Define the food chain and food web as shown by the data collected. How are they different from each other?
7. How can you be a part of the food web in the mangrove?
8. What happens to the food web when we catch even the very small one for food?
9. If a particular species has several food sources, will this improve its chances of survival when one of its food sources become scarce?

D. Abstraction

Mangroves are habitats for diverse flora and fauna. From dry land, you will encounter different species of plants, There is also a diversity of animals in the water, on the ground, and above the water on plants like various kinds of crustaceans.

Ecosystem Function

An ecosystem consists of the biotic, or living communities of different organisms,

and the abiotic, or nonliving components. Examples are the mangrove and coral reef ecosystem. Organisms are involved in functions like production, consumption, and decomposition. ***Production*** includes the process of photosynthesis by which plants use sunlight and raw materials such as carbon dioxide and water to produce food and release oxygen to the atmosphere.

Consumption is a process by which animals ingest or eat plants and other animals for food and energy. Food taken in is digested and converted to substances that can be used by animals to make their protoplasm. ***Protoplasm*** is the living matter which makes up the cells of an organism. The organisms that consume food are called ***consumers***.

Kinds of Consumers

1. ***Herbivores*** - plant-eating consumers
2. ***Carnivores*** - consumers that feed on animals

Consumers may be first-order, second-order, or third-order consumer. ***First-order consumers*** feed on plants, ***second-order consumers*** feed on first order consumers, and ***third-order consumers*** feed on second-order consumers**.**

Mangrove ecosystems being rich in litterfall and other organic matter undergo ***decomposition*** by which ***bacteria*** and ***fungi*** breakdown complex organic matter from animals and plants into simpler forms. These organisms are called ***decomposers***.

The food chain is a single series of eaten and eater relationships.
The food web is a complex series of eater and eaten relationship.

E. Application

Since you are part of the mangrove food web, what can you do to prevent the excessive collection of fingerlings of fish, prawn, and crabs?

F. Generalization

In this lesson, you have learned that mangrove organisms depend on others for food. Some organisms feed on plants while others feed on decaying materials. Those that can provide their food are producers, whereas those that feed on producers are called consumers. Examples of consumers are herbivores that

feed on plants and carnivores that feed on animals. Others can eat both plants and animals and are referred to as omnivores. Still, others found in the water and sediments are important in the decay of dead plants and animals. These are the decomposers. The complex feeding relationships of organisms are illustrated in a food web.

IV. EVALUATION

Test Yourself

The following test items will show how much you have learned. Read the items carefully and choose the letter of the correct answer. Write your answers in your notebook.

1. If you eat prawns that feed on shells, then you are a/an:
   a. Herbivore
   b. Secondary order consumer
   c. Tertiary order consumer
   d. Omnivore

2. Humans feed on shrimps, snails, and crabs. In this case, humans are part of a:
   a. Food chain
   b. Food web
   c. Food pyramid
   d. All of the above

3. If we introduce milkfish into a pond for purposes of increasing available fish for humans, what would be the most important source of food for them?
   a. Bacteria
   b. Zooplankton
   c. Algae
   d. Small shrimps

4. If we remove snails from the pond, which organisms will have less food?
   a. Chickens
   b. Mud crabs
   c. Mud skippers
   d. Fiddler crabs

5. Leaf litter is a food source for all of the following except:
   a. Rabbitfish
   b. Prawns
   c. Mud skippers
   d. Oysters

Answer Key:

1. *b*
2. *a*
3. c
4. *a*
5. c

V. ASSIGNMENT

Investigate how fisherfolk gather crabs, snails, and bivalves from the area. Ask them the amount of catch they usually get and whether the supply of crabs, snails, and bivalves have changed over the years.

Characteristics of Waves: Amplitude and Wavelength

(Surface Waves and Tsunamis)

I. OBJECTIVES

A. Content Standards

The learner demonstrates an understanding of waves as a carrier of energy.

B. Performance Standards

The learner discusses how mangrove trees can reduce the impact of waves.

C. Learning Competency

Code: S7LT-IIId-6

Objective: Relate the characteristics of waves.

Specific Objectives:

1. Calculate the speed, wavelength, frequency, and amplitude of a wave;
2. Characterize the parts of the waves; and
3. Discuss how mangrove trees can reduce the impact of waves.

II. SUBJECT MATTER

A. Topic: Characteristics of Waves: Amplitude and Wavelength

B. Reference: Mangrove Education Series for Secondary Schools *Student's Module*, DepEd Curriculum Guide

C. Materials: Learner's Materials

III. LEARNING ACTIVITIES

A. Motivation

Hi-LLo! Wave-wave naman jan!

Each group will be given an illustration of a wave and they are going to identify its parts. The first group to finish needs to wave their hands and say *Hi-LLo! We're done!* And post their work on the board.

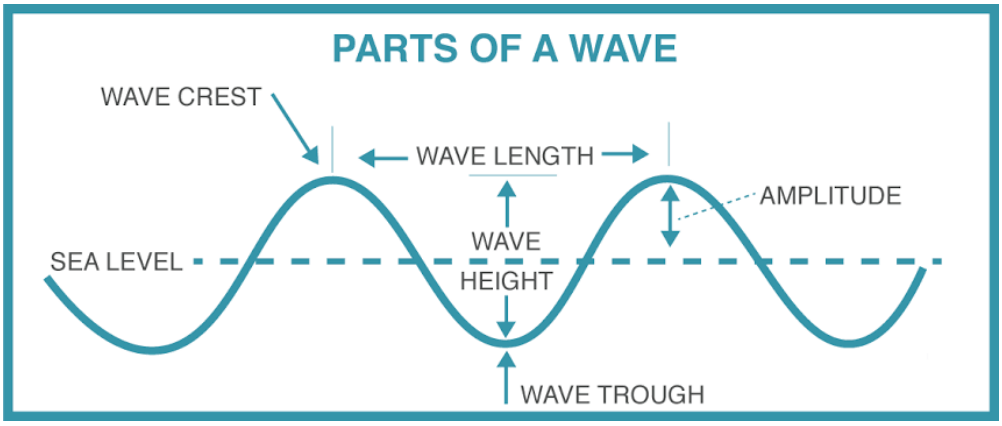


Figure 1. Parts of a Wave

B. Preliminary Activity

(Differentiated Instruction)

Integration in MAPEH subject

The class will perform Activity 1 – Understanding Sea Waves

Objectives:

In this activity, you are expected to:

1. Describe and measure the crest and trough of water waves; and
2. Calculate the amplitude of water waves.

Materials:

1-meter stick, preferably plastic

Marking pen

Procedure:

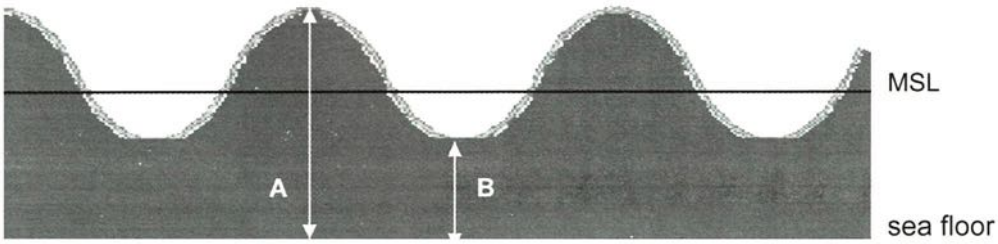
1. Schedule the activity during a low tide. Check the calendar for the exact time of the low tide.
2. Wear comfortable clothes and shoes.
3. Wade into the knee-deep water.
4. Face the approaching waves. Turn right and hold the meter stick upright such that the zero end touches the seafloor.
5. Watch the passing waves. Draw and label on the meter stick the level of the crest and trough of the waves you observe.
6. Wait for an approaching wave. While holding the meter stick, let another member of your group observe and record the highest and the lowest points

of the passing wave. Take several trials and record your data in the table below. Compute the average.

Trial	Highest point (cm)	Lowest point (cm)
Average		

Questions

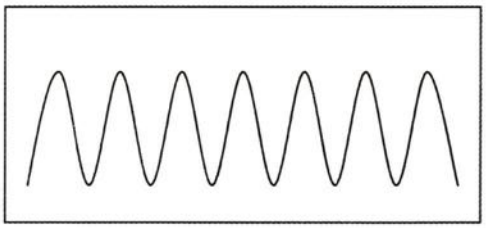
1. What is the average of the highest point and the lowest point of the waves?
2. Show the distance of the crest and trough from the sea floor using the illustration below.



Measure the mean sea level (MSL) of the wave. Subtract the height of the trough (B) from the height of the crest (A). Then divide the difference by two. The result is the measure of the mean sea level.

3. Measure the amplitude of the wave. Subtract the MSL from the height of the crest.
4. What produces a high amplitude wave? A low amplitude wave? How would you compare the amplitude of an ordinary wave with a giant wave or tsunami?
5. What does the amplitude tell about the energy of the wave?
6. At a speed of 10 km/h, large destructive waves are formed with amplitude ranging from 24 m to 35 m high. Consider a one-storey building with a standard height of 3 to 4 meters. How many storeys of a building can a tsunami wave reach?

7. Look at the estimated amplitude of the ordinary surface water waves you observed today. How many times higher is the amplitude of tsunami waves compared with those of ordinary water waves?
8. What is the importance of mangrove trees when tsunamis strike?
9. Planting mangroves along the coastline makes a difference in the impact of tsunamis. Reports on the 2004 tsunami in Asia led people to realize the importance of mangroves. It has been reported that the worst damage to life and property was observed in places with no natural protection. The reports further suggest that the people living behind mangrove forests experienced less devastation *(Environmental Justice Foundation, 2004)*.



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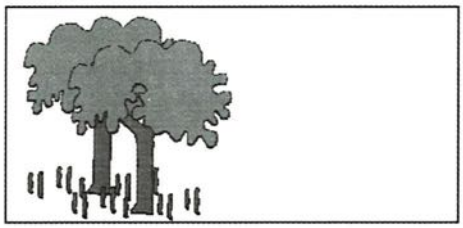


B

How do mangroves provide protection from tsunamis? Figure A above shows the amplitude of giant waves approaching the shore. Imagine and draw the resulting waves in Figure B if there were mangrove trees in the area. How will you explain the illustration you made?

From your illustration, how will you explain the importance of mangrove forests during a tsunami?

Note:

If outdoor activity is not possible, the teacher may prepare three different height of waves like the one on the picture below and the students will follow the procedure and answer the follow-up question in the module. They can present their output through (a) Drawing, (b) Concept Mapping, (c) Pantomime, (d) *Hugot*/ pick-up lines and others.

C. Analysis/ Discussion

Questions for discussion

Follow up question in Activity 1 – Understanding Sea Waves on (B) *Preliminary Activity*.

D. Abstraction

What would happen if surface waves continuously hit the coastline and riverbank? Surface waves can cause problems like erosion. The energy of waves can erode the soil along the beach. There are two ways by which wave action can do this. One is the constant crashing of the waves that loosens particles from the rocks and soil block. This action disperses soil and rock fragments which are eventually carried away by waves. Second, waves send water into cracks and crevices in rocks. The cracks get bigger until finally water pressure splits the rocks open for further action of the waves.

Mangroves and Tsunamis

The greater the energy carried by the wave, the higher is its amplitude. This results in bigger and higher waves. Big waves are powerful and can enclose everything along their way. When the energy of the waves is reduced, it follows that the amplitude is smaller. Smaller waves have less energy and therefore cause less destruction.

Mangroves play a vital role in reducing the energy of giant waves. Friction with the roots, trunks, branches, and leaves of the trees causes resistance that slows down the approaching waves.

Do you now see how mangroves work? The more mangrove species we plant, the stronger is our protection from strong waves. Why not organize local folk to plant more mangrove trees near your place? What do you think are the mangrove species appropriate to your locality? Why?

E. Application

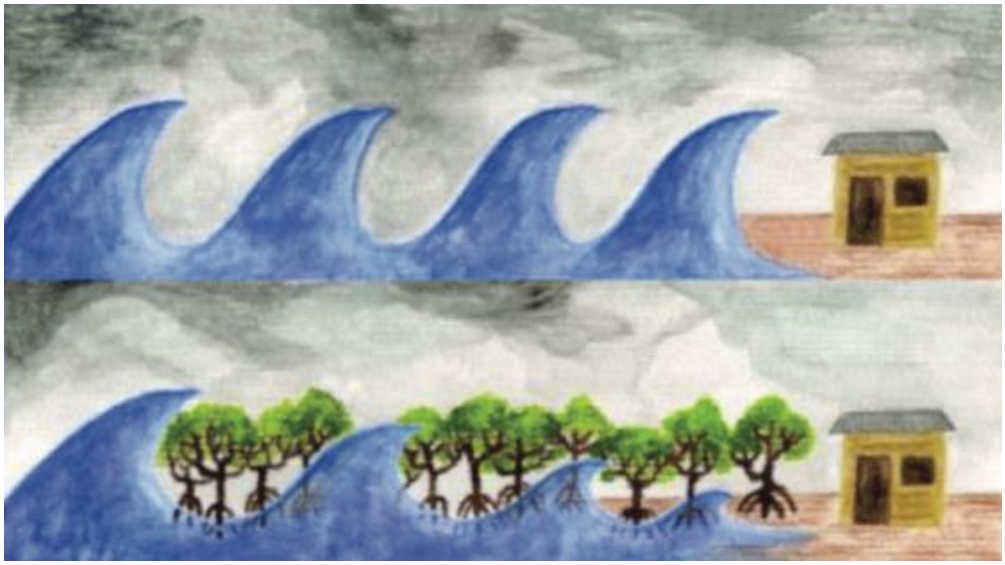
(Integration of Art)

Poster Making

Design a poster portraying how mangrove trees can reduce the impact of waves/ tsunami.

Example:

Provides natural protection for coastal communities



F. Generalization

1. Describe each part of the waves;
2. Discuss how mangrove trees can reduce the impact of waves; and,
3. Discuss how to calculate the speed, wavelength, frequency, and amplitude of a wave.

IV. EVALUATION

Objective Type of Test

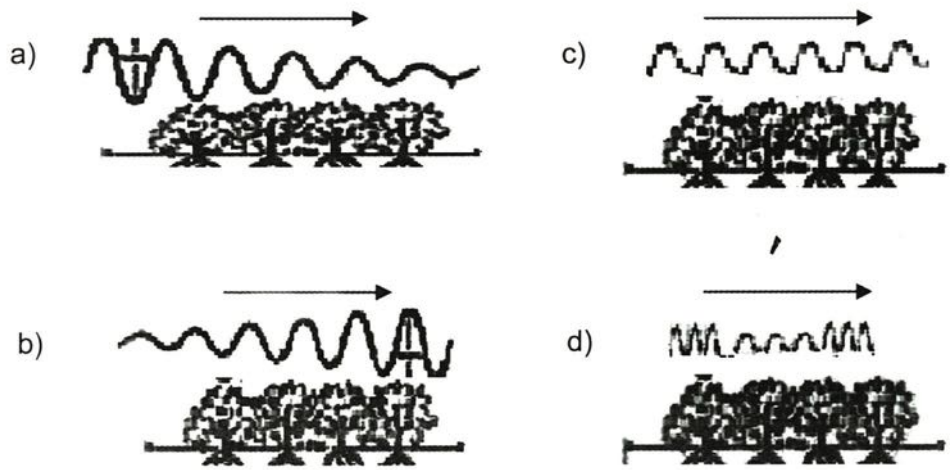
A 10-item quiz on parts of the wave, how mangrove trees reduce the impact of waves and computation of the speed, wavelength, frequency, and amplitude of a wave.

Test Yourself

Read carefully the test items and write the letter of the best answer in your notebook.

1. All the natural forces below cause tsunamis EXCEPT:
   a. Tides
   b. Underwater tectonic earthquake
   c. Underwater volcanic earthquake
   d. Underwater earthquakes with 6.5 magnitude or higher

2. Which of the following illustrations shows what happens to tsunami waves when approaching a shoreline lined with mangrove trees?



3. Waves have common characteristics. Which of these characteristics shows the distance from one wave to another wave?
   a. Speed
   b. Frequency
   c. Amplitude
   d. Wavelength

4. Which of the following statements about the energy of tsunami waves is true?
   a. The energy of a tsunami wave is greater when its speed is faster.
   b. The higher the frequency of the wave, the greater is the energy.
   c. The higher the amplitude of the wave, the greater is its energy.
   d. At the shoreline, the energy of a tsunami wave is determined by its wavelength.

5. When the speed of the wave decreases, its amplitude:
   a. Decreases
   b. Increases
   c. Goes to zero
   d. Remains the same

6. The highest part of the wave is called the:
   a. Crest
   b. Trough

c. Amplitude
d. Wavelength

7. In deep oceans, tsunami waves are not easily seen, but near the coastlines the giant waves have amplitude ranging from:
   a. 500 m to 1, 000 m
   b. 50 m to 100 m
   c. 24 m to 30 m
   d. 8 m to 24 m

8. Which of the following communities may be less affected by tsunamis?
   a. People near an open shoreline
   b. Plants and animals in an open shoreline
   c. People behind wide mangrove plantation or natural forest
   d. Plants and animals behind a thin band of mangrove trees

9. Which of the following is NOT a benefit of mangroves in coastal areas?
   a. Weakens tsunami's impact
   b. Promotes coastline erosion
   c. Provides habitat to some organisms
   d. Protects people from strong winds

10. What can be done to reduce the destructive effect of tsunamis?
    a. Plant more mangroves
    b. Protect existing mangroves
    c. Build sea walls to prevent giant waves from reaching the shore
    d. All of the above

Answer Key:

1. *a*
2. *a*
3. *d*
4. *c*
5. *a*
6. *a*
7. *c*
8. *c*
9. *b*
10. *d*

Tides in the Mangrove Forest

I. OBJECTIVES

A. Content Standards

The learner demonstrates understanding of the occurrence of an eclipse.

B. Performance Standards

The learner is able to discuss how an eclipse occurs.

C. Learning Competency:

Code: S8LT-IVh-21

Objective: Explain how solar and lunar eclipses occur. (S7ES- IVj-12)

Specific Objectives

1. Describe tides;
2. Point out the causes and effects of tides;
3. Discuss the effect of tidal variation on shoreline erosion; and
4. Explain the role of tides in mangroves.

II. SUBJECT MATTER

A. Topic: Tides in the Mangrove Forest

B. Reference: Mangrove Education Series for Secondary Schools *Students' Module*, DepEd Curriculum Guide

C. Materials: Learner's Materials

III. LEARNING ACTIVITIES

A. Motivation

4 PICS 1 WORD about tide, earth, moon, and sun

Afterwards, ask the students how the moon, sun, and earth interact with each other. What is the connection of the position of the earth, moon, and sun to the tides?

B. Preliminary Activities

(Using Differentiated Instruction)

Bring the students to the nearest seashore with mangrove and let them observe the roots, trunks and branches of the mangrove tree. Ask them to observe how tides affect the mangroves. Let students perform Activity 1 (measurement of roots, trunks, and branches).

Activity 1 – Measurement of Roots, Trunks, and Branches

At the end of this activity, the student should be able to:

1. Describe the roots, trunks, and branches of mangrove trees, and
2. Explain how the roots, trunks, and branches of mangrove reduce soil erosion.

Materials:

Bond paper
Pencil
Coloring materials

Procedure:

1. Observe and draw the roots, trunks, and branches of the mangrove trees.
2. Determine the direction of the water current when water begins to ebb during low tide.
3. Determine the direction of the water current on a flood tide. Observe where the materials that you saw during the low tide go.

Questions:

1. How do you describe the roots, trunks, and branches of the mangrove trees?
2. What kind of roots do mangrove have?

C. Analysis/ Discussion

1. How do the roots, trunks, and branches of mangroves reduce soil erosion?
2. How will you determine the direction of the current when water begins to ebb during low tide? How about the direction of the water current on a flood tide? Where will the materials that you saw during the low tide go?
3. What kind of roots do mangroves have?
4. How do tides affect mangroves?
5. What happens to the mangrove forest at high tide?
6. Do tides affect the life at sea? Explain.

D. Abstraction

Tides are the result of sun, earth, and moon interactions. The resulting tide is the rise and fall of sea water in periodic fashion. As the sea water rises and falls, it brings mangrove litter serves as food for some organisms. ***Flood tide*** is the rising of the water level to its highest (high tide level) while ***ebb*** tide is the drawing away of the water level to its lowest point (low tide level).

The gravitational attraction of the moon and sun on the waters of the earth produces the tides. Being nearer to the earth, the moon exerts more influence on its water. However, when the moon and sun are in line with the earth, gravitational effect is reinforced. The high tide becomes exceptionally high and the low tide becomes very low. This phenomenon is called ***spring tide***. On the other hand, ***neap tide*** occurs when the sun and the moon are at right angles to the earth. Because the gravitational effect is weakened, the high tide is lower than its usual height and the low tide higher than usual.

E. Application:

(Integration with MAPEH, English and Filipino)

Based on what you have learned, how do tides affect the mangrove forest? Students will give their ideas through drawing, poem or pantomime or short dialogue.

F. Generalization

1. What are the causes and effects of tides?
2. What is the role of tides in mangroves?

IV. EVALUATION

Test Yourself

True or False: Write true if the statement is correct; otherwise, change the underlined word to make the statement true. Write the answer in your notebook.

