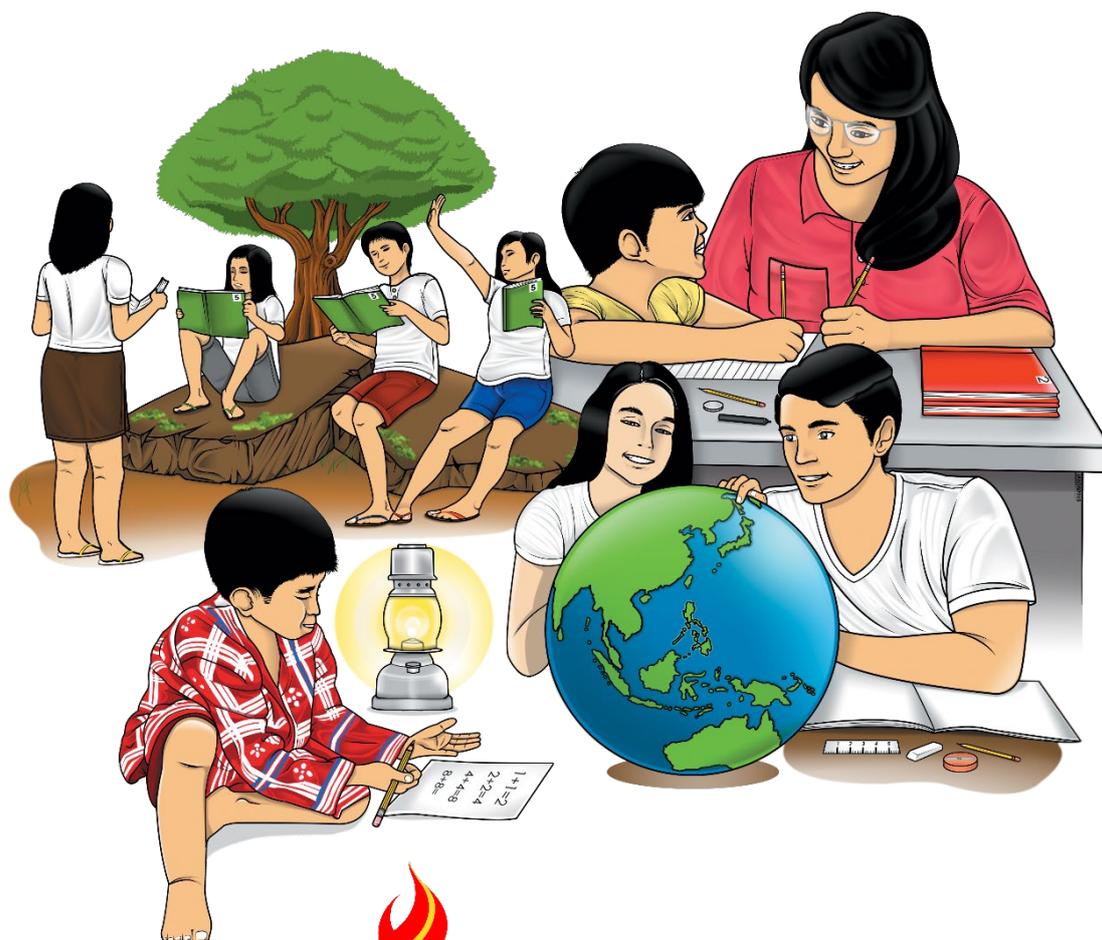


Earth and Life Science

Quarter 1 – Module 20: Mitigation to Coastal Processes and Hazards



Earth and Life Science
Alternative Delivery Mode
Quarter 1 – Module 20: Mitigation to Coastal Processes and Hazards
First Edition, 2021

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Published by the Department of Education
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Undersecretary: Diosdado M. San Antonio

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Printed in the Philippines by _____

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Senior High School

Earth and Life Science
Quarter 1 – Module 20:
Mitigation to Coastal Processes
and Hazards

Introductory Message

This Self-Learning Module (SLM) is prepared so that you, our dear learners, can continue your studies and learn while at home. Activities, questions, directions, exercises, and discussions are carefully stated for you to understand each lesson.

Each SLM is composed of different parts. Each part shall guide you step-by-step as you discover and understand the lesson prepared for you.

Pre-tests are provided to measure your prior knowledge on lessons in each SLM. This will tell you if you need to proceed on completing this module or if you need to ask your facilitator or your teacher's assistance for better understanding of the lesson. At the end of each module, you need to answer the post-test to self-check your learning. Answer keys are provided for each activity and test. We trust that you will be honest in using these.