1. When water is rising, the tide is <u>ebb</u> tide.
2. The changing <u>sediments</u> play a key role in maintaining mangrove forests.
3. <u>Tides</u> help in the circulation of nutrients in the water.
4. The complex forms of mangrove roots and trunks trap <u>sediments</u>.
5. During <u>high</u> tide, outgoing water carries mangrove litter to nearshore habitats.
6. <u>Tides</u> spread pollutants.

7. Mangrove forests are connected to seagrass and coral reefs.
8. Salt water is a physical requirement for mangrove growth.
9. Mangrove roots slow down water flow and trap pollutants.
10. When the water ebbs during low tide, the dense roots and trunks of mangroves prevent mud and sand from being washed away.

Answer Key:

1. *False (high)*
2. *False (tides)*
3. *True*
4. *True*
5. *False (low)*
6. *True*
7. *True*
8. *False (brackish)*
9. *True*
10. *True*

Part II. Grade 8 Competencies

Wind Speed (Weather Disturbances)

I. OBJECTIVES

A. Content Standards

The learners demonstrate an understanding of the formation of typhoons and their movement within the PAR.

B. Performance Standards

The learners shall be able to demonstrate precautionary measures before, during, and after a typhoon, including following advisories, storm signals, and calls for evacuation given by government agencies in charge.

C. Learning Competency

Code: S8ES-IId-18

Objective: Explain how typhoons develop.

Specific Objectives: The learners are expected to understand the weather disturbances in the Philippines and to make an improvised anemometer.

II. SUBJECT MATTER

Topic: Wind speed (Weather Disturbances)

Reference: Science 8 Learner Modules, Mangrove Education Series for Secondary Schools *Students' Module*

Materials: Book, Notebook, Laptop, Television, Quadrat, Activity Notebook

III. LEARNING ACTIVITIES

A. Motivation

4 PICS 1 Word Game

The students will guess what the set of four pictures have in common. After they guess what it is, they need to describe and share their prior knowledge of it.

B. Presentation

(Topic)

A tropical cyclone starts as a tropical depression and progresses into a tropical storm or typhoon. The word *typhoon*, which is used today in the northwest Pacific, may be derived from the Urdu, Persian, and Arabic (Ulan – which in turn originates from Greek *Typhon*, a mythology monster associated with storms). *(ArPan)*

What will you do if a typhoon like Yolanda that once damaged Busuanga has occurred once again? (Localization)**.** Through role-play, singing, poem, spoken poetry, etc. show to the class your answer. (Differentiated Instruction)

Strong winds are brought about by weather disturbances. Communities of people and other life forms subject to wind damage. Those who live near the sea usually suffer from strong winds. Human lives and property are lost during storms and typhoons. As the Philippines, specifically Busuanga (Localization), is regularly hit by typhoons, there should be more active mangrove planting. As a part of this, we need to make an anemometer, a device used for measuring wind direction. It is also a common weather instrument.

C. Preliminary Activity

Activity 1: How to make an improvised anemometer

Objective:

To make an improvised anemometer.

Rubrics for Making an Anemometer *(to be posted on the board)*

Attainment of the objective	30%
Creativity	20%
The usefulness of the anemometer	20%
Quality	20%
Presentation	10%
TOTAL	**100%**

Materials:

Protractor

20cm string

Ping pong ball

Barbecue stick
Masking tape
Needle
Cutter

Procedure:

1. Using a pointed cutter, make a hole in the middle-upper side of the protractor (A).
2. Insert one end of the string in the hole of the protractor (B).
3. Make two holes on the ping pong ball, one on each side.
4. Using a needle, insert the other end of the string through the hole on one side of the ping pong ball. Then, let the string pass through the other hole on the opposite side. Tie the string such that the ping pong ball is free to swing.
5. Make a handle for the anemometer. Use the masking tape to attach the barbecue stick to the straight edge of the protractor (C).
6. Bring the anemometer outside.
7. Now, with your improvised anemometer, you are ready to go on a field trip!

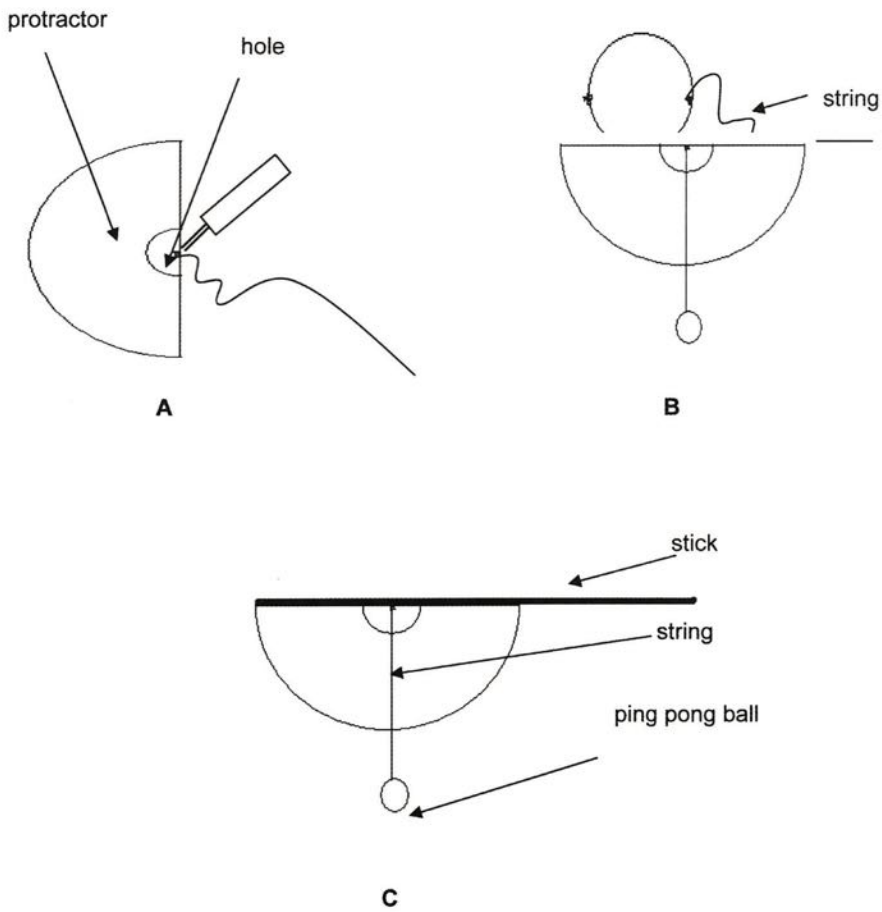


Figure 2. Making an Improvised Anemometer

Table 1. Wind Speed Chart

(Cortes et al., 1996)

Angle (degrees)	Wind Speed (km/h)
90	0
85	9.33
80	13.20
75	16.25
70	18.99
65	21.57
60	23.98
55	26.39
50	28.97
45	31.54
40	34.34
35	37.66
30	41.52
25	46.19
20	52.30

Activity 2: Feel the Wind!

(It is suggested to have an actual mangrove visitation – second day)

Objectives:

In this activity, you are expected to:

1. Measure wind speed;
2. Describe the condition of the sea during an ordinary day;
3. Describe the effect of winds on mangrove trees; and
4. Discuss the importance of a coastal mangrove greenbelt during typhoons and storms.

Materials:
Improvised anemometer
Wind Speed Chart

Procedure:

1. Visit a mangrove forest. Measure the wind speed in different parts of the forest such as in front of the beach, in the middle of the forest and behind the forest.
2. Hold your improvised anemometer and view straight along the upper edge of the handle of the improvised anemometer. Align the anemometer along the horizon (if you are in the coastline) or any fixed object.
3. Let another member of your group record the angle reading as the wind moves the plastic ball. This is the distance the string is displaced from the 90° point of the protractor.
4. Look at the wind speed corresponding to the angle reading from the Wind Speed Chart.
5. Take several readings. Compute the average.

D. Fixing Skills/ Exercises/ D.I.

Presentation of the improvised anemometer on the first day. (MAPEH)
Presentation of the data gathered on the second day.

E. Analysis/ Discussion

1. Does the wind move the ping pong ball of your anemometer?
2. By how many degrees?
3. Look at the wind speed chart and determine the speed of the wind.
4. What is the average speed of the wind in the different parts of the mangrove forest?
5. In what part of the mangrove forest did you measure and feel the strongest wind? Can you explain your observation?
6. What is the effect of wind on the waters of the sea?
7. Compare the effect of the wind on your standing (a) behind the mangrove trees and (b) in front of the beach.

F. Abstraction

(Expected Output)

The Philippines faces the Pacific Ocean where low pressure and other weather disturbances originate. In the process, these weather disturbances bring strong

winds and sea currents. The strong winds are carried by typhoons that visit the Philippines at least 20 times in a year. In coastal areas, mangroves provide protection to coastal residents from harmful weather.

Typhoons often hit the country during the months of June to November, which is also the rainy season in the Philippines. Strong winds and rough seas are experienced during these months. They transfer their energy to the waves that strike the shore and destroy coastal villages. However, wave energy can be reduced by mangrove roots, trunks, and branches.

G. Valuing

"Wave energy can be reduced by mangrove roots, trunks, and branches." How can you relate to this?

H. Application

Aside from wind protection, what are the other uses of mangroves? (Economics/TLE)

I. Generalization

How you understand the weather disturbances in the Philippines and how you make an improvised anemometer.

IV. EVALUATION

1. A weather disturbance that brings about heavy rains and strong winds of about 60 to 119 kph is called a:
   a. typhoon
   b. depression
   c. cyclone
   d. storm

2. All of the following disturbances are tropical cyclones EXCEPT a/an:
   a. depression
   b. ice storm
   c. typhoon
   d. storm

3. Which is NOT true about typhoons and storms in the Philippines?
   a. Strong winds of more than 200 km/h are brought about by storms and typhoons.
   b. Storms and typhoons usually occur during the rainy months.
   c. Winds remain constant during storms and typhoons.
   d. Winds can produce storm surges.

4. Which is the strongest among all tropical cyclones?
   a. typhoon
   b. tornado
   c. storm
   d. gale

5. Which of the numbers in the Beaufort Scale indicates that a storm is starting?
   a. 5
   b. 6
   c. 7
   d. 8

Answer Key:

1. a
2. b
3. c
4. a
5. c

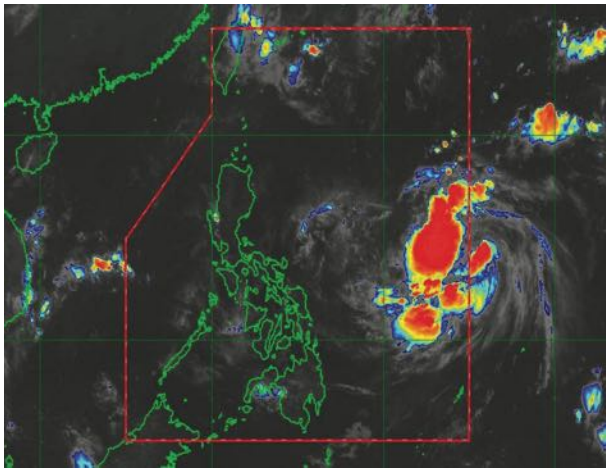
V. ASSIGNMENT

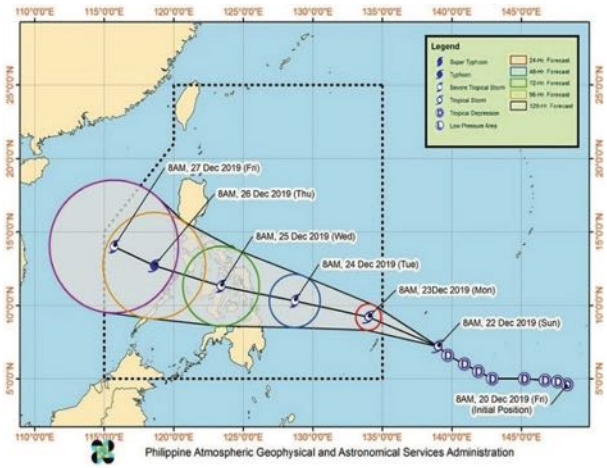
List down reasons why species become extinct.

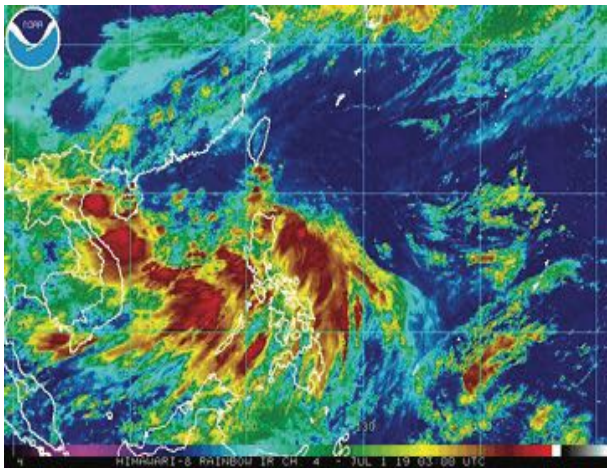
Answer Key:

1. *Asteroid strikes*
2. *Climate change*
3. *Disease*
4. *Better-adaptive competition*
5. *Habitat loss*
6. *Pollution*
7. *Invasive species*
8. *Lack of genetic diversity*
9. *Human predation*

4 PICS 1 Word





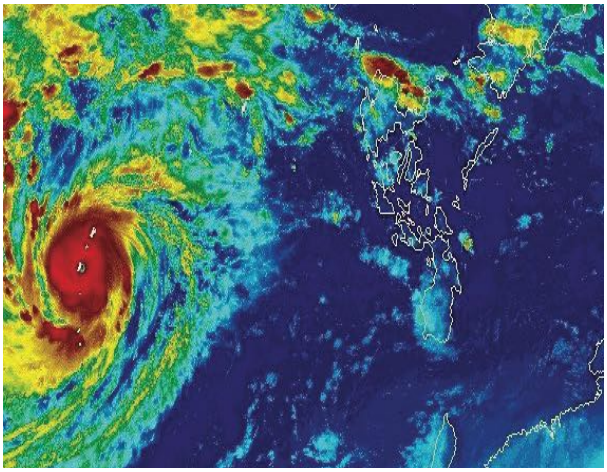


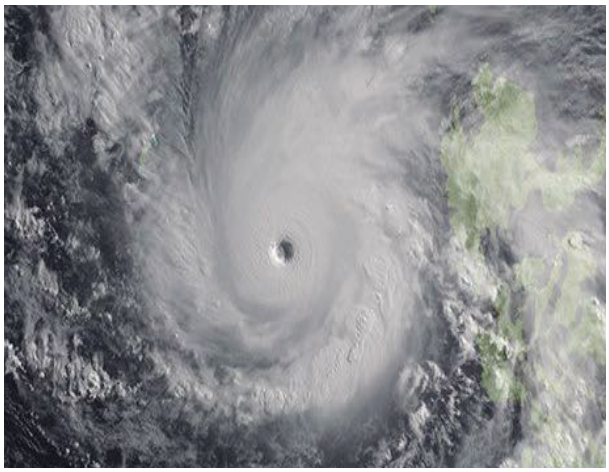
	T							L	
		E					S			N

Answer Key:

1. *Tropical Depression*
2. *Typhoon*

	Y					N





Ecological Workers in the Mud

I. OBJECTIVES

A. Content Standards

The learner demonstrates understanding of the concept of a species.

B. Performance Standards

The learner should be able to report on the activities that communities engage in to protect and conserve endangered and economically important species.

C. Learning Competency

Objective: Explain the concept of species. (S8LT- IVg-19)

Classify organisms using the hierarchical taxonomic system. (S8LT-IVh-20)

Specific Objectives:

1. Identify the ecological services provided by mangroves;
2. Demonstrate these services with the use of mangrove models;
3. Construct a mangrove model; and
4. Explain the ecological functions of mangroves.

II. SUBJECT MATTER

A. Topic: Ecological Workers in the Mud

B. Reference: Mangrove Education Series for Secondary Schools Students' Module, DepEd Curriculum Guide

C. Materials: Learner's Materials

III. LEARNING ACTIVITIES

A. Motivation

(Localization)

Do you have a mangrove forest in your locality? How important is the mangrove forest?

B. Preliminary Activities

(Using Differentiated Instruction)

The students will group into 5. Let them perform the activity. Then followed by group reporting.

Activity 1 – Simulation of Ecological Functions of Mangroves

Objectives:

The activity will enable you to:

1. Construct a mangrove model, and
2. Explain the ecological functions of mangroves.

Materials:

Soil (Soft, can be molded), 2 small plastic bags
Mud, 1 cup
Fine sand, 1 cup
Powdered charcoal, 1 tbsp.
Small pebbles, 1 – 2 mm diameter
Big pebbles, 5 – 6 mm diameter
Small plants, 5 – 10 cm height
Floral foam, 1 pc
Old newspapers
Plastic bottle, 1.5-liter cap.
Bottle, 500 ml cap.
Basin, 15 cm depth
Small bowl, 20 ml cap.
Water, 3 liters
Marking pen

Procedure:

a. Marking a mangrove model

1. Spread a layer of soft soil (as thick as the depth of the basin) on half of the basin to represent land. Leave the other half of the basin empty to represent a body of water.
2. Shape the land so that it gradually slopes down and the highest point reaches the edge of the basin. Smooth the soil along the sides to seal the edges.
3. Along the edges, put a lifting of floral foam or sponge. Dig holes along the

floral foam and plant your seedlings in the holes and top it with soil. This represents the mangrove area.

4. You have now made your own mangrove model. It is ready to perform some functions.

b. Simulation: Mangroves as nutrient and sediment sinks

1. Cover your work area with old newspapers. Place the basin with the mangrove model on the newspapers.
2. Fill a 500-ml water bottle with 250 ml of tap water. Add sand, powdered charcoal, small pebbles, and big pebbles to the bottle. Close the bottle tightly and shake the solution well.
3. The sand represents the sediments while powdered charcoal, small pebbles, and big pebbles represent carbon, nitrogen, and sulfur, respectively.
4. Pour the solution slowly over the land (soil). Observe and record what happens to the sand, charcoal, and pebbles.

c. Simulation: Mangroves and flood control

1. In the empty part of the basin, mark the side 2 cm from the base with a marking pen.
2. Pour clear water slowly over the land (soil). With your timer, note how long (in seconds or minutes) it takes for the water to reach the 2 cm mark in the empty part of the basin. Record your observation.
3. Drain the water from the basin and wipe to dry the empty side. This time remove the floral foam with the plants from your mangrove model.
4. Secure the edges of soil and smoothen with your hand.
5. Again, pour water slowly over the land and observe how long it takes for the water level to reach the 2 cm mark. Record your observation.

d. Revising the mangrove model: Mangroves and water quality improvement

1. Cover your work area with newspapers.
2. Cut the 1.5-liter bottle into half along its length without damaging the neck. Be careful with the cutter.
3. While lying on its side, fill the bottom of the bottle with soil or mud. Put a layer of fine sand on top of the soil or mud.
4. Pack the big pebbles in a small heap at the wide end of the bottle.
5. Plant the small plants in the soil in the neck of the bottle.
6. Place the wide end of the bottle at an angle on a block of wood and rest

the neck of the bottle in a small bowl (so that the water will run down from the wide end into the bowl).

7. In a clear container, mix water with fine soil and sand until it becomes muddy.
8. Slowly pour the muddy water over the big pebbles at the wide end of the bottle. Keep a little of the muddy water in the container.
9. Wait until the water moves through the soil and flows into the small bowl.
10. Compare the collected water in the bowl with the remaining water in the container as to color or appearance and smell.
11. Record your observations in your notebook.

C. Analysis/ Discussion

Discuss the following ecological functions of mangroves:

1. As below ground carbon sinks
2. Shoreline stabilization and sediment traps
3. Water quality improvement
4. Minimize impacts of storm surges and tsunamis

D. Abstraction

Ecological Functions of Mangrove as Ecological Carbon Sinks

Human activities are increasing the concentration of air pollutants such as greenhouse gases. Mangroves play an important role in absorbing atmospheric CO_2. Mangroves act as major CO_2 sinks that capture carbon from the atmosphere and store the same in the form of biomass during growth.

Shoreline stabilization and sediments traps

Mangroves' roots bind and protect the soil from being washed away by wave action and storm surges. Mangroves trap sediments and thus act as sinks for suspended elements. Mangroves reduce tidal flows due to friction provided by the roots and other structures.

Water quality improvement

Mangrove prevents the entry of seawater inland and protects underground water systems, including sources of drinking water in coastal communities. Minimize the impacts of storm surges and tsunamis.

E. Application

(Integration to MAPEH, English, and Filipino)

Using a model demonstrate how mangroves work to provide services especially to coastal communities?

F. Generalization

What are the ecological functions of mangroves?

IV. EVALUATION

Test Yourself

1. What did the floral foam represent in the first mangrove model?
2. What did the small plants represent?
3. What happened to the sand, powdered charcoal, and pebbles that you poured over the model?
4. How long did the water reach the 2-cm mark when you poured it over the model with floral foam and plants and over the model without floral foam and plants? Record your observations in the table below.

Models	Time to reach the 2 cm mark
With mangroves	
Without mangroves	

5. Was there a difference in the color or appearance and smell of the water before and after it passed through the mangrove model? What were the differences?
6. What conclusions can you make about the role of mangroves based on your mangrove model?

The Coastal Zone and its Characteristics

I. OBJECTIVES

A. Content Standards

The learner demonstrates an understanding of key concepts of a species and the species as being further classified into a hierarchical taxonomic system.

B. Performance Standards

The learner reports (e.g. through a travelogue) on the activities that communities engage in to protect and conserve endangered and economically important species.

C. Learning Competency

Code: S8LT-IVh-21

Objective: Explain the advantage of high biodiversity in maintaining the stability of an ecosystem.

Specific Objective: Explore the marine ecosystem.

II. SUBJECT MATTER

A. Topic: The Coastal Zone and its Characteristics

B. Reference: Mangrove Education Series for Secondary Schools *Students' Module*, Deped Curriculum Guide

C. Materials: Learner's Materials

III. LEARNING ACTIVITIES

A. Motivation

Localization

Know Where I am!

Using video clips/pictures of the Different Marine Reserves in the Philippines that protect the mangroves and other coastal ecosystems, the learners will identify from which marine reserve area, the organisms are found (Activity is good for 5

minutes). To ensure maximum participation, it could be done through contests by a group.

Table 2. Marine Reserve Sanctuary and its Ecosystem Conserved

Location of Marine Reserve Sanctuary	Ecosystems/Organisms Conserved
Malampaya Sound, Palawan	Mangroves, birds
Busuanga Island, Palawan	Seagrass beds, dugong
Tubbataha Reef National Marine Park	Mangroves, sea turtles (nesting sites, seabirds (breeding sites), sharks
El Nido, Palawan	Mangroves, coral reefs, seagrass beds, dugong, sea turtles
Taklong Island, Guimaras	Mangroves, seagrass beds, coral reefs
Danjugan Marine Reserve and Sanctuary, Negros Occidental	Mangrove, seagrass beds, coral reefs, manta rays, sea turtles

B. Preliminary Activity

Differentiated Instruction

Integration in MAPEH subject

Divide the class into three groups: (1) *The Seagrass Organisms*, (2) *The Coral Reef Organisms*, and (3) *The Mangrove Organisms*. Each student is given the freedom to choose which group they want to join. They can present their output through (a) Drawing, (b) Concept Mapping, (c) Pantomime, (d) Hugot/pick-up lines, and others.

They will explore each ecosystem. Identify the organisms in each ecosystem which are the consumers and the producers.

C. Analysis/ Discussion

Questions for discussion

1. What are the different organisms found in the 3 different marine ecosystems?

2. Which one are the producers? The consumers?
3. How did you identify the producers and the consumers?
4. Are there direct or indirect relationships between producers and consumers in the three different areas?
5. Are there significant connections between the producers and consumers in the three areas (seagrass, coral reef, and mangrove)?
6. Do organisms from these 3 areas migrate from one area to another?
7. What will happen to organisms (Consumers) in the sea or coral reef if mangroves and seagrass (Producers) will disappear?
8. From the video clips/pictures shown to you awhile ago, why do you think are the purpose of a marine sanctuary in some identified areas?
9. Identify the Marine reserves in Palawan?
10. The ideal size of a marine reserve is about 20% of the total fished area. The remaining 80%, the non-reserve, is open for fishing by small-scale fishers (Alcala, 2000). If the total fished area in Barangay Panlaitan, Busuanga, Palawan is 16 square km, what is the size of the non-reserve area open for fishing by small-scale fishers? (Numeracy)
11. Are you proud that there are many marine reserve sanctuaries in Palawan? Why? (Valuing)
12. How can you help in your little way to protect and conserve the marine ecosystem in Palawan? In Busuanga? In your Barangay?

D. Abstraction

Location of the coastal zone: The coastal zone includes the shore and the water up to 200 m from the shore at high tide. (*Ong et al., 2002*). It contains several ecosystems: mangroves, seagrasses, and coral reefs.

High biodiversity: The coastal zone of the Philippines has more than 2,000 fish species, 430 species of hard corals, 14 seagrass species (second worldwide to Western Australia), and thousands of shellfish species. (Literacy)

1. Seagrass organisms
   - Producers – seagrasses, algae, and plankton
   - Grazers – Grazers- sea cow (dugong), and green sea turtle that eat seagrass
   - Detritus feeders – starfish, sea cucumbers, fishes and crab that consume partly decomposed organic matter

2. Coral reef organisms
   - Producers – microscopic algae living in a symbiotic relationship with corals
   - Consumers – fishes, clams, octopuses, sponges, sea snakes, crustaceans and corals

3. Mangrove Organisms
   - Producers: Mangrove, bacteria, fungi
   - Consumers: crabs, fish, prawns, molluscs, and crustaceans

Interconnected Ecosystems: The different ecosystems are interconnected through organisms and nutrients moving from one ecosystem to another. Adults of animals can migrate between ecosystems, whereas larvae are passively carried by water as part of the plankton.

Trivia

Did you know that the area within 15 km from the shoreline is reserved for the use of Municipal fisherfolk? Commercial fishing is not allowed inside the zone (RA 8550 or the 1998 Phil. Fisheries Code).

Did you know that Busuanga Municipality has declared Marine Protected Areas (MPAs)? In 2006, the Concepcion–Sagrada–Bogtong MPA was declared as marine reserves of the Municipality through a Municipal Ordinance. Marine Reserves/ Sanctuaries are areas of the marine environment protected from the various forms of human extraction or exploitation. Human activities like fishing and harvesting of corals are completely prohibited.

Marine Reserves are important habitats, such as coral reefs, which are established to help ecosystems recover and increase the production of fish and other organisms.

E. Application

(Integration of Art)

Poster Making

Design a poster portraying a marine reserve, the organisms found in the ecosystem, and how the organism is protected and helps them recover and increase in production.

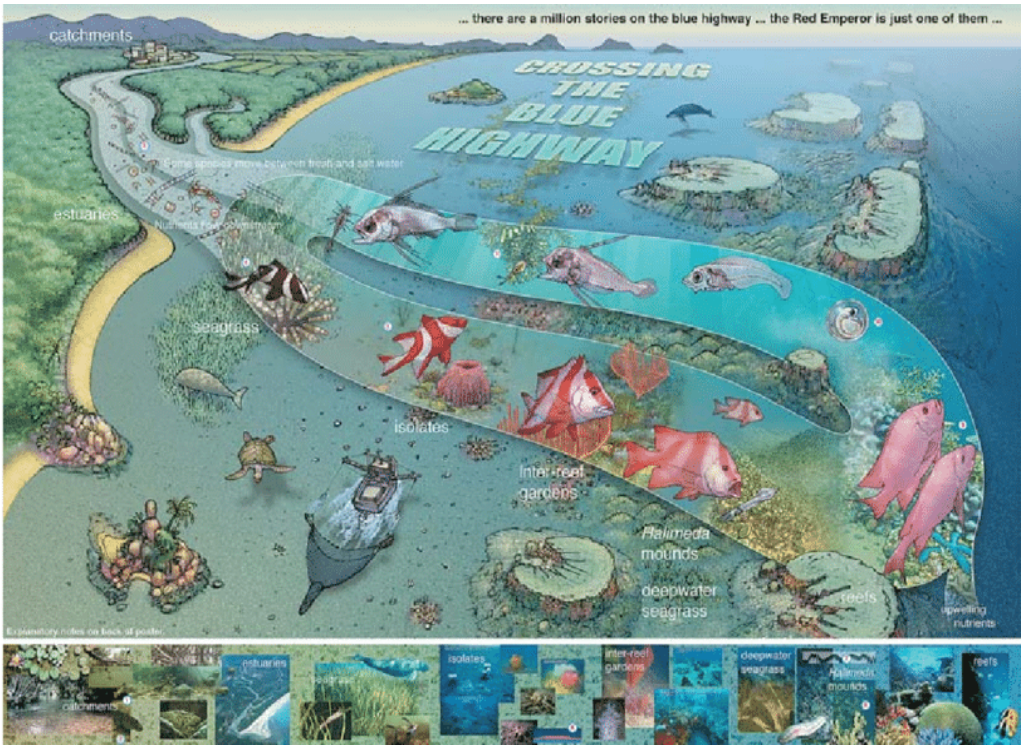


Figure 3. Poster of Marine Reserves

F. Generalization

Explain the advantage of high biodiversity in maintaining the stability of an ecosystem especially in the marine ecosystem and how human being benefits from it. Why do we need to maintain the balance and high biodiversity of an ecosystem?

IV. EVALUATION

Test Yourself

Multiple Choice. Write letters (only) in your notebook.

1. What distance from the shore makes up the coastal zone?
   a. 50 m
   b. 100 m
   c. 200 m
   d. 500 m

2. Which coastal ecosystem supports fisheries in the Philippines?
   a. Seagrass
   b. Coral reef
   c. Mangrove
   d. All of these

3. A mammal which grazes on seagrass is a:
   a. Sea turtle
   b. Dugong
   c. Sea cucumber
   d. None of these

4. The part of an ecosystem where fishing and other activities are completely prohibited to allow the ecosystem to recover from damage and protect juvenile fishes is the:
   a. Reserve
   b. Sanctuary
   c. None of the above
   d. a and b

5. The distance from the shoreline reserved only for the use of Municipal fisherfolk and where commercial fishing is not allowed is:
   a. 15 km
   b. 25 km
   c. 30 km
   d. 40 km

6. The term which means “meeting the needs of the present generation without sacrificing the ability of ecosystems to meet the needs of future generations” is:
   a. Ecosystem
   b. Sustainability

c. Reserve
d. None of these

7. Corals, which are heterotrophs, live in symbiotic relationship with:
   a. Fish
   b. Sea cucumber
   c. Microscopic algae
   d. Larvae

8. Which of the following must be avoided to maintain a continuous supply of fish in a given body of water?
   a. Overharvesting
   b. Overestimating
   c. Overfishing
   d. None of these

9. A reserve or sanctuary:
   a. Is legally protected from any human activity
   b. May have ecological or recreational value
   c. Is established to increase protection of fish and other organism
   d. All of the above

10. A marine reserve in the Philippines which protects mangroves and sharks, a nesting site of sea turtles and a breading site of migratory birds is:
    a. Apo Island, Negros Oriental
    b. Tubbataha Reef National Marine Park, Palawan
    c. Taklong Island National Marine Reserve, Guimaras
    d. Sumilon Island, Cebu

Answer Key:

1. c
2. a & c
3. b
4. d
5. a
6. c
7. c
8. c
9. d
10. b

V. ASSIGNMENT

Take-home Activity/Field activity

Sea Catch

Objectives:

At the end of this activity, the student should be able to:

1. Name some of the organisms caught by fishers;
2. Count the number of species of animals (local or common name) caught in the nets;
3. Determine if present catches of fishers are smaller compared to the past; and
4. Find out if fishers return to the sea the immature fishes they catch.

Materials:

Notebook

Pencil

Procedure:

Before the field

1. The teacher will identify a fishing village near your school for the field trip. The trip should be scheduled during the months of the year when there is fishing. Obtain permission to interview the fishers from the Barangay Head or fishers.

2. The class will be divided into groups, with 4 members each.
3. Wear a hat and apply sunblock.
4. Make two copies of the worksheet in your notebook which you will use when you interview fishers.

During the trip

1. With your group, approach two fishers from different boats that have just landed and introduce yourselves and your school. Then ask permission to look at their catch.
2. Examine the fishes and other animals in their catch. Count the number of species or kinds of fish, shrimps, crabs, etc. If you do not know some animals, ask the local or common name from the fisher. Record your data in your notebook.
3. Determine which kinds of fish are the most abundant. Rank the top 5 most abundant fish.
4. Ask the fishers about their catch (See worksheet). After the interview, be sure to thank the fisher for sharing their time and what they know.
5. In the classroom, compile class data on the total number of kinds of fish, shrimps, crabs, squids, etc. that you observed.

Table 3.a. Sea Catch
Worksheet

A. Checklist of Organisms Caught in Net					
Invertebrates	No. of species (Check the appropriate box)				
	1	2	3	4	5
1. Shrimps					
2. Squids					
3. Crabs					
4. Sea cucumber					
5. Others (please specify):					

Fish (write local or common names):
1.
2.
3.

Table 3.b. Sea Catch *Worksheet*

B. Interview Questions
Name of fisher: Address: Number of years fishing: Date:
1. Has your catch increased or decreased in the past years? 2. Can you give reasons why your catch increased/decreased? a. b. c. 3. What kinds of fish were many in the past but are fewer now? 4. What do you do with fishes that are too small to be sold?

Species Diversity

What are the Characteristics of Mangrove Plants?

I. OBJECTIVES

A. Content Standards

The learner demonstrates the understanding concept of species.

B. Performance Standards

The learner shall be able to report (through a travelogue) on the activities that communities engage in to protect and conserve endangered and economically important species.

C. Learning Competency

Code: S8LT-IVh-21

Objective: Explain the advantage of high biodiversity in maintaining the stability of an ecosystem.

Specific Objectives:

1. Describe the different characteristics of leaves and flowers of mangrove plants**;**
2. Understand and apply these characteristics in classifying some mangrove species; and
3. Explain the advantage of the high biodiversity of mangroves in Busuanga in maintaining the stability of the marine ecosystem.

II. SUBJECT MATTER

A. Topic: Species Diversity

B. Reference: Mangrove Education Series for Secondary Schools *Students' Module*, DepEd Curriculum Guide

- *Field Guide to Philippines Mangroves* (*Primavera, 2009*)

C. Materials: Learner's Materials

III. LEARNING ACTIVITIES

A. Motivation

MA-PUT-TITIK

Using pictures of the different physical structure and characteristics of mangroves, students will identify the form and structure of the flower by putting the missing letter.

__ O __ __ T __ R __ *(example)*

B. Presentation

Presentation of different pictures of flowers, leaves, and roots of mangroves.






Photos by C3 Philippines, Inc.

C. Preliminary Activity

Differentiated Instruction

Integration in MAPEH subject *(If an outdoor activity will not be possible)*

The class is divided into 5 groups. Each group will be given 2 minutes to study the mangrove samples in each Station and try to match the characteristics of your specimens with the characteristics of the identified species in the Field Guide to Philippines Mangroves (*Primavera, 2009*).

After they study each sample, they are going to present their output through (a) Drawing, (b) Concept Mapping, (c) Pantomime, (d) Hugot/ pick-up lines, (e) Jingle and others.

GROUP ROUTE

Group 1	Station 1 → Station 2 → Station 3 → Station 4 → Station 5
Group 2	Station 2 → Station 3 → Station 4 → Station 5 → Station 1
Group 3	Station 3 → Station 4 → Station 5 → Station 1 → Station 2
Group 4	Station 4 → Station 5 → Station 1 → Station 2 → Station 3
Group 5	Station 5 → Station 1 → Station 2 → Station 3 → Station 4

Activity 1 – Identification of Floral Patterns, Roots, and Leaf Characteristics of Mangrove Plants

Objectives:

1. To understand the different types of floral patterns, roots, and leaf characteristics; and
2. To classify leaves and flowers of mangrove plants according to these types.

Materials:

Laboratory notebook
Pencil
Marking pen
Plastic bags
Field Guide to Philippine Mangroves (*Primavera, 2009*)
Colored pencils or crayons
Masking tape

Insect repellent
Camera (optional)
Ruler

Procedure:

a. Preliminary activities

1. Identify a mangrove area near your locality for your sampling site.
2. Get a calendar that shows the lunar phases and tidal elevation. Select a date with low tide (0 to 0.5 m) during the day for mangrove fieldwork.
3. Wear comfortable clothing (long pants and long sleeves), hat and old rubber shoes and apply sunblock and insect repellent.
4. Before going to the site, make sure that your materials are complete. Copy the report sheets and questions in Activity 1 of the lesson in your notebook. Use this to record your data.

b. Sample collection

1. Visit your local mangrove site again, and check if the mangrove plants are flowering (season varies, but most mangroves flower from March to June).
2. It is best to do this activity when the plants are flowering. However, if there are no plants with flowers, you may identify leaf characteristics first. Return to the site to do identification when flowers appear.
3. Gather a few twigs or small branches of different mangrove plants. If the plants are flowering, try to get a twig with flowers. This way, you will get both specimens of leaves and flowers. Collect one specimen as a representative for each plant species.
4. Place these in your plastic bags. (Make sure you have separate plastic bags for each different plant, to avoid mixing of samples.) **Watch out for ants and plant sap!** These may be irritating to the skin. As a precautionary measure, apply insect repellent before fieldwork.
5. Draw the plant from which you have gathered your samples or take pictures. Write down in detail the description of the roots of the plant (refer to the icons of roots in the presentation of the lesson) in your notebook. Note also the texture of the trunk of the tree. Is it smooth or rough? Note the location of the plant. Is it seaward and submerged in water? Near or far from the shoreline?
6. Using masking tape and marking pen, number your specimens. Refer to, and examine, them by numbers.

7. Consult the drawings in your module and identify and classify each specimen as to (a) leaf type, (b) leaf arrangement, (c) leaf shape, (d) leaf margin, (e) leaf apex, (f) leaf base, (g) flower arrangement, (h) inflorescence, and (i) form and root type.
8. Fill-up the tables on the report sheet. Draw and color each specimen.
9. Based on the characteristics you recorded, identify as many specimens as you can. Include the scientific and local names of the plants.
10. You may confirm your identification by referring to the *Field Guide to Philippine Mangroves* (*Primavera, 2009*).
11. Based on your drawings of the location of each specimen, create a zonation map showing the areas where each species is commonly found. Consult the zonation diagram (Appendix 1) and check if the mangrove species you have identified is growing in the zone where it is usually found.
12. Do not throw away your specimens. You may create a mangrove herbarium using these specimens which can be stored in the Biology Department of your school. Consult Appendix 2 for herbarium preparation.

Activity 1 – Identification of Plant Location, Roots, Leaf Characteristics, and Floral Patterns in Mangrove Plants

Report Sheets

1. Plant Location

Sample No.	**Plant Location (Zonation)**			
	Low intertidal (roots submerged in water during high tide)	**Middle intertidal** (trunks submerged in water during high tide)	**Upper intertidal** (near upstream estuarine creeks)	**Landward**
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Form and Root Type

Sample No.	**Form**			**Root Type**					
	Palm	Shrub	Tree	Prop/ Stilt	Buttress	Plank	Conical pneumatophore	Peg-shaped pneumatophore	Knee
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									

2. Leaf Type and Arrangement

Sample No.	**Leaf Type**		**Leaf Arrangement**	
	Simple	Compound	Alternate	Opposite
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

3. Leaf Shape and Leaf Margin

Sample No.	Leaf Shape					Leaf Margin				
	Ovate	Obovate	Elliptic	Lanceolate	Others (Specify)	Entire, Smooth	Entire, Undulate	Serrate	Lobed	Others (Specify)
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

4. Leaf Apex and Base

Sample No.	**Leaf Apex**						**Leaf Base**		
	Round	Acute	Obtuse	Mucronate	Acuminate	Emarginated	Round	Acute	No petiole
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									

5. Floral Arrangement and Inflorescence

Sample No.	**Flower Insertion**		**Inflorescence Type**						
	Terminal	Axillary	Solitary	Raceme	Spike	Catkin	Panicle	Cyme	Umbel
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									

D. **Analysis/ Discussion**

Question for discussion

1. Were you able to identify the mangrove specimens in each station? What are the scientific names and common names of your samples?
2. How were you able to name each sample? What plant characteristics were helpful in identifying the specimens?
3. What conclusion(s) can you make based on how you identified the different mangrove species?
4. How many different species of mangroves have you collected? Based on this observation, can you say that your local mangrove community is diverse in mangrove species?
5. What do you think are the advantages of the high biodiversity of mangroves in Busuanga in maintaining the stability of the marine ecosystem? (Valuing)
6. Why do we need to maintain the balance and high biodiversity of mangroves in Busuanga? (Valuing)

E. **Abstraction**

Plant diversity or the presence of different kinds of plants in a given ecosystem is important because it affects the different ecological relationships within that ecosystem. Mangroves, like most plants, are identified through the physical characteristics of their leaves, flowers, roots, and propagules/fruits.