In addition to the material in the main text, Notes to the Teacher are also provided to our facilitators and parents for strategies and reminders on how they can best help you on your home-based learning.

Please use this module with care. Do not put unnecessary marks on any part of this SLM. Use a separate sheet of paper in answering the exercises and tests. And read the instructions carefully before performing each task.

If you have any questions in using this SLM or any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator.

Thank you.



What I Need to Know

This module was designed and written with you in mind. It is here to help you master the nature of Earth and Life Science. The scope of this module permits it to be used in many different learning situations. The language used recognizes the diverse vocabulary level of students. The lessons are arranged to follow the standard sequence of the course. But the order in which you read them can be changed to correspond with the textbook you are now using.

The module covers:

- Lesson 1 – Mitigation to Coastal Processes and Hazards

Learning Competency: Cite ways to prevent or mitigate the impact of land development, waste disposal, and construction of structures on control coastal processes Week 8 S11/12ES-Ii-41

After going through this module, you are expected to:

1. identify the different impacts of human activities to coastal processes;
2. define mitigation to coastal hazards development; and
3. enumerate different ways to prevent or mitigate the impact of land, waste disposal and construction of structures on coastal processes.



What I Know

Directions. Read the following questions and choose the letter of the correct answer. Write the chosen letter on a separate sheet of paper.

1. Which of the following is NOT a reason for human population to choose coastal zones as settling grounds?
 - A. fertile agricultural land
 - B. abundant marine resources
 - C. peaceful and safe residential area
 - D. great possibility for trade and transport
2. What refers to the action taken to eliminate or reduce the long-term risks and hazards in the coastal area?
 - A. alteration
 - B. mitigation
 - C. renovation
 - D. restoration
3. What are the two processes interacting in a highly dynamic natural systems of coastlines?
 - A. chemical and physical processes
 - B. endogenic and exogenic processes
 - C. oceanic and continental processes
 - D. atmospheric and geologic processes
4. Which of the following activities in coastal areas DOES NOT trigger hazard to the natural balance of coastal system?
 - A. allowed number of tourists
 - B. construction of houses
 - C. development of hotels
 - D. prohibition of mining
5. Which of the following is NOT a result of a geologically active zone on Earth coastal system?
 - A. erosion
 - B. salt intrusion
 - C. sea-level change
 - D. water nourishment
6. What refers to a climate change phenomenon through which ocean water volume increases, ice sheets and glaciers melt, and thermal expansion occurs?
 - A. erosion
 - B. salt intrusion
 - C. sea-level change
 - D. water nourishment

7. What do you call the movement of saline water to fresh water aquifers which can lead to the degradation or contamination of ground water including drinking water resources?
 - A. erosion
 - B. salt intrusion
 - C. sea-level change
 - D. dewatering of beach

8. Which of the following is an impact of mining activities to coastal processes?
 - A. deposition
 - B. ice melting
 - C. reforestation
 - D. surface run-off

9. Which of the following is the BEST method to avoid erosion?
 - A. break water construction
 - B. controlling land development
 - C. improving waste management
 - D. maintaining plant cover or vegetation

10. Which of the following processes is described as pumping out water from the shores to prevent erosion?
 - A. beach dewatering
 - B. beach nourishment
 - C. breakwater construction
 - D. installation of sand bags

11. Which method are you going to use when there is a need to add a large amount of sand to the coast?
 - A. beach dewatering
 - B. beach nourishment
 - C. breakwater construction
 - D. installation of sand bags

12. What will you construct to prevent the further advancement of saltwater if already present in the coastal areas?
 - A. beach hotels
 - B. beach house
 - C. breakwater
 - D. sand bags

13. Which of the following DOES NOT ensure effective management of saltwater intrusion cases?
 - A. construction of seawalls
 - B. monitoring of coastal activities
 - C. assessment of coastal areas regularly
 - D. regulation of human activities along coastal zone

14. One of your classmates is living in a coastal area of the community. You found out that this coastal area is already polluted. What activity can you suggest to mitigate the said problem?
- A. acoustic concert
 - B. coastal clean-up drive
 - C. population control campaign
 - D. recollection and reflection among the community
15. Your school is located in a coastal area. You notice that waves are already damaging the shore near the fence of the school especially during high tide and monsoon seasons. What can be constructed to mitigate the said problem of the school?
- A. beach dewatering
 - B. breakwater
 - C. sandbags
 - D. sea wall

Lesson

1

Mitigation to Coastal Processes and Hazards

Coastal areas have been attractive settling grounds for human population as they provide abundant marine resources, fertile agricultural land and possibilities for trade and transport. This has led to high population densities and high levels of development in many coastal areas and this trend is continuing into the 21st century. At present, about 1.2 billion people live in coastal areas globally, and this number is predicted to increase to 1.8–5.2 billion by the 2080s due to a combination of population growth and coastal migration. Along with this increase follows major investments in infrastructure and the build environment.