Table 4. Leaf description of some common mangrove species *(Primavera et al., 2004)*

Mangrove Species	Leaf Type	Leaf Attachment	Leaf Apex	Leaf Base	Leaf Shape	Leaf Margin
Acanthus spp. (lagiwliw, ragoyroy)	Simple	Opposite	Acute	Acute	Elliptic	Lobed
Aegiceras corniculatum (saging-saging)	Simple	Alternate	Round	Acute	Abovate	Entire, smooth
Avicennia marina (bungalon)	Simple	Opposite	Acute	Acute	Elliptic	Entire, smooth
Camptostemon philippinensis (gapas-gapas)	Simple	Alternate	Round	Acute	Abovate	Entire, smooth
Ceriops tagal (tungog)	Simple	Opposite	Round	Round	Obovate	Entire, smooth
Nypa fruticans (nipa)	Compound	Alternate	Acute (leaf-let)	Sessile	Lanceolate (leaflet)	Entire, smooth (leaflet)
Rhizophora apiculata (bakhaw lalaki)	Simple	Opposite	Apiculate	Acute	Elliptic	Entire, smooth
Rhizophora mucronata (bakhaw babae)	Simple	Alternate	Mucronate	Acute	Elliptic	Entire, smooth
Sonneratia alba (pagatpat)	Simple	Opposite	Round	Round	Obovate	Entire, smooth
Xylocarpus granatum (tabigi)	Compound	Alternate	Round (leaf-let)	Acute (leaf-let)	Obovate (leaflet)	Entire, smooth (leaflet)

Table 5. Floral patterns of some common mangrove species
(Primavera et al., 2004)

Mangrove species	Floral Arrangement	Inflorescence
Cone/peg roots – aerial roots arising from lateral roots, shorter, and more woody than.	Terminal	Spike
Cone/peg roots – aerial roots arising from lateral roots, shorter, and more woody than.	Terminal	Raceme
Cone/peg roots – aerial roots arising from lateral roots, shorter, and more woody than.	Terminal	Spike
Cone/peg roots – aerial roots arising from lateral roots, shorter, and more woody than.	Axillary	Solitary
Cone/peg roots – aerial roots arising from lateral roots, shorter, and more woody than.	Axillary	Cyme
Cone/peg roots – aerial roots arising from lateral roots, shorter, and more woody than.	Axillary	Catkin
Cone/peg roots – aerial roots arising from lateral roots, shorter, and more woody than.	Axillary	Cyme
Cone/ peg roots – aerial roots arising from lateral roots, shorter, and more woody than.	Axillary	Cyme
Cone/ peg roots – aerial roots arising from lateral roots, shorter, and more woody than.	Terminal	Cyme
Cone/ peg roots – aerial roots arising from lateral roots, shorter, and more woody than.	Axillary	Panicle

In this lesson, you learned the different leaf characteristics and flower patters. You were able to apply these characteristics to the identification of mangrove specimens. Moreover, you were able to see and appreciate the different flowers, roots, and leaves of mangrove plants.

Descriptions of Flowers, Leaves, and roots

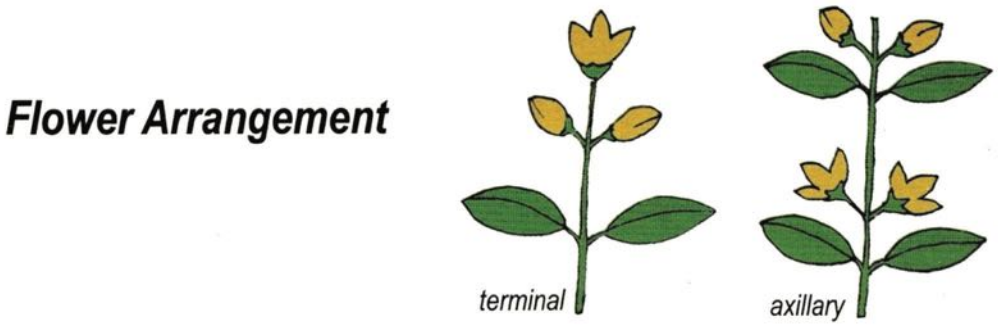


Figure 4. Plant Parts: Flower Arrangement

Terminal – flowers borne at the end or apex.
Axillary – flowers arise from the axil.

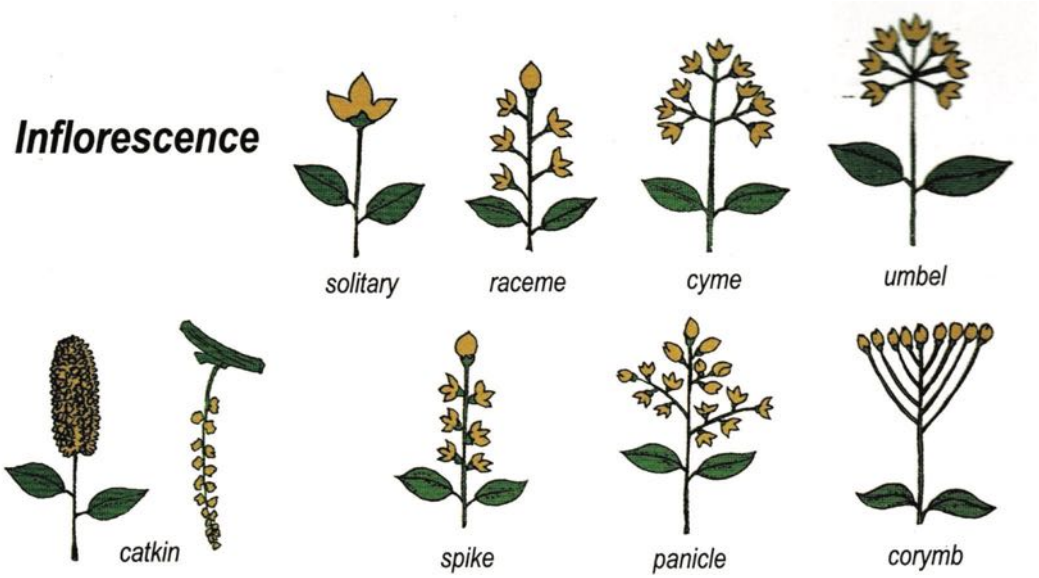


Figure 5. Plant Parts: Inflorescence

Solitary – flowers borne singly.

Raceme – unbranched inflorescence with stalked flowers arranged along sides of common peduncle.

Cyme – compound inflorescence whose inner or center flowers open first; flat or convex.

Umbel – umbrella like inflorescence with pedicels arising from common base.

Catkin – with many small, sessile flowers or a spike-like axis, usually pendulous.

Spike – elongated, unbranched inflorescence like a raceme, but flowers are sessile.

Panicle – inflorescence whose primary branches are racemose, flowers pedicellate.

Corymb – is a raceme in which the pedicels of the lower flowers are longer than those of the upper flower.

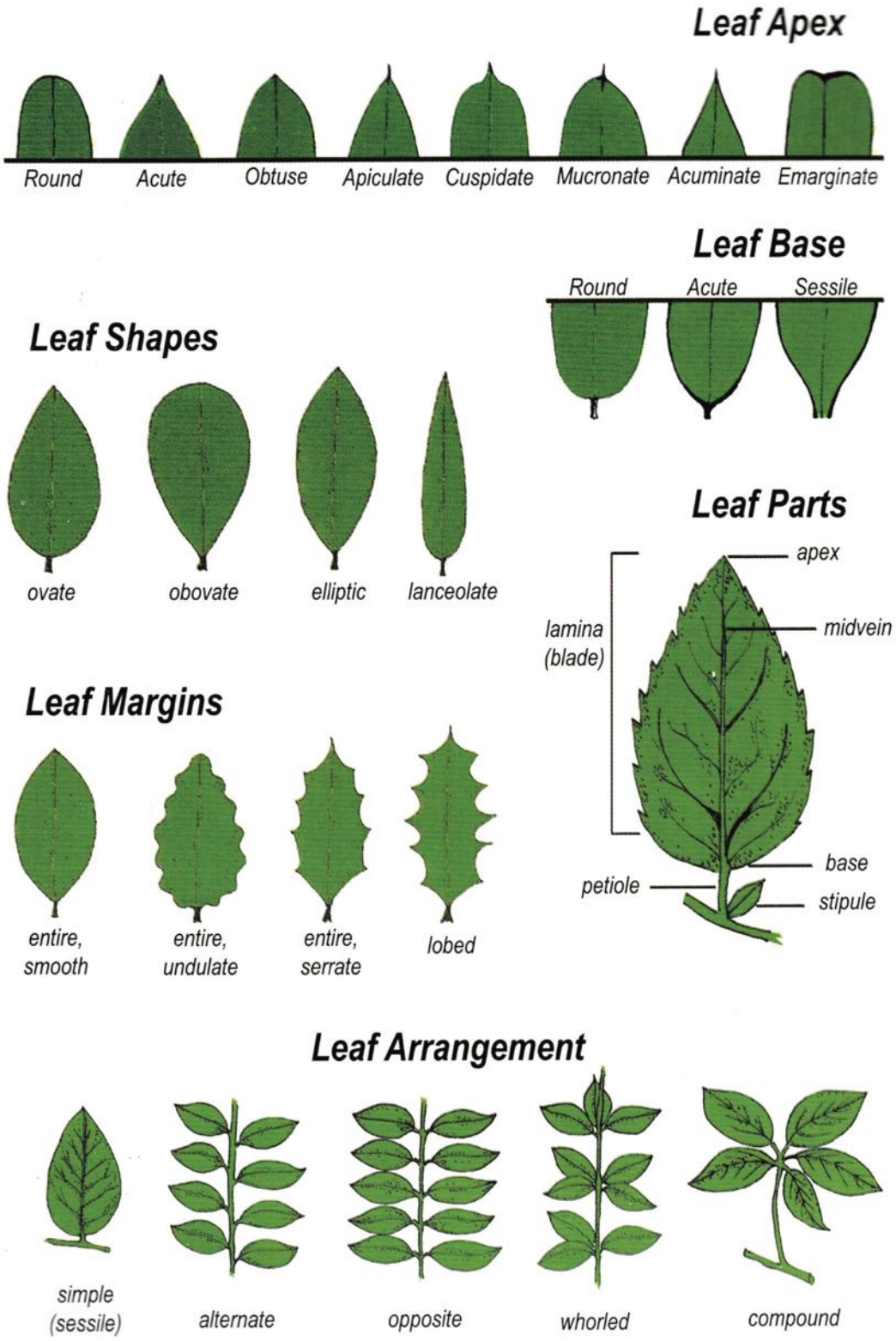


Figure 6. Plant Parts: Leaf

Leaf Apex

Round – apex not forming an angle but continues on a smooth curve.

Acute – sharply pointed, the sides straight or nearly so forming an angle of less than.

Obtuse – blunt, forming an angle of more than 90 degrees.

Apiculate – ending as an abrupt tip which is not stiff.

Cuspidate – somewhat abruptly and sharply concave and constricted into a cusp.

Mucronata – terminated by a short, stiff point called mucro; apex usually broad.

Acuminate – tapering, the slides or more less concave before reaching the tip.

Emarginate – with a shallow notch at the apex.

Leaf Base

Round – base not terminating in a smooth curve and not an angle or corner.

Acute – sharply pointed, the sides straight or nearly so forming and angle of less than.

No petiole – leaf blade continues to the leaf insertion.

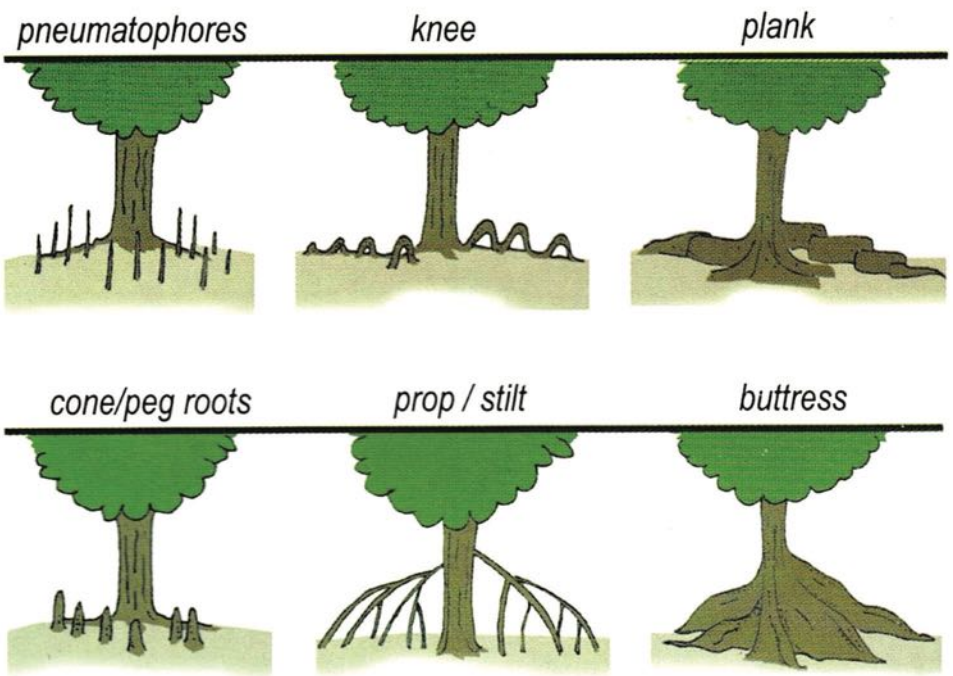


Figure 7. Plant Parts: Root Type of Mangroves

Pneumatophores – pencil or cone-shaped aerial roots arising from lateral roots; spongy/corky in texture.
Knee – above-ground roots shaped like a knee.
Plank – ribbon-like and vertically flattened lateral extensions.
Cone/peg roots – aerial roots arising from lateral roots, shorter, and more woody than pneumatophores.
Prop/stilt – adventitious roots that form on the stem above ground.
Buttress – downward sloping, flattened projection from lower trunk.

G. Application

(Integration of Art)

Poster Making

Design a poster portraying a marine reserve, the organisms found in the ecosystem, and how the organism is protected and helps them recover and increase in production.

H. Generalization

Explain the advantage of the high biodiversity of mangroves in Busuanga in maintaining the stability of our marine ecosystem?

IV. EVALUATION

Test Yourself

1. Which plant characteristics are often used to classify and identify mangrove plants?
   a. Leaf characteristics
   b. Inflorescence
   c. Leaf apex
   d. Both A and B
   e. All of these

2. Which leaf characteristic refers to the shape of the edge of the leaf?
   a. Leaf margin
   b. Leaf apex
   c. Leaf shape

d. Leaf arrangement
e. Leaf venation

3. Which leaf characteristic refers to the shape of the end of the leaf opposite its stem?
   a. Leaf margin
   b. Leaf apex
   c. Leaf shape
   d. Leaf arrangement
   e. Leaf venation

4. A floral arrangement wherein the flowers are borne at the end of the stem is what type of arrangement?
   a. Axillary
   b. Terminal
   c. Catkin
   d. Umbel
   e. Raceme

5. What is the type of inflorescence wherein the inner or center flowers open first?
   a. Raceme
   e. Axillary
   c. Cyme
   d. Solitary
   b. Umbel

6. How many different species of mangroves have you collected? Based on this observation, can you say that your local mangrove community is diverse in mangrove species?

7. Why is there a need to classify plants?

Answer Key:

1. e
2. c
3. b
4. b
5. c
6. _____
7. _____

V. ASSIGNMENT

Take-home Activity

Prepare a herbarium of the different mangrove specimens that can be found in Busuanga with their local name specified. If you want to learn more about mangrove taxonomy, consult *Primavera et al. (2004)*

Save, Protect, and Rehabilitate the Mangrove

I. OBJECTIVES

A. Content Standards

The learner demonstrates an understanding of key concepts of protection and conservation of endangered and economically important species.

B. Performance Standards

The learner report (e.g., through a travelogue) on the activities that communities engage in to protect and conserve endangered and economically important species.

C. Learning Competency

Code: S8LT-IVh-21

Objective: Explain the advantage of high biodiversity in maintaining the stability of an ecosystem.

Specific Objective: Maintaining the stability of an ecosystem.

II. SUBJECT MATTER

A. Topic: Save, Protect, and Rehabilitate the Mangrove

B. Reference: Mangrove Education Series for Secondary Schools Students' Module, Deped Curriculum Guide

C. Materials: Learner's Materials

III. LEARNING ACTIVITIES

A. Motivation

Localization

Picture Parade

Flash pictures of human activities on the projector screen. (*Ways Humans Have Harmed Mangroves*)

B. Preliminary Activity

Differentiated Instruction

Perform Activity 1 – First Look at Human Activities in Mangroves

Each group is instructed to fill in the table:

Human Activity Observed in Mangroves	Effect of Activity on the Mangrove Ecosystem
Mangrove-Friendly	
Example: People catching crabs using traps	*No harmful effect*
1.	
2.	
3.	
Non-Mangrove-Friendly	
Example: Converting part of mangrove to nipa plantation	*Loss of other species that serve as producers in food chains, decreased biodiversity*
1.	
2.	
3.	

The output of each group could be represented by role-playing, declamation, debate, poem, drawing, interpretative song or dance.

A. Analysis/ Discussion

Questions for discussion

1. What are the different human activities in mangroves?
2. Identify mangrove-friendly and non-mangrove-friendly activities.
3. How can you minimize or eradicate non-mangrove-friendly activities?
4. Can we save mangroves? How?
5. Are there laws/ policies on mangroves being enforced?

6. If there is, is it effective enough to protect the existence of different mangrove species?
7. Do you know government or NGO projects on mangrove conservation?
8. What are the gains, benefits, contributing factors in conserving and rehabilitating mangroves?

B. Abstraction

1. Play video clips on successful mangrove conservation and rehabilitation.
2. Discuss the benefits gained by the community from these success stories.
3. Flash or distribute copies of Table 6. Philippine Laws on Mangrove Protection, Use, and Rehabilitation (*Primavera et al., 2004, www.chanrobles.com*)

Table 6. Philippine Laws on Mangrove Protection, Use and Rehabilitation (*Primavera et al., 2004, www.chanrobles.com*)

Presidential Decree 705 (1975)	Presence of 20-meter-wide strip along shorelines and its exclusion from pond development
Presidential Proclamation 2146 (1982) Ministry of Natural Resources	Prohibition of mangrove cutting throughout the country
Administrative Order 42 (1986)	Expansion of mangrove belt in storm surge, typhoon areas: 50–100 m along shorelines, 20–50 m along riverbanks
Department of Environment and Natural Resources Administrative Order 15 (1990)	Reversion of abandoned ponds to forest and non-conversion of thickly vegetated areas
Republic Act 7161 (1991)	Ban on cutting of all mangrove species
Executive Order 263; Department of Environment and Natural Resources Administrative Order 30 (1994)	Community-Based Forest Management (CBFM) as national strategy for sustainable development of forests. Non-government organizations (NGOs) allowed to assist people in management of mangroves

Fisheries Code of the Philippines (Republic Act 8550 of 1998)	Reversion of undeveloped, underutilized, and abandoned ponds to mangroves

C. Application

(Integration of Art)

My Artwork on Mangrove Laws

Choose from the seven Mangrove Laws in the Philippines. Describe the law and how it is expected to be implemented through drawing.

D. Generalization

1. Is it important to have mangrove law?
2. How does it help to protect and conserve the mangrove species?
3. How can you help to protect and conserve the mangroves?
4. Why do we need to maintain the stability of an ecosystem?

IV. EVALUATION

Objective Type of Test

Essay on the advantage of imposing mangrove laws on the stability of an ecosystem.

V. ASSIGNMENT

Take-home Activity

Interview a person or organizations experts on mangrove rehabilitation project (for example: a C3 Philippines, Inc. employee) and fill up the worksheets below.

Activity 2 – Visit to a Mangrove Rehabilitation Project

Worksheet

Part A. *Write down your observations as you go around the mangrove rehabilitation area.*
1. What did the project accomplish?
2. What mangrove species were planted? How many were planted?
3. If a footwalk was built, how long is it? What other structures were built?
4. Observe the natural forest and the planted area. Compare the natural and planted portions as to area covered, number of mangrove species, height of trees, etc. a. Natural forest b. Reforested area
5. Other observations

Part B. *Answer this part by interviewing a person involved in the project from the start.*
Name of interviewee: Age: Date:
1. What was your role in the project? 2. How many were involved in the project and who were they? 3. When did the project start? 4. Who started the project? 5. Who funded the project? 6. How wide is the area covered by the project? 7. What were the initial goals of the project? 8. Have these goals been achieved? 9. How did you determine what mangrove species to plant? 10. What problems did you encounter in trying to achieve your goals? 11. How did you solve these problems? 12. What factors contributed to the success of the project? 13. What benefits did you gain from the project?

Transfer of Energy in Trophic Levels

Who Eats Who in the Mangroves?

I. OBJECTIVES

A. Content Standards

The learner demonstrates understanding of one-way flow of energy and the cycling of materials in an ecosystem.

B. Performance Standards

The learner should be able to make a poster comparing food choices based on the trophic levels.

C. Learning Competency

Code: S8LT-IVi-22

Objective: Describe the transfer of energy through the trophic levels;

Specific Objectives:

1. Describe the feeding relationship in a mangrove;
2. Understand the interdependence in mangrove ecosystems; and
3. Discuss the energy flow in a mangrove.

II. SUBJECT MATTER

A. Topic: Transfer of Energy in Trophic Levels: Who eats who in the mangroves?

B. Reference: Mangrove Education Series for Secondary Schools *Students' Module*, DepEd Curriculum Guide Students' Module

C. Materials: Video clip, pictures

III. LEARNING ACTIVITIES

A. Motivation

Localization

Feeding Frenzy!

The class will be divided into 4 groups. Each group will be given a chance to pick from the draw lots if what trophic level they will belong. Then they will pick the

pictures of the species that belongs to the trophic level that they picked and the game will start.

If a member of a group was able to eat up another member from other group (from lower trophic level) he/she is already safe from that level of the game.

B. Presentation

Video clip showing food chain in mangrove ecosystem

C. Preliminary Activity

Integration in MAPEH subject

Activity 1 – Food Chains and Food Webs

Objectives:

At the end of this activity, you must be able to:

1. Identify examples of food chains in a mangrove forest;
2. Discuss the energy flow in a mangrove; and
3. Compare food chains with food webs.

Materials:

Notebook
Pencil
Marking pen
Masking tape
Scissors
Manila paper (1 piece)
Orange-colored yarn or string
Small piece of cartolina (with hole at each end, 10-15 pcs)

Procedure:

a. Preliminary activities

1. Check the schedule of tides in the calendar and select a date with a suitable low tide (preferably 0.2 – 0.3 m). Take note of the time and depth of water at low tide and at high tide.
2. Wear beach sandals or shoes, long-sleeved shirt, long pants, wide-brimmed hat.
3. Bring drinking water, snacks, and sunblock lotion.

4. Bring the materials listed.
5. Form groups of five members each.

b. Field activity

1. Each group should start at the subtidal zone (coral reefs or seagrass beds), then walk to the intertidal zone and the mangrove forest.
2. As you walk, quietly and carefully observe organisms that may be feeding. Identify organisms that are eating or are being eaten by others. You may use either their scientific or common name.
   Examples include:
   Animals that live in water, on the mud surface, or on branches of trees: fishes like mullet (*banak*), milkfish (*bangus*), mud skipper (*chilangkok*) and shrimps, mud crabs, fiddler crabs, hermit crabs, oysters, barnacles and different kinds of snails.
3. Take note of decaying matter or detritus. You may include this in your list.

D. Analysis/ Discussion

Questions for discussion

Analyze the feeding relationships in the food chain and food web that you made.

1. Identify the organisms that eat and those that are eaten.
2. Label each organism: producer, consumer or decomposer. For consumers, identify the level whether primary consumer, secondary consumer and the like.
3. Assuming that algae are found in your study area, what might happen to the other organisms if you remove algae from the chain? (You may base your answer on the food web that you formed with your group.)
4. Are there animals listed in your diagram that eat several items of food? Name them.
5. Mud crabs feed on decomposing leaf litter. If humans harvest and eat them, what will happen to other organisms that feed on young mud crabs?
6. Define food chain and food web as shown by the data collected. How are they different from each other?
7. Copy the diagram of a food web in the study area to your notebook.

E. Abstraction

An ecosystem consists of the biotic or living communities of different organisms

and the abiotic or nonliving components. Examples are the mangrove and coral reef ecosystems.

Organisms are involved in functions like production, consumption, and decomposition. ***Production*** includes the process of photosynthesis by which plants use sunlight and raw materials such as carbon dioxide and water to produce food (carbohydrates) and release oxygen to the atmosphere. This is the major function of plants (including mangroves). Some bacteria can also produce organic compounds from inorganic substances and are called producers along with plants.

Consumption is process by which animals ingest or eat plants and other animals for food and energy. Food taken in is digested and converted to substances that can be used by animals to make their own protoplasm. ***Protoplasm*** is the living matter of cells that compose an organism. The organisms are called ***consumers***. Plant-eating consumers are called ***herbivores***. Some consumers eat both plants and animals and are called ***omnivores***. Consumers that feed on animals are called ***carnivores***. Carnivores that hunt other organisms are predators; the animals being hunted are called ***prey***.

F. Application

(Integration of Art)

Poster Making

Design a poster portraying a Food Chain or Food Web that can be found in a mangrove forest.

G. Generalization

1. Describe the feeding relationship in a mangrove
2. Discuss the energy flow in a mangrove

How important a mangrove tree in the Food Chain or Food Web? What will happen to Food Chain or Food Web if there will be no more mangrove trees?

IV. EVALUATION

Objective Type of Test

Essay reflection about feeding relationship in mangrove forest, energy flow in a mangrove and the interdependence in the mangrove ecosystem.

Energy Flows, Water Cycle, and Carbon Cycle

I. OBJECTIVES

A. Content Standard

The learners demonstrate an understanding of the one-way flow of energy and the cycling of materials in an ecosystem.

B. Performance Standard

The learners shall be able to make a poster comparing food choices based on the trophic levels.

C. Learning Competency

Code: S8LT-IVi-24

Objective: Explain how materials cycle in an ecosystem.

Specific Objective: The learners are expected to:

1. Understand how energy flows in the mangrove ecosystem; and
2. Relate how nutrients are exchanged in mangroves.

II. SUBJECT MATTER

A. Topic: Energy flows, water cycle, and carbon cycle

B. Reference: Science 8 Learner Modules, Mangrove Education Series for Secondary Schools Students' Module

C. Materials: Book, notebook, laptop, television, quadrat, activity notebook

III. LEARNING ACTIVITIES

A. Motivation

Where do I belong?

Classify the following words according to its group. Why do you categorize the words like that? (Literacy)

Food Chain	Water Cycle	Carbon Cycle
Consumers	Evaporation	Respiration
Producers	Infiltration	Erosion
Carnivores	Condensation	Carbon dioxide dissolved in water
Herbivores	Precipitation	Dissolved carbon

B. Presentation

Based on your activity, make a one-way flow diagram of energy and the cycling of materials in an ecosystem (Numeracy). Present your diagram in the class through drawing, poem, singing, making a story, etc. (Differentiated Instruction)

The study of the feeding relationships enables biologists to trace the flow of energy between trophic levels. The initial source of energy in the grazing food chain is the sun. Plants are able to convert sunlight energy to energy stored in food. In the case of the detrital food chain, the initial source of energy is the input from dead organic matter derived from the grazing of food chain. Mangroves for instance give so much importance in the food chain.

C. Preliminary Activity

Understanding energy interactions in mangrove ecosystems

Objective:

Make models of ecological pyramids and understand energy flow through these models.

Activity 1: (Pre-Activity)

Using the completed table, make your own diagram of the food chain, water cycle and carbon cycle. You can use your skills in presentation as well as you can use different materials for the presentation.

There are other sources of carbon dioxide in mangroves such as decomposing organisms. Burning of dried leaves and stems also releases carbon dioxide.

In both cases, the carbon compounds are also called organic compounds, as they come from organisms.

Activity 1 – Understanding Energy Interactions in Mangrove Ecosystems

The previous lessons have provided the field experience that may be useful in understanding the interactions of energy and matter in mangrove ecosystems.

Objectives:

At the end of this activity, the student should be able to:

1. Make models of ecological pyramids; and
2. Understand energy flow through these models.

Materials:

Cartolina
Pencil
Coloring materials
Bond paper
Clear adhesive tape
Marking tape

Procedure:

a. Analyzing energy flow

1. Study the figure below *(Figure 8. Mangrove Food Web)*.
2. Describe the energy pathway from the producers to the tertiary consumers.
3. The size of the boxes represents the amount of energy found in a particular trophic level. Compare the amount of energy found in producers with that in other trophic levels.
4. As a consumer, what organisms provide you with energy?

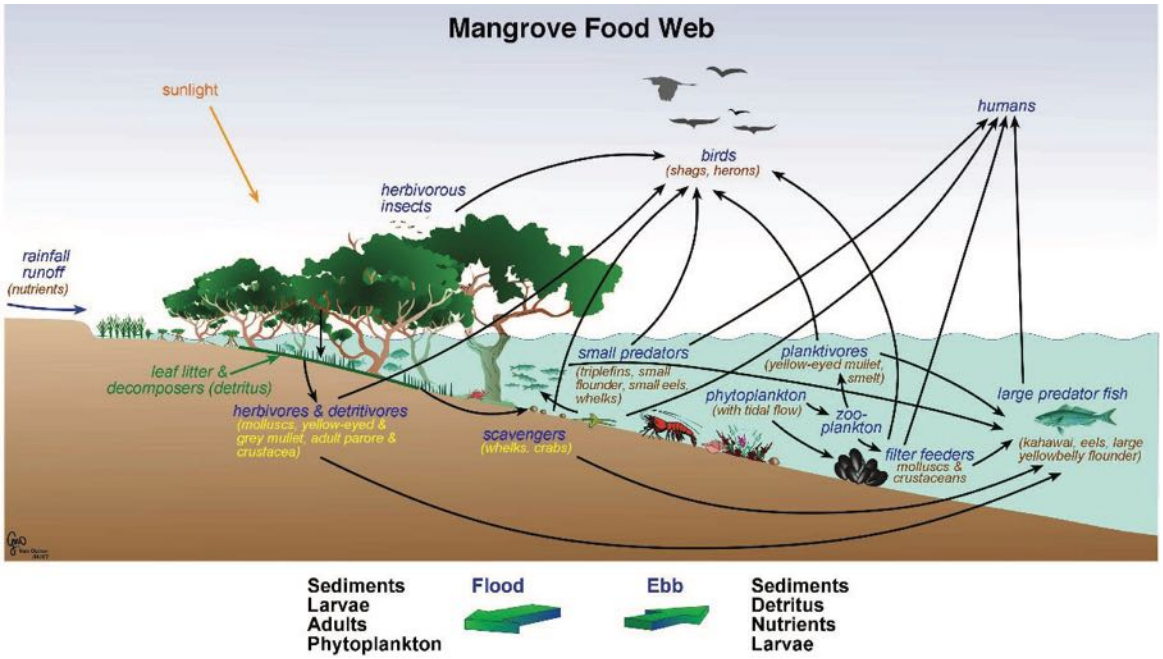
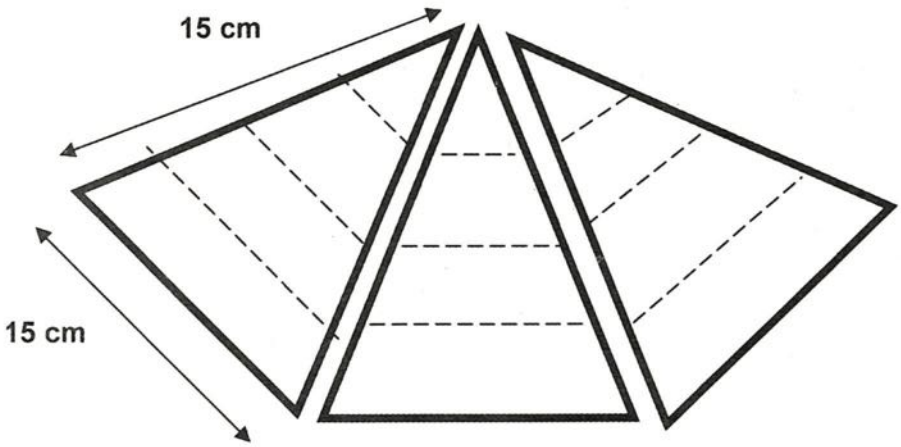


Figure 8. Mangrove Food Web
(image from wordpress.com)

b. Constructing ecological pyramids

You will construct an energy pyramid for a mangrove ecosystem based on information from Fig. 9 of this Teachers' Manual. The model must contain at least four trophic levels. Divide the cartolina horizontally into four equal parts by measuring with a ruler then putting dotted lines. You may use different colors for each level. Identify the organisms at each level.

1. With a piece of cartolina, construct a three-dimensional pyramid, 15 cm high and 15 cm wide (per side), showing the relative amount of energy within the trophic level. The sketch below can guide you.
2. With a clear tape, connect the three sides of the cartolina to let it stand on the table. The pyramid shows the relative amount of energy within a trophic level.



3. Based on the energy pyramid you have made, solve the problems given below:
   a. Assume that seaweeds obtain 10,000 units of energy from the sun. If each level uses 90% of the energy it receives from the previous level, how many units are available to *Siganus* (rabbitfish) that feed on seaweeds?
   b. How can a food chain be applied to the flow of energy and nutrients?

D. Fixing Skills/ Exercises/ D.I

Presentation of the pyramids. (Arts)

E. Analysis/ Discussion

1. How do organisms in mangrove habitats get their supply of carbon?
2. Assume that seaweeds obtain 10,000 units of energy from the sun. If each level uses 90% of the energy it receives from the previous level, how many units are available to *Siganus* (rabbitfish) that feed on seaweeds?
3. How can a food chain be applied to the flow of energy and nutrients?

F. Abstraction

Expected output

1. Each box represents a trophic or feeding level.
   The base is usually occupied by the producers in the grazing food chain. The size of the base is related to the amount of energy (kcal) obtained from the sun and fixed in the living tissues of organisms.

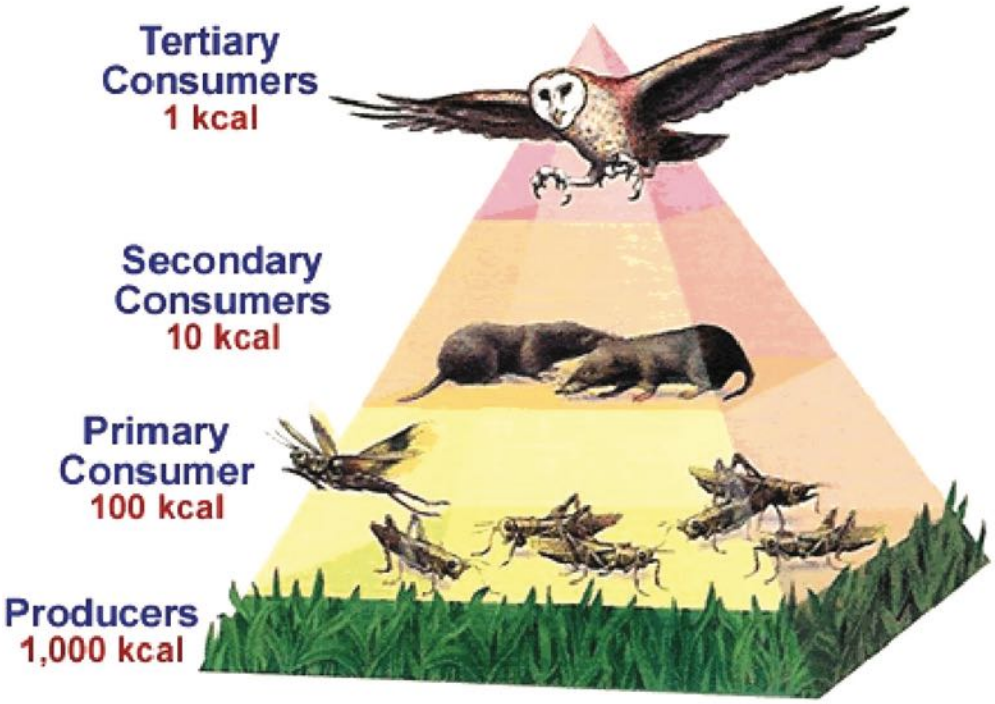


Figure 9. Typical Energy Pyramid
(image from www.logan.us)

2. Nutrient cycling (Water cycle)
   Organisms in mangrove habitats need water and nutrients such as nitrogen, phosphorous and sulfur. The process involves the evaporation, condensation, precipitation and infiltration.

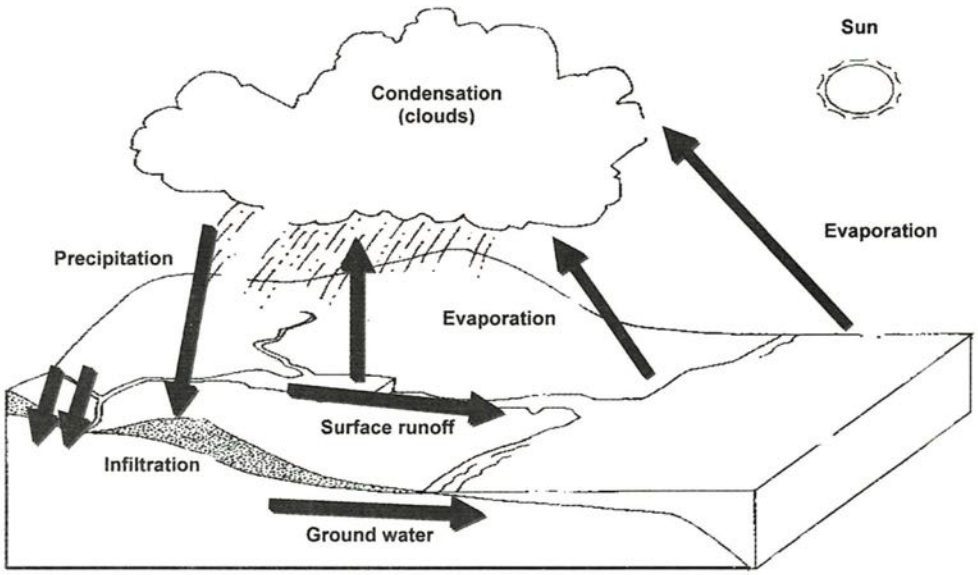


Figure 10. The Water Cycle *(modified from Miller, 1999)*

3. Nutrient cycling (carbon cycle) plants are able to utilize carbon in the form of carbon dioxide during the process of photosynthesis. Carbon compounds are produced at the same time energy fixed in molecules of these compounds. The energy in carbon compounds is used by plants to produce new roots, stems, leaves, flowers, fruits, and seeds. As consumers feed on plants, they get carbon compounds. When consumers use these compounds in the process of respiration, they release carbon dioxide back to the atmosphere that becomes available to plants.

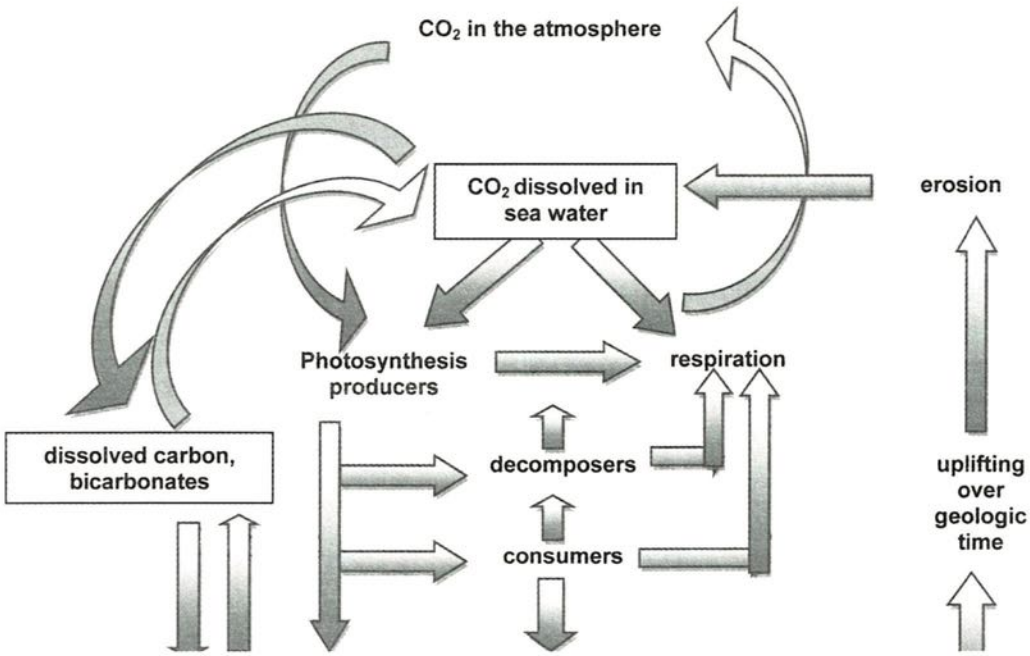


Figure 11. The Carbon Cycle *(modified from Miller, 1999)*

G. Valuing

Energy flows everywhere. It has a big factor to secure that everything should be in balance. How can you relate to this?

H. Application

When consumers use compounds in the process of respiration, they release carbon dioxide back to the atmosphere that becomes available to plants. You, how can you give back to the environment?

I. Generalization

1. How energy flows in the mangrove ecosystem; and
2. Relate how nutrients are exchanged in mangroves.

IV. EVALUATION

1. What best describe precipitation?
   a. As the moist air rises, it cools and the tiny droplets become clouds
   b. When the clouds become heavy and fall.
   c. Evaporation from leaves of plants.
   d. Contributes to water vapour in the atmosphere.

2. What is condensation?
   a. As the moist air rises, it cools and the tiny droplets become clouds.
   b. When the clouds become heavy and fall.
   c. Evaporation from leaves of plants.
   d. Contributes to water vapour in the atmosphere.

3. How energy flows in the mangrove ecosystem?
   a. Through water cycle only
   b. Through carbon cycle
   c. Through nutrient cycling
   d. Cannot be distinguished

4. What organisms provide you with energy?
   a. Animals
   b. Plants
   c. Sunlight
   d. All of the above

5. How can a food chain be applied to the flow of energy and nutrients?
   a. As the food transferred, the nutrients also increase.
   b. As the food transferred, the energy and nutrients become less.
   c. It depends upon the food to be transferred.
   d. It cannot be determined.

Answer Key:

1. *b*
2. *a*
3. *c*
4. *d*
5. *b*

V. ASSIGNMENT

Research about transpiration in mangroves and how decomposition occurs.

Activity 2 – Classify the following words according to its group

Where do I belong?