The characteristics of coastal environments, however, pose some great challenges to human habitation. Coastlines are highly dynamic natural systems that interact with terrestrial, marine and atmospheric processes and undergo continuous change in response to these processes. Over the years, human society has often failed to recognize the hazards related to these dynamics and this has led to major disasters and societal disruption to various degrees. Even today, coastal development is often taking place with little regard to the hazards present in these environments, although climate change is likely to increase the general hazard levels. Societal activities in coastal areas can also pose a hazard to the natural balance of coastal systems, thereby disrupting e.g. sensitive ecosystems and subsequently human livelihood.

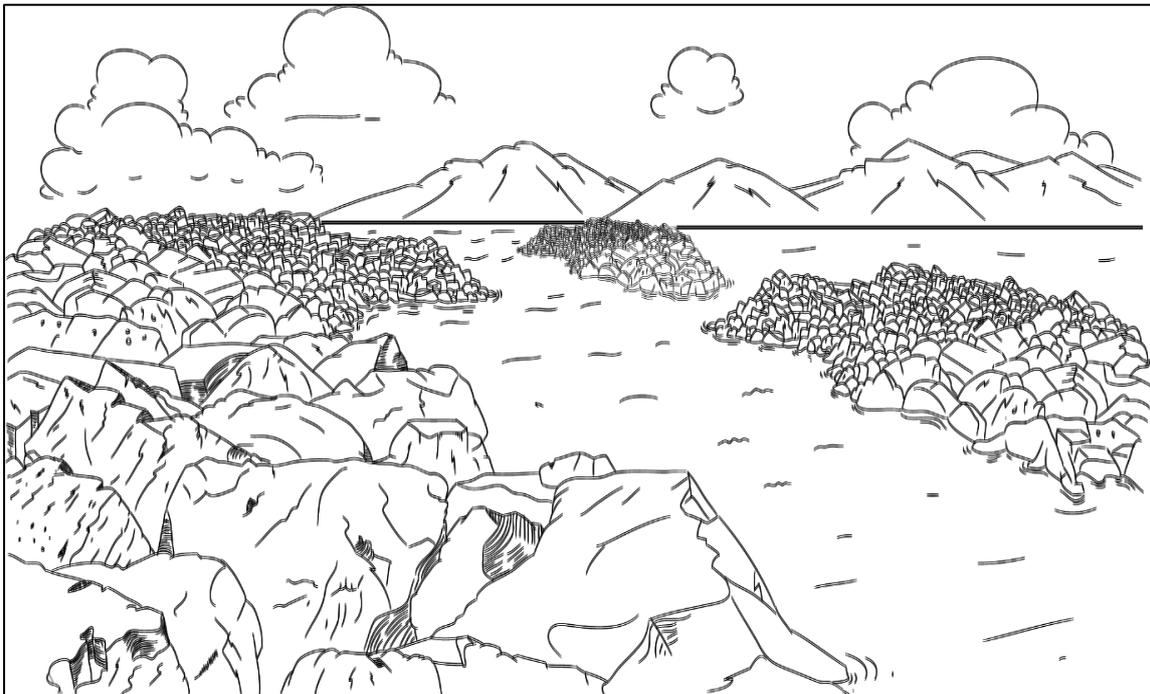


Figure 1. Breakwaters



What's In

Activity 1: Read to Fill-out!

Directions. Read the article about coastal processes. Then, fill in the given table below with the corresponding information needed.

According to the Department of Environment and Natural Resources, coastal ecosystems of the Philippines are very productive and represent the huge amount of natural resources. It provides food and livelihood to many people. However, it is also the most geologically active zone on Earth. Coastal processes in this zone may result to erosion, submersion and saltwater intrusion. These effects could lead to different hazards such as:

1. Barrier islands movement.

Barrier islands are formed due to deposition of sand brought by waves protecting the mainland from damage due to large waves. It also provides habitat for the aquatic wildlife. It can be destroyed or moved by erosion on the contrary.

2. Flooding

It also destroys habitat and may lead to great erosion. The main cause of this hazard is the submersion or sea level rise, a climate change phenomenon through which ocean water volume increases, ice sheets and glaciers melt, and occurrence of thermal expansion.

3. Fresh water contamination

Intrusion or movement of saline water to fresh water aquifers can lead to the degradation or contamination of ground water including drinking water resources. Intrusion is aided by hydraulic action but triggered by human activities.