Consumers	Producers
Carnivores	Precipitation
Evaporation	Infiltration
Herbivores	Dissolve carbon
Respiration	Erosion
Condensation	Carbon dioxide dissolve in water

Food Chain	Water Cycle	Carbon Cycle

Answer Key:

Food Chain

1. *Consumers*
2. *Producers*
3. *Carnivores*
4. *Herbivores*

Water Cycle

1. *Evaporation*
2. *Infiltration*
3. *Condensation*
4. *Precipitation*

Carbon Cycle

1. *Respiration*
2. *Erosion*
3. *Dissolve carbon*
4. *Carbon dioxide dissolved in water*

Field Trip: Juvenile Fishing

I. OBJECTIVES

A. Content Standards

The learner demonstrates understanding of key concepts of the one-way flow of energy and the cycling of materials in an ecosystem.

B. Performance Standards

The learner report (e.g., through a travelogue) on the activities that communities engage in to protect and conserve endangered and economically important species.

C. Learning Competency

Code: S8LT-IVj-25

Objective: Suggest ways to minimize human impact on the environment.

Specific Objectives: Perform ways to minimize human impact on the environment.

II. SUBJECT MATTER

A. Topic: Field Trip, Juvenile Fishing

B. Reference: Mangrove Education Series for Secondary Schools *Students' Module*, DepEd Curriculum

C. Materials: Learner's Materials

III. LEARNING ACTIVITIES

A. Motivation

Students are grouped into 5. Each group has a fishnet (*salibot* or *sarap* in local name). They are instructed to dip their fishnets into the water and try, by all means to catch some sea creatures. Fill-up worksheet in Activity 2: Checklist of Organisms Caught in the Net.

B. Preliminary Activity

Differentiated Instruction (Localization)

Save Me!

Pre-arranged with local fisherfolks: There are predetermined fishes caught by fisherfolks. Different kind/species and sizes of fishes are given to each group. Following the procedure of Activity 1 – Give Those Young Fish a Chance. They will measure and tabulate the different fish according to kind/species and measurement. Each group may present their output in different ways like rap music, poem, jazz chants, choral recitation, speech. The content of their presentation is the type/species of fish, the number of pieces, and the smallest and largest measures of fish.

Activity 1 – Give Those Young Fish a Chance!

The number of fish in a given area must be maintained at a certain level to ensure a continuous supply for harvest. Overfishing must be avoided to give fish a chance to reproduce and replace those that have been caught. Juvenile fish (especially those that are still alive when caught) must be returned to the sea to give them a chance to mature and reproduce.

Objectives:

At the end of this activity, you should be able to:

1. Determine if fish sold in the local market are juveniles or not;
2. Give the common and scientific names of some common fishes; and
3. Explain why juvenile fishes should be returned to the sea.

Materials:

5-10 fishes of the same species
Plastic plate or basin
Fish identification reference
Pencil
Ruler

Procedure:

1. The teacher will divide the class into groups, each with 5 members. Each group will be assigned one of the fish species listed in Table 7.
2. Buy 5-10 pieces (of different sizes, if available) of the kind of fish assigned to your group and bring to school.
3. Copy *Worksheet B – Group Data* in your notebook.
4. Identify the fish your group brought with the help of the Fish Identification

reference provided with this manual (or by asking the fish vendor). Write its scientific and common names in the notebook.

5. Get one fish and measure the total length (in cm) from the tip of the mouth to the tip of the tail (*Froese and Pauly, 2000*) with a ruler. Record in the worksheet. Do the same for the remaining fish.

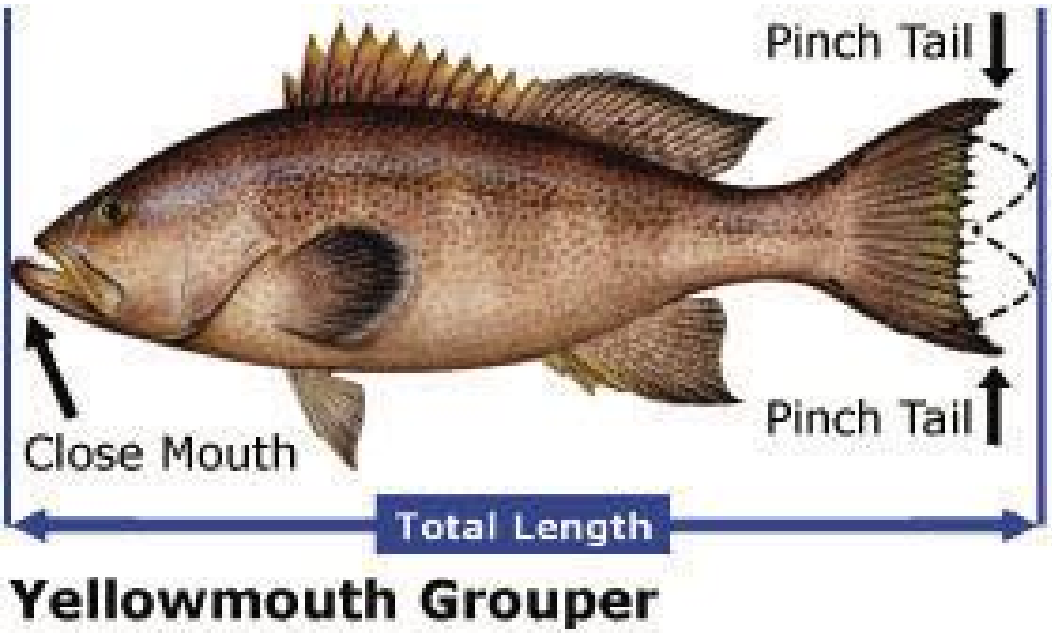


Image by www.dixiediver.com

6. Determine if the fish you brought are juvenile or mature by comparing the total length of your fish with the average length at maturity of the species (size at which some fish species develop ripe testes or ovaries for the first time). If the total length is less than the average length at maturity (table 7 of this manual) then the fish is juvenile and has not yet reproduced.
7. Check the corresponding column in *Worksheet B – Group Data* if the individual fish is juvenile or mature.
8. Compute the percentage of juvenile fishes in your sample of 5-10 fishes using the formula:

$$\textbf{\% of juvenile fishes} = \frac{\textbf{No. of juvenile fish}}{\textbf{Total no. of fishes (juvenile + mature)}} \times 100$$

9. Record your group data on the blackboard or notebook to contribute to or complete the class data following *Worksheet C – Class Data*. Compute the

percentage of each kind of fish that are still juveniles using the formula in No. 8, above.

C. Analysis/ Discussion

Questions for discussion

1. What different kinds/species of animal did you catch in your fish nets?
2. Is it hard to catch fish, shrimps, etc.?
3. After catching sea creatures like fish and shrimps what did you feel? What came into your mind?
4. What will you do with your catch?
5. In your second activity, why do you think you are instructed to measure the different fish caught by the fishermen?
6. If you caught a small fish, will you sell it or cook it? Why? (Valuing)

D. Abstraction

Flash or give a printed copy of Table 7 of this manual.

Table 7. Average length at maturity of some community-caught fishes in Philippine waters

Common Name of Fish	Scientific Name	Length at maturity (cm)
Dalagang Bukid	*Caesio spp.*	34
Tulingan	*Auxis thazard*	31
Talakitok	*Alepes djedaba*	23
Bukaw	*Priacanthus tayenus*	20
Galunggong	*Decapterus macrosoma*	19
Bulao	*Rastrelliger kanagurta*	18
Putihan/Latab	*Gerres filamentosus*	16
Bisogo	*Nemipterus furcosus*	16
Bilong-bilong	*Mene maculate*	15

Tabagak	*Sardinella gibbosa*	14
Maya-maya	*Lutjanus bigutatus*	14
Saly-salay	*Selaroides leptolepsis*	13
Dilis	*Stolephorus indicus*	11
Asuhos (Aso-os)	*Sillago sihama*	11
Salmunete	*Parapeneus spp, Upeneus spp.*	10

Literacy: Juvenile fish catch measures less than the average length of matured length indicated in the given table.

E. Application

Give Me A Chance!

Give Those Young Fish a Chance!

Worksheet A – Total Length of Fish

Common Name of Fish	Scientific Name	Total Length of Fish (cm)
Dalagang Bukid	*Caesio spp.*	
Tulingan	*Auxis thazard*	
Talakitok	*Alepes djedaba*	
Bukaw	*Priacanthus tayenus*	
Galunggong	*Decapterus macrosoma*	
Bulao	*Rastrelliger kanagurta*	
Putihan/Latab	*Gerres filamentosus*	
Bisogo	*Nemipterus furcosus*	

Bilong-bilong	*Mene maculate*	
Tabagak	*Sardinella gibbosa*	
Maya-maya	*Lutjanus bigutatus*	
Saly-salay	*Selaroides leptolepsis*	
Dilis	*Stolephorus indicus*	
Asuhos (Aso-os)	*Sillago sihama*	
Salmunete	*Parapeneus spp, Upeneus spp.*	

Give Those Young Fish a Chance

Worksheet B – Group Data

Scientific name of fish: _____

Common name of fish: _____

Length of fish at maturity (cm): _____

Fish No.	Actual length of fish	Check below if	
		Juvenile	Mature
1			
2			
3			
4			
5			

Give Those Young Fish a Chance

Worksheet C – Class Data

% of juvenile fishes = $\frac{\text{No. of juvenile fishes}}{\text{Total No. of fishes (juvenile + mature)}} \times 100$		
Scientific name of fish	Common name of fish	% Juvenile

F. Generalization

1. What is/are your conclusion/s from this activity?
2. What will be the consequence of juvenile fishing?
3. How will you convince fishers to return juvenile fishes to the sea?

IV. EVALUATION

Objective Type of Test

Essay suggesting ways to minimize/ eradicate juvenile fishing.

1. What are your conclusions from this activity?
2. If more than 20% of your fish are juvenile or immature, it indicates that there is overfishing (*DENR-BFAR-DILG-CRMP, 2001*). What will be the consequence if

many of the fish caught by fishers are juvenile?

3. How will you convince fishers to return juvenile fishes to the sea?

V. AGREEMENT

Let us do coastal clean-up to help our marine ecosystem.

Our Mangrove Rehabilitation Project

I. OBJECTIVES

A. Content Standards

The learner demonstrates understanding of key concepts of protection and conservation of endangered and economically important species.

B. Performance Standards

The learner report (e.g., through a travelogue) on the activities that communities engage in to protect and conserve endangered and economically important species.

C. Learning Competency

Code: S8LT-IVh-21

Objective: Explain the advantage of high biodiversity in maintaining the stability of an ecosystem.

Specific Objective: Maintaining the stability of an ecosystem.

II. SUBJECT MATTER

A. Topic: Our Mangrove Rehabilitation Project

B. Reference: Mangrove Education Series for Secondary Schools *Students' Module*, Deped Curriculum Guide

C. Materials: Learner's Materials

III. LEARNING ACTIVITIES

A. Motivation

Localization

Cross word puzzle

Given the table of mangrove species for rehabilitation and a crossword puzzle. Each group will look for the mangrove species to be rehabilitated. The first group to find all the species wins.

B. Preliminary Activity

(A C3 Philippines expert will be invited to do this Project)

Follow the Procedure of Activity 5 – Our Mangrove Nursery

1. Site Selection
2. Planning and Building the Nursery
3. Collecting propagules of *Avicennia*, *Sonneratia*, *Rhizophora* and Other Mangrove Species
4. Germinating Propagules (Fruits)
5. Nursery Care

C. Analysis/ Discussion

Questions for discussion

1. How long will the process run?
2. Will it be successful?
3. What is/are needed to be done to ensure the success of this project?
4. What will be the end-project of this?

D. Abstraction

1. Discuss the process of establishing a mangrove nursery (Speaker is an expert on mangrove rehabilitation e.g., C3 Philippines, Inc.).
2. How will it help rehabilitate mangrove?
3. Discuss the process on doing the mangrove rehabilitation project, as the end-project of mangrove nursery.

E. Application

Activity 6: Our Mangrove Rehabilitation Project

1. Select a degraded mangrove area (with the help of experts to mangrove rehabilitation e.g., C3 Philippines, Inc.).
2. Determine the mangrove species for planting and preparation of area.
3. Prepare a map for transplanting activity.
4. Select seedlings for transplanting (from the nursery), planting date and transport to planting site.
5. Replant the area.
6. Monitor seedling growth and survival.

F. Generalization

1. How does mangrove nursery and mangrove rehabilitation help maintain the

stability of mangrove ecosystem?

2. How can you help sustain your mangrove nursery?
3. How can you help influence other people in the community put up mangrove nursery and help in mangrove rehabilitation?

IV. EVALUATION

Evaluate the two projects based on the output. Rubrics for rating will be discussed before the project starts.

V. AGREEMENT

Make a campaign on mangrove ecosystem sustainability by avoiding non-mangrove-friendly activities and help mangrove rehabilitation.

Part III. Grade 9 Competencies

Mangroves in History and Culture

I. OBJECTIVES

A. Content Standards

The learners demonstrate an understanding of how changes in the environment may affect species extinction.

B. Performance Standards

The learners shall be able to make a multimedia presentation of a timeline of extinction of representative microorganisms, plants, and animals.

C. Learning Competency

Code: S9LT-Ie-f-30

Objective: Relate species extinction to the failure of populations of organisms to adapt to abrupt changes in the environment.

Specific Objectives: Learners are expected to:

1. To identify the origin of the names of mangrove species based on stories and beliefs; and
2. To identify the endangered, threatened and extinct species that live in the mangroves.

II. SUBJECT MATTER

A. Topic: Mangroves in History and Culture

B. Reference: Science 9 Learner Modules, Mangrove Education Series for Secondary Schools Students' Module

C. Materials: Book, notebook, laptop, television, and activity notebook

III. LEARNING ACTIVITIES

A. Motivation

Identify the names of the mangrove to its picture by connecting it properly. Upon checking, student should describe briefly the pictures. (Literacy and MAPEH)

B. Presentation

(Topic)

Based on your activity, did you encounter the mangroves being presented? Does it occur in your places? (Localization). Why or why not?

C. Preliminary Activity

Mangroves in History and Culture

Objective:

To identify the origin of the names of some places in our country which are based on local names of mangrove species and associates.

D. Fixing Skills/ Exercises / D.I

Before the presentation of the table, the group will first perform their yell/ hugot lines/short song/story-telling about the stories and beliefs on the existence of mangroves.

E. Analysis/ Discussion

1. How the mangroves got its name? How about the other species like the birds and animals?
2. What is the origin of the names of the mangroves? (ArPan)
3. Are they all the same? What have you observed with their names?
4. How does the stories and beliefs about the existence of mangroves become an advantage or disadvantage?

F. Abstraction

Expected Output

Mangroves also play an important role in history and culture. We hear stories and beliefs about the existence of supernatural beings of mangroves. Whether these stories are true or not, the fear of some fisherfolk prevents cutting and hunting in a mangrove forest, allowing endangered species to recover. Scientists named the species in different ways. Some scientist named it to the person who discovered it and some are on the places where it can only be found to acknowledge its

contribution. Salt water crocodile live in the mangroves and they are threatened nowadays. If human continuously destroyed their habitats and catch them for different purposes time will come that this crocodile will became extinct.

G. Valuing

"*Mangroves also play an important role in history and culture.*" How can you relate to this?

H. Application

What is the connection of mangroves to the survival of the mangrove-living species?

I. Generalization

Identify the origin of the names of mangrove species based on stories and beliefs. Identify the endangered, threatened and extinct species that live in the mangroves.

IV. EVALUATION

Activity will serve as an evaluation.

V. ASSIGNMENT

A. Identifying Mangrove Species

Identify the names of the mangrove to its picture by connecting it properly. **Connect column A** (names) **to column B** (pictures).

Column A	Column B
1. *Lumnitzera littorea* (Dublisa)	
2. *Bruguiera gymnorrhiza* (Botsing)	
3. *Rhizophora* species (Bakhaw)	
4. *Nypa fruticans* (Nipa)	
5. *Sonneratia* species (Pagatpat / pedada)	

Answer Key:

1. *Lumnitzera littorea* (Dubilsa) = **2**
2. *Bruguiera gymnorrhiza* (Botsing) = **5**
3. *Rhizophora* species (Bakhaw) = **1**
4. *Nypa fruticans* (Nipa) = **3**
5. *Sonneratia* species (Pagatpat / pedada) = **4**

B. Mangroves In History and Culture

Objective:

To identify the origin of the names of some places in our country which are based on local names of mangrove species and associates and to categorize the mangroves as endangered, threatened, or extinct.

Procedure:

1. Identify the scientific name of the mangrove species by choosing from the options below.
2. Identify the mangroves as endangered, threatened or extinct.

   Excoecaria agallocha (Alipata)
   Rhizophora species (Bakhaw)
   *Scyphiphora hydrophyllacea (*Nilad)
   Sonneratia species (Pagatpat / pedada)
   Avicennia marina / Avicennia alba (Piapi)
   Nypa fruticans (Nipa, sapsap, sasa)
   Heritiera racemosa (Culasi / tabao)

Scientific Name / Local Name	Philippine Cities, Towns, and Villages	Other Species that live in the Mangroves; and categorize it as Endangered, Threatened, Extinct
	Piapi Beach, Dumaguete City Piapi, Hamtic, Antique	
	Lipata, Culasi, Antique Lipata, Bacacay, Albay Ipata, Surigao City	
	Dungon, Jaro, Iloilo City	
	Casapsapan, Aurora Canipaan River, Palawan	
	Bakhaw, Jaro, Iloilo City Bakhaw, San Joaquin, Iloilo Bacjauan, Iloilo	
	Maynilad, Manila	
	Pagatpatan, Jasaan, Misamis Oriental Pedada Bay, Ajuy, Iloilo	

Answer Key:

1. *Avicennia marina / Avicennia alba* (Piapi)
2. *Excoecaria agallocha* (Alipata)
3. *Heritiera racemosa* (Culasi / tabao)
4. *Nypa fruticans* (Nipa, sapsap, sasa)
5. *Rhizophora species* (Bakhaw)
6. *Sonneratia* species (Pagatpat / pedada)
7. *Scyphiphora hydrophyllacea* (Nilad)

Index of Diversity and Population Assessment in Mangroves

(What are the Kinds of Animals Found in Mangroves?)

I. OBJECTIVES

A. Content Standards

The learners demonstrate an understanding of how changes in the environment may affect species extinction.

B. Performance Standards

The learners shall be able to make a multimedia presentation of a timeline of extinction of representative microorganisms, plants, and animals.

C. Learning Competency

Code: S9LT-Ie-f-30

Objective: Relate species extinction to the failure of populations of organisms to adapt to abrupt changes in the environment.

Specific Objectives: The learners are expected to:

1. To measure species distribution using the mathematical way of expressing the amount of biodiversity and species (mangrove snails) distribution in a community; and
2. To make a rough estimate of the population size of the snails in one quadrat.

II. SUBJECT MATTER

A. Topic: Index of Diversity and Population Assessment

B. References: Science 9 Learner Modules, Mangrove Education Series for Secondary Schools *Students' Module*

C. Materials: Book, notebook, laptop, television, quadrat, activity notebook

III. LEARNING ACTIVITIES

A. Motivation

1. How many are you in the class? What is your population? How about how many species of trees you found in the campus? (Numeracy)
2. What is population? Give an example.
3. A population is a group of living things within a certain area that are all of the same species. (Literacy).
4. What is species diversity? Species diversity is the number of different species that are represented in a given community.

B. **Presentation**

(Topic)

A balanced ecosystem, organisms need a balanced environment. A change in population sizes may be due to factors affecting the environment. Like the Calauit area in Palawan (Localization), which is set aside as park preserve, and no hunting is allowed in the park. A number of animals like giraffe and zebra are placed in the area. There are plenty of plants to serve as food for the giraffe and zebra population. The herd of giraffe and zebra are assumed to be healthy and begin to multiply faster than expected (Economics).

Like giraffe and zebra, mangrove snails can reproduce or decline faster depending on its food and availability of the factors that can be considered.

C. Preliminary Activity

(Note: This is a field activity)

Observation and Population Assessment of Mangrove Snails

Objectives:

1. To observe some physical characteristics of mangrove snails; and
2. To make a rough estimate of the population size of the snails in one quadrat.

Activity 2 – Observation and Population Assessment of Mangrove Snails

Objectives:

1. To observe some physical characteristics of mangrove snails; and
2. To make a rough estimate of the population size of the snails in one quadrat.

Materials:

Laboratory notebook

Pencil

Marking pen

Weighing scale, 2 kg cap
Net bags
Sealable plastic bags
Garden trowel
Scissors
Colored pencils and crayons
Meter stick
30 cm bamboo pegs, 12 pcs
Plastic straw or nylon rope, 12m
Ruler
Camera (optional)

Procedure:

a. Preliminary activities

1. Select a mangrove area near your locality as a sampling site.
2. Get a calendar that shows the lunar phases and tidal elevation. Select a date with a low tide (0 to 0.5 m) during the day for mangrove fieldwork.
3. Wear comfortable clothing (long pants and long sleeves), hat and old rubber shoes and apply sunblock and insect repellent.
4. Before going to the site, make sure that your materials are complete. Copy the report sheets and questions in Activity 2 of the lesson in your notebook. Use this to record your data.

b. Quadrat preparation

1. Go to your local mangrove area.
2. Observe the area for snails. You may dig up the surrounding soil.
3. When you have identified an area with snails, make a 1 m x 1 m quadrat. This is done by setting the four bamboo pegs to form a square, 1 m long by 1 m wide. Tie the rope to each corner of the square. This area you have marked off is called a quadrat. Make 3 quadrats for your sampling areas in different parts of the mangrove.

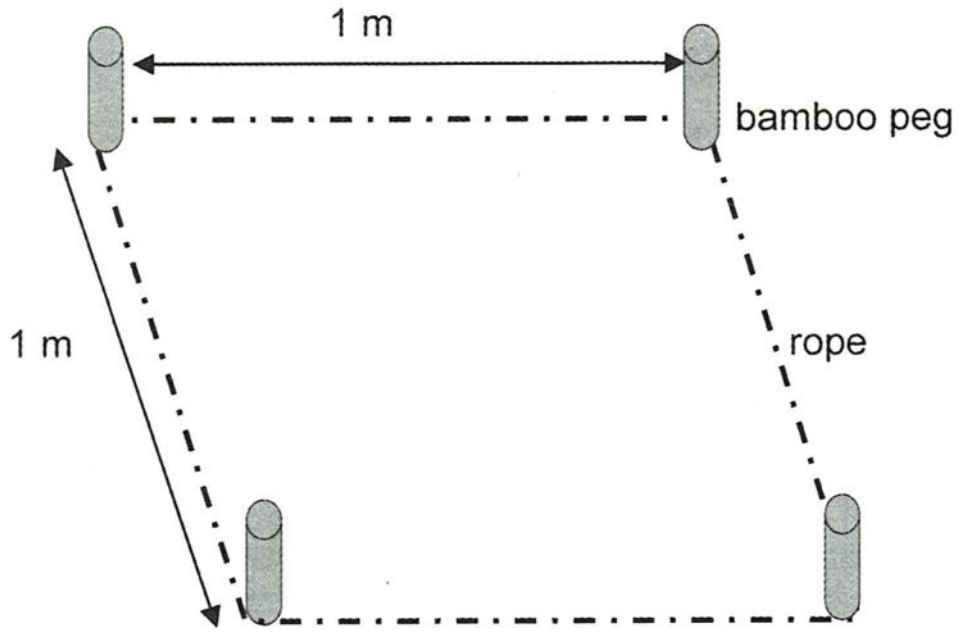


Figure 12. One-meter Square Quadrat

c. Quadrat sampling

1. Using the trowel, dig the soil up to 10 cm deep and collect samples from the first quadrat.
2. Wash the samples from the first quadrat with sea water and place them inside plastic bags labelled Q1.
3. Bring the plastic bags with the specimens to a dry area not reached by the tide.
4. Draw or take pictures of the specimens.
5. Classify the snails according to size.
6. Measure the length of 5 snails using a ruler. Record this on the report sheet.
7. Count the total number of snails from Q1. Record this on the report sheet.
8. Obtain the total weight of all snails from Q1. Divide this by the number of snails for Q1 to get the average weight. Record the data on your report sheet.
9. Repeat counting and weighing snails for Q2 and Q3. Record all data on the report.

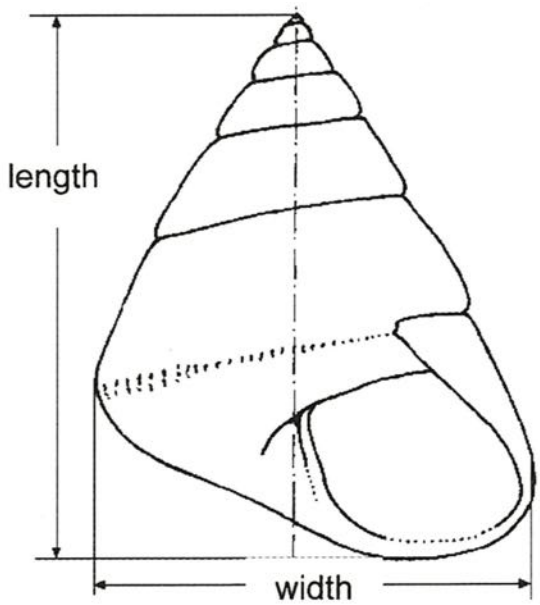


Figure 13. Measurements of a Shell (*Carpenter and Niem, 1998*)

Observation and Population Assessment of Mangrove Snails

Report Sheet

a. Physical characteristics of snails

Quadrat	Sample No.	Length (cm)
Q1	1	
	2	
	3	
	4	
	5	
	Average	
Q2	1	
	2	
	3	
	4	
	5	
	Average	
Q3	1	
	2	
	3	
	4	
	5	
	Average	

b. Approximate population of snails per quadrat

Quadrat No.	Total Weight of Snails (g)	Total No. of Snails	Average Weight of Snails (g)
1			
2			
3			
Total			
Average of three quadrats			

Guide Questions:

1. Are your snail samples of the same size? What are the size ranges of snails you collected?

   _____

   _____

   _____

2. Why is there a need for quadrats? In your sample, was it more convenient to divide the area into quadrats?

   _____

   _____

   _____

3. Can the population of the snails be measured using their weights? Why or why not?

   _____

   _____

   _____

4. In what instances can you use the weights of your specimens to measure the population?

   _____

   _____

   _____

D. Fixing Skills/ Exercises/ D.I.

Presentation of the observation and Population Assessment of Mangrove Snails

E. Analysis/ Discussion

1. Are your snail samples of the same size? What are the size ranges of snails you collected?
2. Why is there a need for quadrats? In your sample, was it more convenient to divide the area into quadrats?
3. Can the population of the snails be measured using their weights? Why or why not?
4. In what instances can you see weights of your specimens to measure the population?
5. Were you able to identify all the snails?
6. Did the species and populations of snails differ in each quadrat?

F. Abstraction

(Expected Output)

Species diversity – is the number of different species that are represented in a given community.

Index of diversity = *Number of species* x *number of runs* / *Number of snails*

(Numeracy)

Population sizes vary among organisms. They change with the number of births and when they move into an ecosystem. They also change when members die or move out of an ecosystem. Moreover, you were introduced to the concept of quadrat sampling and how to assess the populations of animals based on number and mass (biomass).

Gastropods like snails usually burrow in areas with soil rich in organic matter, and are therefore expected to be abundant in a mangrove ecosystem. (Connect it to TLE)

G. Valuing

"Species diversity is the number of different species that are represented in a given community." How can you relate to this?

H. Application

How can you represent yourself as a part of the community?

I. Generalization

1. How you measure the species distribution using diversity index?
2. How you make a rough estimation of the population size of the snails on one quadrat?

IV. EVALUATION

1. What can be used to estimate the population size of the snails in an ecosystem?
2. How you measure the species distribution using diversity index?
3. Why estimation of population of a species is important?

Answer Key:

1. *Using quadrats*
2. *Index of diversity =* $\frac{\text{No. of species}}{\text{No. of snails}}$ *x number of runs*
3. _____

V. ASSIGNMENT

List down reasons why species become extinct.

Answer Key:

1. *Climate change*
2. *Pollution*
3. *Habitat loss*
4. *Human predation*
5. *Disease*
6. *Invasive species*

Species Extinction

Mangrove Invertebrates!

I. OBJECTIVES

A. Content Standards

The learners demonstrate an understanding of how changes in the environment may affect species extinction.

B. Performance Standards

The learners shall be able to make a multimedia presentation of a timeline of extinction of representative microorganisms, plants, and animals.

C. Learning Competency

Code: S9LT-Ie-f-30

Objective: Relate species extinction to the failure of populations of organisms to adapt to abrupt changes in the environment.

Specific Objectives: The learners are expected to:

1. To identify the causes and effects of species extinction; and
2. To relate mangrove invertebrates and vertebrates' species extinction to the failure of populations of organisms.

II. SUBJECT MATTER

A. Topic: Species Extinction: Mangrove Invertebrates!

B. Reference: Science 9 Learner Modules

C. Materials: Book, notebook, laptop, television

III. LEARNING ACTIVITIES

A. Motivation

What is your favourite seafood menu? (TLE). Identify the seafood. Where can you find this?

B. Presentation

There are some organisms that have no vertebral column or what we call the invertebrate animals. The teacher will show the pictures (arts) of mangrove invertebrates found in Busuanga, Palawan and then the students will say something about it. (5 minutes)

Pictures of vertebrate and invertebrate animals.

Anodontia dentula (Imbao)

Anadara spp. (Litub)

Geloina (Tuway)

Teredo spp. (Tamilok)

Telescopium spp. (Susu)

Pagurus spp. (Hermit crab)

Scylla olivacea (Mud crab)

Thalassina spp. (Mangrove Lobster)

Mugil spp. (Banak/ Gisao)

Lutjanus spp. (Mangagat)

Identification of Different Mangrove Animals (Teachers Guide Answer)

Direction: Categorize the following species as vertebrates or invertebrates and indicate its ecological status, if it is endangered, endemic or extinct.

Species	Invertebrates	Vertebrates	Ecological Status
Anodontia dentula (Imbao)			
Lutjanus spp. (Snapper or Mangagat)			
Scylla olivacea (Mud crab)			
Pagurus spp. (Hermit crab)			
Telescopium spp. (Susu)			
Teredo spp. (Tamilok)			
Geloina (Tuway)			
Anadara spp. (Litub)			
Mugil spp. (Banak/Gisao)			
Thalassina spp. (Mangrove Lobster)			

Answer Key:

Species	Categorization
Anodontia dentula (Imbao)	Invertebrates
Lutjanus spp. (Snapper or Mangagat)	Vertebrates
Scylla olivacea (Mud crab)	Invertebrates
Pagurus spp. (Hermit crab)	Invertebrates
Telescopium spp. (Susu)	Invertebrates
Terebo spp. (Tamilok)	Invertebrates
Gelonia (Tuway)	Invertebrates
Anadara spp. (Litub)	Invertebrates
Mugil spp. (Banak/Gisao)	Vertebrates
Thalassina spp. (Mangrove Lobster)	Invertebrates

C. Preliminary Activity

Identification of different mangrove animals as endangered, endemic and extinct. *(Use Table 8 of this manual)*.

D. Fixing Skills/ Exercises/ D.I.

Presentation of output using differentiated instruction.

1. Role Playing – Common characteristics of invertebrate and vertebrate species.
2. Poem – Example of invertebrate's species that are under endangered, threatened and extinct species category.
3. Drawing – image of the endangered, threatened and extinct species. (Arts)
4. Role Play – Causes of the extinction of the species.

E. Analysis/ Discussion

1. What are the common characteristics of vertebrates? of invertebrates?
2. Differentiate threatened, endangered and endangered. (Literacy)
3. What did you consider to categorize the species as endangered, endemic and extinct?

4. What do you think are the reasons why species become endangered, threatened, or extinct?
5. What are the species that are distinct to Busuanga? (Localization)

F. Abstraction

(Expected Output)

Invertebrates are organisms belonging to the animal kingdom with no vertebral column. The most common phyla of invertebrates found in the mangroves are as follows: (*See Mangrove Education Series for Secondary Schools at page 49*)

1. Phylum Mollusca (Shells)
   - Class Bivalvia (Bivalves) – mollusck with 2 shells enclosing the body.
   - Class Gastropoda (Univalves) – usually coiled shells (snails) or without shells (slugs).

2. Phylum Athropoda (Arthropods) – organism with a segmented body enclosed in a hard, jointed external skeleton made mainly of chitin.
   - Class Crustacea (Crustaceans)
   - Class Insecta (Insects)

3. Phylum Sipunculida (Peanut Worms).

   Some invertebrates and vertebrates thrive in the mangrove canopy, of which the most abundant are the crabs. When a species population becomes so low that only a few remain, the species is considered ***endangered***. Species that declines so fast that it becomes endangered and is said to be ***threatened***. ***Extinction*** is the disappearance of a species when the last of its members die.

   The teacher will discuss the wildlife depletion, water pollution, air pollution (MAPEH), destruction of coastal resources, and acid precipitation (TLE) affects the extinction of a species.

G. Valuing

"Extinction is the disappearance of a species when the last of its members die." How can you relate to this sentence?

H. Application

Why do we need to save endangered species?

I. **Generalization**

What did you learn today?

IV. EVALUATION

1. List down five reasons of species extinction.
2. How does mangrove invertebrates and vertebrates species extinction to the failure of populations of organisms?

V. ASSIGNMENT

Research about the species that became extinct and the effects of their loss nowadays.

Direction: Categorize the following species as vertebrates or invertebrates and indicate its ecological status, if it is endangered, endemic or extinct.

Table 8. Identification of Different Mangrove Animals

Species	Invertebrates					Vertebrates	Ecological Status
	Class Bivalve	Class Gastropoda	Class Crustacea	Class Insecta	Phylum Sipunculida		
Anodontia dentula (Imbao)							
Lutjanus spp. (Snapper or Mangagat)							
Scylla olivacea (Mud crab)							
Pagurus spp. (Hermit crab)							
Telescopium spp. (Susu)							
Teredo spp. (Tamilok)							
Geloina (Tuway)							
Anadara spp (Litub)							
Mugil spp. (Banak/ Gisao)							
Thalassina spp. (Mangrove Lobster)							

Part IV: Grade 10 Competencies

Mangroves: Nature's Treasure Chest

I. OBJECTIVES

A. Content Standards

The learners demonstrate an understanding of an ecosystem as being capable of supporting a limited number of organisms.

B. Performance Standards

The learners shall be able to:

C. Learning Competency

Code: S10LT-IIIj-43

Objective: Suggest ways to minimize human impact on the environment.

Specific Objectives: The learners are expected to:

1. To identify the goods or products we derive from mangroves; and
2. To give sources of these goods and understand the importance of mangroves as providers of products useful to humans.

II. SUBJECT MATTER

A. Topic: Uses of Mangroves to Sustain Human Needs

B. Reference: Science 9 Learner Modules, Mangrove Education Series for Secondary Schools Students' Module

C. Materials: Book, notebook, laptop, television, and activity notebook

III. LEARNING ACTIVITIES

A. Motivation

My K-W-H-L

Objectives:

Recall what you already know about mangroves, then list down what you would

like to learn about mangroves and fisheries resources. Afterwards, list down what you have learned from the activities in this lesson. (Literacy)

K (What did I know about the uses and benefits of mangroves?)	W (What do I want to learn about the uses and benefits of mangroves?)	H (How would I like to learn about mangrove and their importance in fisheries?)	L (What have I learned after doing the activities in the lesson?)

B. Presentation

(Topic)

Mangroves have provided humans with varied and useful goods and service. In recent decades, however, businessmen and even city planners have viewed mangroves as "wastelands". They have converted mangrove areas into fish ponds, commercial complexes (malls and entertainment parks), and even subdivisions in response to market demand. Conservation efforts of environmental advocates focus on highlighting the economic value of mangroves. (ArPan/Economics)

C. Preliminary Activity

Direct Uses of Mangroves

Objectives:

1. Interview individuals on the direct uses of mangroves;
2. Develop your skills in gathering data through interviews; and,
3. Describe the different uses of mangroves.

Products	Example of Sources	Number of Individuals Interviewed and Answered The Products (Numeracy)
Beverage (fermented drinks, sugar, vinegar)	Nipa sap	
Medicine / drugs	Dungon seeds	
Fisheries (food, livelihood)	Fish, shrimps, crabs	
Construction (roofing materials, fencing)	Nipa leaves	
Fuel (Firewood, charcoal)	Branches of bakhaw, bungalon	
Other products	Honey	

Guide Question:
What goods and services are provided by mangroves?

D. Fixing Skills/ Exercises/ D.I.

Presentation of the table (Numeracy). They can also present the table through poem, role play, spoken poetry and rap (differentiated instruction).

E. Analysis/ Discussion

Guide Questions

1. What are goods and services are provided by mangroves? (TLE)
2. What may happen if the mangroves will disappear?
3. What have you found from your interviews?
4. Here in Busuanga, where are the areas that have a lot of mangroves? (Localization)
5. What is the common problem of the localities regarding the protection of the mangroves? (Health / Economics)

F. Abstraction

(Expected Out-put)

Mangroves protect shorelines from damaging storm and hurricane winds, waves, and floods. Mangroves also help prevent erosion by stabilizing sediments with their tangled root systems. They maintain water quality and clarity, filtering pollutants and trapping sediments originating from land.

Local communities	National interests	Global interests
Shelter	Timber production	Conservation
Construction timber	Charcoal production	Education
Firewood	Fishing industry	Effects of climate change
Food (TLE)	Mixed shrimp—mangrove forestry enterprises	Preservation of biodiversity
Income from fishing shrimp culture and wood gathering	Recreation	
Income through cottage industries	Tourism	
Medicine	Education	
Fodder of animals	Coastal and estuary protection	
Protection from storm damage and river bank erosion		

G. Valuing

"Mangroves also help prevent erosion by stabilizing sediments with their tangled root systems." You as an individual, you encountered different typhoon in life. How can you reflect on the above stated statement?

H. Application

What is the aesthetic value of mangroves?

I. Generalization

Identify the goods or products we derive from mangroves. Give sources of these goods and the importance of mangroves as providers of products that are useful to humans.

IV. EVALUATION

1. Which of the following are the uses of mangroves in local communities?
   a. Shelter
   b. Timber production
   c. Conservation

2. Which of the following DOES NOT belong to the group?
   a. Medicine
   b. Food
   c. Education

3. What is/are the importance of mangroves?
   a. Carbon sinks
   b. Rich in biodiversity
   c. Resources for humans

4. What are the global interests in mangroves?
   a. Timber production
   b. Medicine
   c. Effect of climate change

5. Which of the following DOES NOT belong to the group?
   a. Local communities
   b. National interests
   c. International interests

Answer Key:

1. a
2. c
3. a, b, and c
4. c
5. c

V. ASSIGNMENT

Research about mangroves in history and culture.

Part V. Grade 11 Competencies

What Shakes Life Near the Sea?

I. OBJECTIVES

A. Content Standards

The learner demonstrates understanding of (1) plate tectonics; and (2) the different hazards caused by geological processes (earthquakes, volcanic eruptions, and landslides).

B. Performance Standards

The learner shall be able to, using maps, diagrams, or models, (1) predict what could happen in the future as the tectonic plates continue to move; and (2) conduct a survey to assess the possible geologic hazards that your community may experience.

C. Learning Competency

Code: S11/12ES-Id-22 and S11/12ES-If-32

Objectives:

1. Explain how the movement of plates leads to the formation of folds and faults; and,
2. Give practical ways of coping with geological hazards caused by earthquake, volcanic eruptions and landslides.

Specific Objectives:

1. Describe the Plate Tectonics Theory;
2. Name the two kinds of earthquakes; and
3. List the things to do in case of an earthquake.

II. SUBJECT MATTER

A. Topic: What Shakes Life near the Sea

B. Reference: Mangrove Education Series for Secondary Schools *Students' Module*, DepEd Curriculum Guide

C. Materials: Learner's Materials

III. LEARNING ACTIVITIES

A. Motivation

Localization

Jigsaw Puzzle – Busuanga Map

Let the students group into three and fix the puzzle. Give extra points for the first three who will fix the puzzle first. Let them identify the barangays of Busuanga. Ask them of its relevance to the Continental Drift which happened 225 million years ago.

B. Preliminary Activity

(Differentiated Instruction)

Perform Activity 1- Plate Tectonics Model

This activity will enable the students to demonstrate the interactions of plate boundaries.

Materials:

2 whole graham crackers
Cup of water
Wax paper
Plastic knife
1 square rice krispy or pop rice
Globe or world map
300 mL frosting/icing or mayonnaise
Saucer

The class was already divided into four groups ahead of time. Each group will be given instructions to follow and questions to be answered after performing their task. They are also allowed to eat the tectonic plates only after their presentation (which could be in the form of singing, dancing, acting, reporting, etc.)

Group 1 – Divergent Plate Boundaries
Group 2 – Convergent Plate Boundaries (Continental and Oceanic)

Group 3 – Convergent Plate Boundaries (Continental)
Group 4 - Transform Plate Boundaries

C. Analysis/ Discussion

Questions for discussion

1. What plate tectonic process creates new ocean floor from diverging plates?
2. What happens when a tectonic plate gets subducted?
3. How do earthquakes occur?
4. Why does the Philippines prone to earthquakes?
5. What causes tectonic earthquakes?
6. How do volcanoes cause earthquakes?
7. What are you going to do in the event of an earthquake?

D. Abstraction

Theory of Plate Tectonics

1. Outline the main principles of Plate Tectonics:
   a. The Earth's outermost rigid layer (lithosphere) is broken into discrete plates each moving more or less as a unit.
   b. Driven by mantle convection, the lithospheric plates ride over the soft, ductile asthenosphere.
   c. Different types of relative motion and different types of lithosphere at plate boundaries create a distinctive set of geologic features.