Table 1. Coastal processes, causes and effects of different hazards

Hazard	Responsible Coastal Processes	Causes	Effects
Barrier island movement	Waves		Loss of Wildlife Habitat
Flooding		Climate Change	
Fresh water contamination	Sea level change	Salt water intrusion	



Notes to the Teacher

This module will help you to understand the concepts about mitigation of impacts of human activities to coastal processes. All parts consists of activities. Students should be guided with the instruction on how they will answer each. Recall the different coastal processes and you may give particular examples in the community if applicable. Expectedly you will meet the target at the end of the module.



What's New

Activity 2: Break it Out!

Directions. Take a look at the given pictures. Then, answer the guide questions.

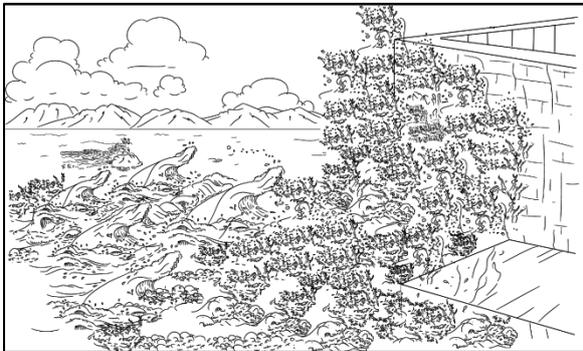


Figure 2. Sea walls

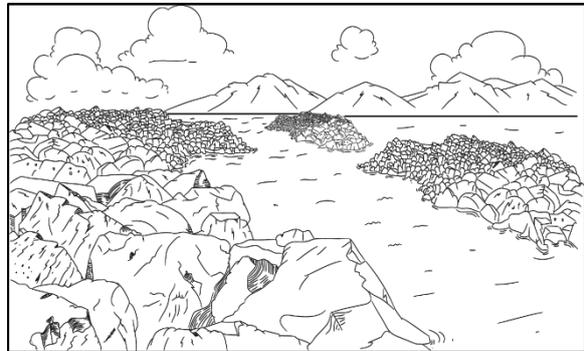


Figure 3. Breakwaters

Guide Questions:

1. What can you say about Figure 2? Figure 3?

2. Explain how these ways help in preventing coastal hazards?



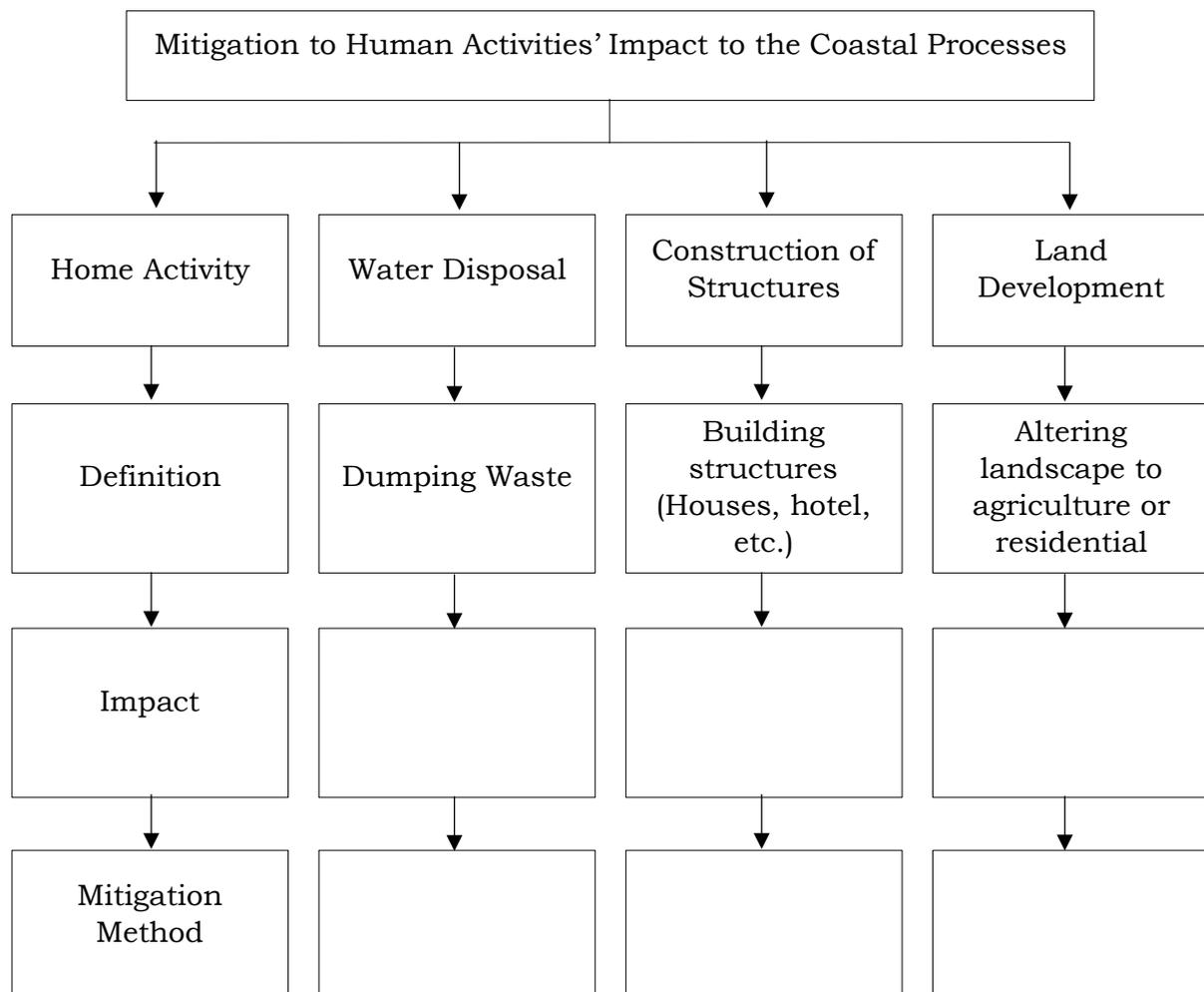
What is It

Activity 3: Root Mapping

Coastal hazard-prone areas in the Philippine local government units in areas that are ranked extremely high in susceptibility to landslide and flooding are advised to immediately relocate the residents of these zones to safer areas. Especially during typhoons that can cause coastal hazards. Though naturally occurring, there are human activities that can affect coastal processes that may lead to hazards.

With this, mitigation methods in the coastal zones for protection are enhanced in these areas. Mitigation refers to action taken to eliminate or reduce the long-term risks and hazards,

Directions. Complete the following concept map by identifying the impacts and mitigation method appropriate in the given human activities.



Options for Impacts:

- Increased erosion
- Increased sediments run-off
- Sea level rise
- Change natural drainage patterns
- Enhanced salt intrusion

Options for Mitigation Methods:

- Seawalls - These are used to counteract waves that hit the shores. These are offshore structures that protect coasts from parallel waves.
- Groins / Stone barriers – It intercepts the steady flow of sand keeps the particular sand from eroding.
- Breakwaters – It can be constructed along coasts to prevent further advancement of saltwater if already present
- Beach nourishment – It is a method where a large amount of sand is added to the coasts.
- Installation of small walls or sandbags – These are used to counteract waves that hit the shores.
- Beach dewatering – It involves pumping out water from the shores to prevent erosion.
- Construction of buildings in a safe distance from the water.
- Ban of mining activities – This can cause decrease in pollutants.

Options for Mitigation Methods:

- Maintaining plant cover – This can result to improved vegetation
- Monitoring and assessment - It ensures effective management of saltwater intrusion cases.
- Regulation of Laws
- Artificial recharge – It pumps freshwater to the reservoir to prevent saltwater from intruding through the coasts.
- Engineering structures.
- Jetties – It prevent coastal erosion by promoting beach build-up as they trap sand.
- Prepare and emergency survival kit
- Create an evacuation plan.
- Know where the evacuation center is and how to get there.
- Listen to news from any means.

Development in Coastal Zone

Coastal ecosystems are very productive and represent the ample amount of natural resources. It provides livelihood to many people for being the most famous tourist destinations in the country. Thus, there are many business men who made expeditious development in coastal zones. Along with these are the land development and number of construction sites near the zone. However, it is also the most geologically active zone on Earth. Coastal processes in this zone may result to erosion, submersion and saltwater intrusion.

Erosion as discussed from the previous module is brought by processes like waves and tides. During intense storms and tidal waves, most coastal erosion occurs. It may cause damages on properties, and affect human habitation and tourist activities. They put structures like seawalls to avoid that. These are used to counteract waves that hit the shores. These are offshore



Figure 4. Sea walls

structures that protect coasts from parallel waves. Groins / Stone barriers that intercepts the steady flow of sand are also built to keep sands from eroding. Breakwaters can also be constructed along coasts to prevent further advancement of saltwater if already present. Though these structures avoid erosion it has disadvantages, too. It prevents natural deposition of sands. They absorb wave energy but permanently destroy sand grasses and dunes. Eventually, it will destroy marine habitat.

Aside from concrete structures, there are also practices that can disturb and totally destroy the natural coastal process.

Beach nourishment is commonly done by adding sand to the shore to extend their houses, hotels and other structures. Likely, beach dewatering is another method to

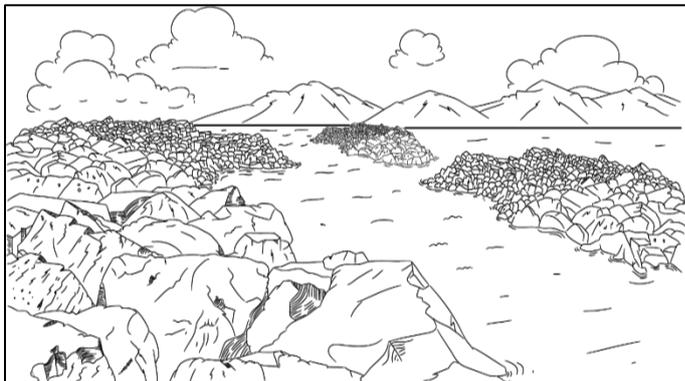


Figure 5. Breakwaters

avoid erosion. It involves pumping out water from the shores. However, these practices may lead to saltwater intrusion or movement of saline water into freshwater aquifers. It will result to groundwater quality degradation. Groundwater includes drinking water.

Global Warming and Coastal processes

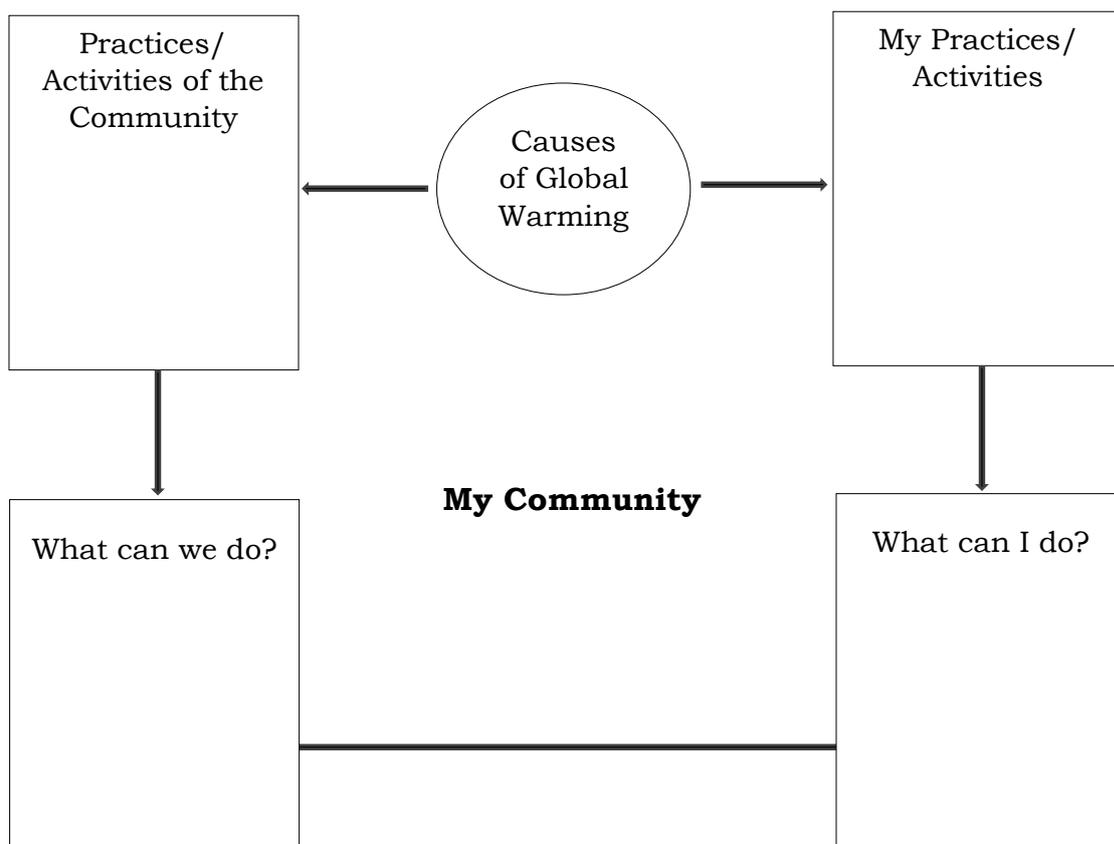
Crustal movements and sea level change are coastal processes and its interactions affect the climate. They are part of tight interconnected Earth system that affects both global and regional climates. On the other hand, climate change also affects these processes.