2. Review the concept of lithospheric plate:
   a. The lithosphere consists of the crust and the uppermost mantle.
      - Average thickness of continental lithosphere: 150km
      - Average thickness of old oceanic lithosphere: 100km
   b. Composition of both continental and oceanic crusts affect their respective densities.
   c. The lithosphere floats on a soft, plastic layer called asthenosphere.
   d. Most plates contain both oceanic and continental crust; a few contain only oceanic crust.
   e. A plate is not the same as a continent.
      - Identify and describe the three types of plate boundaries

Table 9. Types of Plate Boundaries

Plate Boundary		Plate Movement	Description	Examples
Divergent	Oceanic-Oceanic	Plates moving away from each other	Forms elevated ridge with rift valley at the center; submarine volcanism and shallow earthquakes	Mid-Atlantic ridge; East Pacific rise
	Continental-Continental		Broad elevated region with major rift valley; abundant volcanism and shallow earthquakes	East African Rift valley; Red Sea
Convergent	Oceanic-Continental	Plates moving toward each other	Dense oceanic plate slips beneath less dense continental plate; trench forms on the subducting plate side and extensive volcanism on the overriding continental plate; earthquake foci becoming deeper in the direction of subduction	Western South America
	Oceanic-Oceanic		Older, cooler, denser plate slips beneath less dense plate; trench forms on subducting plate side and island arc on overriding plate; band of earthquakes becoming deeper in the direction of subduction	Aleutians; Marianas
	Continental-Continental		Neither mass is subducted; plate edges are compressed, folded, and uplifted resulting in the formation of major mountain range	Himalayas; Alps
Transform		Plates sliding past each other	Lithosphere is neither created nor destroyed; most offset oceanic ridge systems while some cut through continental crust; characterized by shallow earthquakes	Mid-ocean ridge; San Andreas fault

Trivia

Did you know that since 1900, the only earthquakes recorded with high magnitude were the 1960 ***Great Chilean Earthquake*** *(magnitude 9.5) and the 1964* ***Good Friday Earthquake*** *in Prince William Sound, Alaska (magnitude 9.2). The only other recorded earthquake of magnitude 9.0 or greater was off Kamchatka, Russia, on November 4, 1952 (magnitude 9.0). Each of these megathrust earthquakes also created tsunamis in the Pacific Ocean, but the death toll from these was significantly lower in number.*

E. Application

(Literacy)

Debate

A mangrove forest is to be cleared to give way to fishpond development. Would you allow it? Why? Why not?

F. Generalization

1. How do you describe the Plate Tectonics Theory based from the activity that you have done?
2. What are the two kinds of earthquakes?
3. How do these two kinds of earthquakes occur?
4. What should you do before, during, and after an earthquake?

IV. EVALUATION

The activity of the students will be served as their quizzes.

V. ASSIGNMENT

Take-home Activity

Prepare an emergency supply kit. Bring it to the school and let the teacher check the content of your kit. It must include non-perishable food, water, first aid kit, a battery-operated radio, clothes, flashlights and extra batteries.

Transpiration in Mangroves

(The Energy Connection in Mangroves)

I. OBJECTIVES

A. Content Standards

The learner demonstrates understanding of the basic principles of ecology.

B. Performance Standards

The learner prepares an action plan containing mitigation measures to address current environmental concerns and challenges in the community.

C. Learning Competency

Code: S11/12LT-IVhj-28

Objective: Describe the principles of ecology.

Specific Objectives:

1. Relate how nutrients are exchanged in mangroves; and
2. Appreciate the role of mangrove plants in supporting organisms in their habitat.

II. SUBJECT MATTER

A. Topic: The Energy Consumption in Mangroves: Transpiration and Decomposition

B. Reference: Mangrove Education Series for Secondary Schools *Students' Module*, DepEd Curriculum Guide

C. Materials: Learner's Materials

III. LEARNING ACTIVITIES

A. Motivation

Students are grouped into 3. Each group will observe transpiration from leaves of *Sonneratia sp*. and infer what happens to water released by leaves.

<u>Materials:</u>

Twigs of *Sonneratia sp.*, 30 cm long, 4pcs

Clear plastic bottles, 330 mL
Water from the mangrove swamp in a 1.5-liter bottle
Clear plastic bag, 25 x 50 cm, 4 pcs
Marking pen
Laboratory thermometers, 2pcs
Clear adhesive tape

Procedure:

Note: The best time to conduct this activity is between 9:00 a.m. and 3:00 p.m.

1. Collect four twigs of *Sonneratia sp*. about 30 cm long, each with a similar number of leaves.
2. Collect around 1.5 liters of water from the mangrove swamp in a plastic bottle.
3. Remove the cap from each bottle and fill with water obtained from the swamp.
4. Place a twig in each bottle. Put clear tape around the mouth of the bottle to cover the space not occupied by the twig. Enclose the exposed part of the twig with clear plastic bag. See to it that there is no opening from where water can escape except to the clear plastic bag.
5. Label the bottles: A1, A2, B1, and B2. The set-up will look like the one below.
6. Find a hot sunny place outside your school building and expose set-ups A1 and A2. Record the air temperature.
7. Place set-ups B1 and B2 in a cool, dark place inside the classroom, without any direct source of light. Record the air temperature.
8. After an hour, examine the set-ups by looking closely at the plastic bag and leaves of the specimen. Record the outside air temperature.
9. Leave the set-ups for another hour. Examine the set-ups and take note of the outside air temperature.

- Ask the students to answer the guide questions of Activity 2 on p.85.

B. Preliminary Activity

(Differentiated Instruction) Localization

Decomposition!

1. Form groups of 4 members. Consult the tide table and select a date with suitable low tide levels. The teacher will locate an area where students can collect decaying mangrove leaves or branches for this activity.
2. Each group will observe the different stages of decomposition of leaves; arrange collected leaves according to the sequence in decomposition; name

organisms and physical factors that may contribute to decomposition; and discuss carbon cycle.

3. The teacher will provide the printed procedures and guide questions to each group. They are going to present their output in creative ways (e.g., buzz group, reporting, diagrams, tabular, role play, short skit, etc.)

C. Analysis/ Discussion

Questions for discussion

1. How does the water cycle occur?
2. How does the transpiration take place?
3. What is the importance of transpiration in the atmosphere?
4. What are the sources of carbon dioxide in the mangroves?
5. How do organisms in mangrove habitats get their supply of carbon?
6. If there is only 1 billion km^3 of water in the world, how much of this is fresh water?
7. How much of this fresh water may be available for our use? (Numeracy)
8. Reflect on this phrase: From dust you came, to dust you shall return. (Valuing)

D. Abstraction

Nutrient Cycling

Water cycle

1. Water moves from the atmosphere to the bodies of water to land and back.
2. Evaporation from leaves of plants, known as transpiration, contributes to water vapor in the atmosphere.
3. When the clouds become heavy, they fall as precipitation.
4. Organisms in mangrove habitats need water and nutrients such as nitrogen, phosphorus, and sulfur.

Carbon cycle

1. Carbon compounds are produced at the same time energy is fixed in molecules of these compounds.
2. When consumers use carbon compounds in the process of respiration, they release carbon dioxide back to the atmosphere that becomes available to plants.

E. Application

Making a Booklet

This activity provides the opportunity to express in meaningful ways the

knowledge the students have gained in their lesson. (See p. 90 of Module 2 for the procedure.)

Materials:
Drawing booklet
10 pages or more (or one piece of white cartolina cut into 12 equal sizes, bound by a string)
Crayons or colored pens

F. Generalization

1. What can you conclude in the activities that you have done?
2. Why do organisms have to utilize the chemical energy in food?
3. How important the organic materials flow in cycles?

IV. EVALUATION

The activity of the students will serve as their quizzes.

V. AGREEMENT

Let us prevent anybody from cutting mangroves, because it may affect the balance of carbon and oxygen.

What are the Conditions in a Mangrove Environment?

I. OBJECTIVES

A. Content Standards

The learners demonstrate an understanding of biotic potential and environmental resistance defined; population distribution and dispersal patterns; and population size and density.

B. Performance Standards

The learners shall be able to prepare an action plan containing mitigation measures to address current environmental concerns and challenges in the community.

C. Learning Competency

Code: S11/12-IVhj-29

Objective: Categorize the different biotic potential and environmental resistance (diseases, availability of food, and predators) that affect population explosion

Specific Objectives:

1. Differentiate physical from chemical factors; and
2. Have an idea of the general physical and chemical conditions of sea water and soil in mangrove habitats.

II. SUBJECT MATTER

A. Topic: What are the Conditions in a Mangrove Environment?

B. Reference: Mangrove Education Series for Secondary Schools *Students' Module*, Deped Curriculum Guide

C. Materials: Learner's Materials

III. LEARNING ACTIVITIES

A. Motivation

What Do I Know?

1. Review levels of biological organization (atom to biosphere) and orient

students at which organizational level the discussion is.

2. Review the definition of ecology: The study of the ecosystem which is composed of biotic (living) and abiotic (non-living) components.

B. Preliminary Activity

(Differentiated Instruction) (Numeracy) (Location)
(Integration in MATH and ARTS subjects)

Instruction: The class will be divided into two groups.

1. **The first group will do the measurement of physical factors**
   Each member of the group will choose among the physical factors, they could ask for a partner or do it individually (Water temperature, Soil temperature, Air temperature, Relative humidity, and Soil texture)

2. **The second group will do the measurement of chemical characteristics**
   Each member of the group will choose among the chemical characteristics, they could ask for a partner or do it individually (Water salinity, Soil and water pH, Dissolved oxygen measurement, Dissolved organic matter measurement). They will identify and measure the physical characteristics (Group 1); and identify and measure the chemical characteristics of a mangrove habitat (Group 2).

   This activity must be performed along the nearest mangrove habitat in your area.

   The two groups will present their data accurately, but through creative presentation.

C. Analysis/ Discussion

Questions for discussion

1. What are the physical characteristics of a mangrove ecosystem?
2. What are the ways of measuring the physical and chemical parameters of an ecosystem?
3. How do the soil pH and water pH being measured?
4. Why does the water in mangrove habitats has lower dissolved oxygen than in the open ocean?
5. When is the best time to collect soil sample?

6. If a refractometer is not available in salinity measurement, what is the best alternative method for it?

D. Abstraction

Physical and Chemical Characteristics of a Mangrove Ecosystem

1. Refers to properties that can be measured without changing the composition of the area or the samples gathered for analysis.
2. These are temperature, relative humidity, water transparency, and soil texture.
3. The chemical characteristics of a mangrove ecosystem apply to the abiotic components of soil and water.
4. Water in mangrove habitats generally has lower dissolved oxygen in the open ocean due to abundant organic matter.
5. Decomposition leads to active recycling of nutrients in mangrove ecosystems.

E. Application

(Integration of Math)

Venn diagram

Construct a Venn diagram which shows the similarities and differences of physical and chemical characteristics of a mangrove ecosystem.

F. Generalization

Differentiate physical from chemical factors; and describe general physical and chemical conditions of sea water and soil in mangrove habitats. What is/are the significance of measuring the physical and chemical parameter of an ecosystem?

IV. EVALUATION

Test Yourself

1. Which of the following is not a physical characteristics?
   a. Temperature
   b. Relative humidity
   c. pH
   d. Water transparency
   e. None of these

2. Which of the following is not a chemical characteristics?
   a. pH
   b. Dissolved oxygen
   c. Salinity
   d. Relative humidity
   e. Organic matter content

3. Which is considered a “harsh” environmental condition?
   a. High salinity
   b. High acidity
   c. Aerobic conditions
   d. Both a and b
   e. Both b and c

4. Describe a specific situation in which the physical and chemical characteristics of an ecosystem affect the local flora and fauna?

5. Why are mangrove habitats considered “harsh environments” for plants?

Answer Key:

1. c
2. *d*
3. c
4. _____
5. _____

V. ASSIGNMENT

Localization

Choose between the two activities:

1. Conduct an investigatory study of a coral reef or seagrass ecosystem within your locality.

2. Conduct an investigatory study of a forest ecosystem or any terrestrial ecosystem, like grassland or rice field.
3. Compare the results with the other ecosystems you have studied.

Mangroves: Nature's Treasure Chest

I. OBJECTIVES

A. Content Standards

The learners demonstrate an understanding of terrestrial and aquatic ecosystems and how human activities affect the natural ecosystem.

B. Performance Standards

The learners shall be able to prepare an action plan containing mitigation measures to address current environmental concerns and challenges in the community.

C. Learning Competency

Code: S11/12-IVhj-30

Objective: Describe how the different terrestrial and aquatic ecosystems are inter linked with one another.

II. SUBJECT MATTER

A. Topic: Mangroves: Nature's Treasure Chest

B. Reference: Mangrove Education Series for Secondary Schools, DepEd Curriculum Guide

C. Materials: Learner's Materials

III. LEARNING ACTIVITIES

A. Motivation

Localization

What's in a name?

In this activity, the students are going to present their homework, wherein they have:

1. Interviewed older local folk who live near the mangrove forest and ask them about places (cities, towns, villages, etc.) that were named after mangrove plants and animals; and
2. Made a list of these places and the mangrove species to places.

B. Preliminary Activity

Draw, Show, and Tell – By Pair

The students are asked to find a partner in performing this activity. They have to show how mangroves are useful to humans through art.

Materials:

Cartolina (white or colored), one piece

Crayons, or colored pencils

Procedure:

1. Based on the information and insights you have gathered from your previous activities, make a sketch or drawing that shows the usefulness of mangroves to people.
2. Use the available art materials.
3. Prepare a short write-up about your drawing.
4. On a piece of bond paper, write a slogan expressing the need to save or conserve remaining mangrove forests.
5. Present and discuss briefly your output.

C. Analysis/ Discussion

Questions for discussion

1. What are the uses of mangroves?
2. What are the different things being provided by the mangroves to fishermen in many coastal areas in our country?
3. What are the significance of the practice of giving names of mangrove species to places?
4. Aside from drawing or sketching, in what way can you show how useful mangroves are?
5. What are the different mangrove species that can be used to treat ailments?

D. Abstraction

(Integration of ICT)

Power Point Presentation

The teacher will discuss more about the following topics and clarify some misconceptions.

a. Uses of mangroves;

b. Significance of mangroves;

c. Common Names of mangroves;
d. Significance of the practice of giving names of mangrove species to places; and
e. Medicine from mangroves.

E. Application

Activity: Mangroves as Pharmacy

In this activity, the students will be grouped into three and asked to do three things: After class hours or on a Saturday, your group will interview a folk healer (***manugbulong*** or ***manughilot***), a grandmother, your mother and a Day Care worker. Ask their permission for an interview.

Guide questions

1. Have you used any plants from mangrove areas to treat ailments or as first aid for insect bites?
2. If so, what are these plants?
3. How are these plants prepared and for what specific use?
4. For how long have you been using the plants?

When you finish the interview, make an information card for a given plant and write down its traditional medicinal uses. (The teacher will show how information cards look like.) Each group shall have at least two of these cards. Make sure the persons interviewed read the information in the cards. Ask their permission before you write their names as sources of data on the information card.

Share the information card with your teacher and classmates by posting these on bulletin boards in your room. Discuss your experiences. Get the scientific name of the plant (*Primavera et al., 2004*) and look it up in the school library or the internet, including its uses.

F. Generalization

1. How did the practice of giving names of mangrove species to places become significant?
2. How are mangrove species used to treat ailments?
3. How can you show the usefulness of mangroves to other people?

IV. EVALUATION

Essay type

Reflection on the importance of mangrove forests to coastal areas.

V. AGREEMENT

Do research on ***Balangay*** boats. You may search the internet about this boat and how it was part of Filipino life in pre-Hispanic times.

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Glossary

Abiotic – a non-living component in the environment, it can be a chemical or physical presence.

Amplitude – is the maximum height of the wave crest above the level of calm water or the maximum depth of the wave trough below the level of calm water.

Biodiversity – defined as the variety of all forms of life, from genes to species, and through to the broad scale of ecosystem.

Biotic – are the living components of an ecosystem.

Carbon cycle – a series of processes by which carbon compounds are interconverted in the environment, involving the incorporation of carbon dioxide into living tissue by photosynthesis and its return to the atmosphere through respiration, decay of dead organisms, and the burning of fossil fuels.

Carnivores – are animals that eat other animals.

Coastal zone – is an interface between the land and sea which comprised of a continuum of coastal land, intertidal area, aquatic systems with includes rivers, estuaries, islands, transitional and intertidal areas, salt marshes, wetlands, and beaches.

Condensation – is a change in the state of water from a gas or vapor form into liquid form.

Coral Reefs – are large underwater structures composed of the skeletons of colonial marine invertebrates called coral.

Conservation – the act of protecting and preserving animals, plants and natural resources on a various quantity.

Consumers – are organisms that consume food in order to obtain energy and also known as heterotrophs.

Consumption – the act of consuming, as by use, decay, or destruction.

Convergent boundaries – a tectonic boundary where two plates are moving toward each other. If the two plates are of equal density, they usually push up against each other, forming a mountain chain.

Cyclone – a large-scale, atmospheric wind-and-pressure system characterized by low pressure at its center and by circular wind motion, counterclockwise in the northern hemisphere and clockwise at the southern hemisphere.

Decomposers – is an organism that decomposes, or breaks down, organic material such as the remains of dead organisms.

Dispersal – is an ecological process that involves the movement of an individual or multiple individuals away from the population in which they were born to another location, or population, where they will settle and reproduce.

Divergent boundaries – a tectonic boundary where two plates are moving away from each other and new crust is forming from magma that rises to the earth's surface between the two plates.

Earthquake – is an intense shaking of earth's surface. The shaking is caused by movements in earth's outermost layer.

Ebb Tide – seaward flow in estuaries or tidal rivers during a tidal phase of lowering water level.

Ecosystem – is a geographic area where plants, animals, and other organisms, as well as weather and landscape, work together to form a bubble of life.

Endangered – any species that is at risk of extinction because of a sudden rapid decrease in its population or a loss of its critical habitat.

Endemic – an organism that is restricted or peculiar to a locality or region.

Evaporation – is the process whereby atoms or molecules in a liquid state (or solid state if the substance sublimes) gain sufficient energy to enter the gaseous state.

Extinct – a species of animal or plant that has no longer any living members, either in the world or in a particular place.

Flood Tide – the period between low tide and high tide, during which water flows toward the shore.

Food Chain – the sequence of transfers of matter and energy in the form of food from organism to organism.

Food Web – shows a multiple food chains, multiple relationships and connections. Most of the organisms consume more than one species and also consumed by more than one species.

Herbivores – are animals whose primary food source is plant-based.

Humidity – describes the amount of water vapor or water molecules in the air.

Infiltration - is the process by which precipitation or water soaks into sub-surface soils and moves into rocks through cracks and pore spaces**.**

Intertidal Areas – are areas along the beach which are covered with water during high tide and are partially or completely exposed during low tide.

Invertebrates – generally soft-bodied animals that lack a rigid internal skeleton for the attachment of muscles but often possess a hard-outer skeleton such as mollusks, crustaceans, and insects that serves for body protection.

Juvenile – is an individual organism that has not yet reached its adult form, sexual maturity or size.

Mangroves – are trees or large shrubs which grow within the intertidal zone in tropical and subtropical regions and have special adaptations to survive in saline environment.

Marine Protected Area – is an area of sea especially dedicated to the protection and maintenance of biodiversity, and of natural and associated cultural resources, and managed through legal or other effective means.

Microorganisms – is a microscopic organism which may exist in its single-celled form or in a colony of cells.

Neap Tide – when the moon is at right angles to the earth-sun line known as first or last quarter. Range of tide is smaller than average.

Pneumatophore – a specialized structure developed from the root in certain plants growing in swamps and marshes which serve as respiratory organ.

Precipitation – is any liquid or frozen water that forms in the atmosphere and falls back to the earth.

Producers – are organisms that make their own food. They are also known as autotrophs.

Propagule – any of various structures that can give rise to a new individual organism, especially parts of a plant that serve as means of vegetative reproduction.

Protoplasm – defined as the organic and inorganic substances that constitute the living nucleus, cytoplasm, plastids and mitochondria of the cell.

Quadrat – is a frame that is laid down to mark out a specific area of the community to be sampled.

Rehabilitation – the act of restoring something to its original state, like the rehabilitation of the forest that had once been cleared for use as an amusement park.

Respiration – is the biochemical process in which the cells of an organism obtain energy by combining oxygen and glucose, resulting in the release of carbon dioxide, water, and ATP.

Salinity – refers to the concentrations of salts in water or soils.

Seagrass – are aquatic angiosperms which are confined to the marine environment. Thriving and reducing sediments of shallow tropical and sub-tropical coasts.

Spring Tide – the tidal effect of the sun and the moon acting in concert twice a month, and when the sun, earth and moon are all in a straight line (full moon or new moon). The range of tide is larger than average.

Sub-tidal Areas – area found in the deeper zone and remain underwater even during low tide.

Tectonic Plate – is a massive, irregularly shaped slab of solid rock, generally composed of both continental and oceanic lithosphere.

Transform boundaries – are boundaries where plates slide sideways past each other.

Threatened – any species of animals and plants which are vulnerable to endangerment in the near future.

Tropical Depression – is a tropical cyclone that has a maximum sustained surface wind (one-minute average) of 38 mph (33 knots) or less.

Tsunami - are giant waves caused by earthquakes or volcanic eruptions under the sea.

Typhoon – a type of large storm system having a circular or spiral system of violent winds, typical hundreds of kilometers or miles in diameter.

Vertebrates – are animals that have a backbone inside their body. The major groups include fish, amphibians, reptiles, birds and mammals.

Water cycle – also called hydrologic cycle, cycle that involves the continuous circulation of water in the earth-atmosphere system.

Wavelength – is the distance between corresponding points of two consecutive waves.

C3 Philippines, Inc. and Salvacion National High School signing a Memorandum of Understanding (MoU) for the development of the Teachers' Manual