We are very familiar with the enhanced global warming. It gives a lot of consequences even if it is just a few degrees increased than the usual average temperature. Global warming results to intense storms, flooding, droughts and extreme storm. High temperature resulted to ice melting. Consequently, sea level rises affecting the people throughout the world.

What are the different causes of climate change?

Activity 4: We Can!

Directions. Observe your community. Identify the different practices and activities that cause and triggers global warming. Write your answer inside rectangles.





What's More

Activity 5: Making an Action Plan

Directions. Suppose you are the coordinator of the Municipal Disaster Risk Reduction Management of your town. You are tasked to make an action plan to mitigate the effects of coastal processes in risk zone. The action plan template is already given below. Remember that the environment and people's health are your priorities. Then, kindly answer the guide questions.

Table 2. Action plan for mitigation of coastal processes and hazards

Project	Activity	Objectives	Resources Needed	Persons Involved	Duration	Action Taken	Remarks
Project <i>READY!</i> Resilience Enhancement Amidst Disaster -Youth Empowerment	Conduct of Symposia and Awareness Campaign	To inform and empower residents on coastal hazards and mitigation	Resource Speaker Venue Sound System Projector Learning kits	Residents Barangay Officials Committee	2 months	Preparation of action plans, and emergency response teams	The participants gained knowledge and skills on coastal mitigation through action plans

Guide Questions:

1. What are the factors did you consider to make projects and activities?

2. Are all your objectives measurable and attainable? Justify your answer.

3. What are the difficulties/problem did you encounter in making the action plan?

4. How did you cope up with the problem encountered in making the action plan?



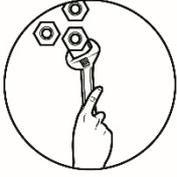
What I Have Learned

Directions: Read the following statements and fill in the blanks with the correct answer. Choose from the pool of words given below.

1. _____ have been attractive settling grounds for human population as they provide abundant marine resources, fertile agricultural land and possibilities for trade and transport.
2. _____ refers to action taken to eliminate or reduce the long-term risks and hazards in the coastal area.
3. Coastlines are highly dynamic natural systems that interact with _____, _____, and _____ processes and undergo continuous change in response to these processes.
4. _____ activities in coastal areas can also trigger hazard to the natural balance of coastal systems, thus disrupting e.g. sensitive ecosystems and subsequently human livelihood.
5. As the most geologically active zone on Earth coastal processes zone may result to _____, _____, and _____.
6. _____ is a climate change phenomenon through which ocean water volume increases, ice sheets and glaciers melt, and thermal expansion occurs.
7. _____ movement of saline water to fresh water aquifers which can lead to the degradation or contamination of ground water including drinking water resources.
8. _____ is a mitigation method where a large amount of _____ sand is added to the coasts.
9. _____ involves pumping out water from the shores to prevent erosion.
10. _____ or total prohibition of mining activities avoid pollution and sediments run-off.

WORD POOL

coastal area	salt intrusion	erosion
mitigation	beach nourishment	adaptation
submersion	atmospheric	sea-level rise
terrestrial	putting sand bag	marine
beach dewatering	human	ban of mining



What I Can Do

Activity 6: Researcher's Problem

Directions. Suppose you are one of the leading researchers in your coastal community. A land developer wants to build a mall that is 20 feet off the edge of the coast. He presented that his mall will not be affected by coastal processes because there were no records of any major damages done in your community. As a researcher, what are the problems that the land developer might encounter if he would continue to build his mall? Answer the question in the form of a letter.



Assessment

Directions. Read the following questions and choose the letter of the correct answer. Write the chosen letter on a separate sheet of paper.

1. Which of the following activities in coastal areas can trigger hazard to the natural balance of coastal system?
 - A. allowed number of tourists
 - B. construction of breakwater
 - C. enhancing vegetation
 - D. prohibition of mining
2. Which of the following is/are natural result/s of a geologically active zone on earth coastal system?
 - A. breakwater
 - B. sand erosion
 - C. sandbags and stone barriers
 - D. seawalls and island barriers
3. What refers to a climate change phenomenon through which ocean water volume increases, ice sheets and glaciers melt, and thermal expansion occurs?
 - A. erosion
 - B. salt intrusion
 - C. sea-level change
 - D. water nourishment
4. Which of the following is the BEST reason for human population to choose coastal zones as settling grounds?
 - A. abundant marine resources
 - B. peaceful and safe residential area
 - C. small possibility for trade and transport
 - D. unfertile agricultural land
5. What refers to the action taken to eliminate or reduce the long-term risks and hazards in the coastal area?
 - A. alteration
 - B. mitigation
 - C. renovation
 - D. restoration
6. Salt intrusion is the movement of saline water to fresh water aquifers which can lead to the following EXCEPT
 - A. loss of vegetation
 - B. erosion to low land area
 - C. contamination of ground water
 - D. shortage in drinking water supply

7. What are the two processes interacting in a highly dynamic natural systems of coastlines?
- A. chemical and physical
 - B. endogenic and exogenic
 - C. oceanic and continental
 - D. atmospheric and biosphere
8. The following activities promote erosion EXCEPT
- A. break water construction
 - B. land development
 - C. mining activities
 - D. waste disposal
9. Which of the following is NOT an impact of mining activities to coastal processes?
- A. enhanced erosional activities
 - B. improved biodiversity
 - C. loss of vegetation
 - D. surface run-off
10. Which of the following structures are built to counteract waves that hit the shores?
- A. barrier
 - B. groins
 - C. jetties
 - D. seawalls
11. Which of the following DOES NOT ensure effective management of saltwater intrusion cases?
- A. construction of seawalls
 - B. monitoring of coastal activities
 - C. assessment of coastal areas regularly
 - D. regulation of human activities along coastal zone
12. Which method are you going to use when there is a need to add a large amount of sand to the coast?
- A. beach promotion
 - B. beach nourishment
 - C. sand bag installation
 - D. seawalls construction
13. One of your classmates is living in a coastal area of the community. You found out that this coastal area is already polluted. What activity can you suggest to mitigate the said problem?
- A. acoustic concert
 - B. coastal clean-up drive
 - C. population control campaign
 - D. recollection and reflection among the community

14. Your house is located in a coastal area. You notice that waves are already damaging the shore near the fence of the house especially during high tide and monsoon seasons. What can be constructed to mitigate the said problem of your house?
- artificial water recharge
 - beach dewatering
 - breakwater
 - sea wall
15. What will you construct to prevent the further advancement of saltwater if already present in the coastal areas?
- beach nourishment
 - beach dewatering
 - breakwaters
 - sand bags



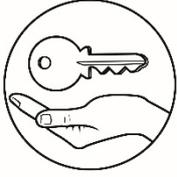
Additional Activities

Directions. Choose one from the given activities. Do the tasks given adhering to the theme: *“Benefits and Costs of Coastal Sustainable Development.”*

- Write a 1000-word essay.
- Make a poster-collage using recyclable materials.
- Create a jingle.
- Create a two-minute infomercial.

Table 3. Rubrics for the activities

Activity	Content	Grammar/ Creativity	Timeliness	Points
Essay	Accurate and well-organized	Exemplar grammar	Submitted on or before the deadline	10
	Organized with minimal error	With 1-5 grammatical errors	Submitted one-two days after the deadline	7
	Not organize and with errors	With five or more grammatical errors	Submitted a week after the deadline	5 and below
Poster-collage Jingle Infomercial	Accurate and well-organized	Exemplar creativity and resourcefulness	Submitted on or before the deadline	10
	Organized with minimal error	With creativity within the standard	Submitted one-two days after the deadline	7
	Not organize and with errors	Lacking of creativity and resourcefulness	Submitted a week after the deadline	5 and below



Answer Key

<p>What I Can Do</p> <p>Activity 5</p> <p>Answer may vary</p> <p>Assessment</p> <p>1. A 2. B 3. C 4. A 5. B 6. B 7. C 8. A 9. B 10. D 11. A 12. B 13. B 14. D 15. C</p>	<p>What is It</p> <p>Activity 3</p> <p>Impact</p> <p>1. Sea level rise 2. Erosion, intrusion, changed in drainage pattern 3. Changed in drainage patterns, increased erosion</p> <p>Mitigation</p> <p>Answers may vary</p> <p>What's More</p> <p>Answers may vary</p> <p>What I have Learned</p> <p>1. Coastal area 2. Mitigation 3. Terrestrial, marine, atmospheric 4. Human 5. Erosion, submersion, salt water intrusion 6. Submersion 7. Salt water intrusion 8. Sand bag barriers 9. Beach dewatering 10. Ban</p>	<p>What I Know</p> <p>1. C 2. B 3. C 4. D 5. D 6. C 7. B 8. D 9. D 10. A 11. B 12. C 13. A 14. B 15. D</p> <p>What's In</p> <p>Activity 1</p> <p>Answers may vary</p> <p>What's New</p> <p>Activity 2</p> <p>Answer may vary</p>
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