Senior High School

Department of Education
National Capital Region
SCHOOLS DIVISION OFFICE
MARIKINA CITY

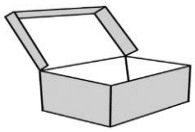
Earth & Life Science

First Quarter-Module 11

Coastal Processes

Evangeline C. Agtarap

City of Good Character
DISCIPLINE • GOOD TASTE • EXCELLENCE



What I Need to Know

This module was designed and written with you in mind. It is here to help you understand coastal processes. 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.

Learning Competencies:

1. **Describe how coastal processes result in coastal erosion, submersion, and saltwater intrusion S11/12ES-Ih-38** and
2. **Cite ways to prevent or mitigate the impact of land development, waste disposal, and construction of structures on control coastal processes S11/12ES-Ii-41.**

The module has two lessons which are:

- Lesson 1 – Coastal Erosion, Submersion, and Saltwater Intrusion
- Lesson 2 – Preventing or Mitigating the Impact of Land Development, Waste Disposal and Construction of Structures on Coastal Processes

After going through this module, you are expected to

1. determine the cause behind coastal processes;
2. define and explain coastal erosion, submersion, and saltwater intrusion
3. identify the effects of coastal processes;
4. describe how coastal processes result in coastal erosion, submersion and saltwater intrusion;
5. determine the adverse effects of coastal and land development to the environment; and
6. cite ways to prevent or mitigate the impact of land development, waste disposal, and construction of structures on control coastal processes.

What I Know

Read the question carefully and encircle the letter of the correct answer.

1. What type of wave is illustrated based on the intensity of backwash and swash?

A. Constructive
B. Destructive
C. Tidal
D. Tsunami

2. What can you infer from the pictures below?

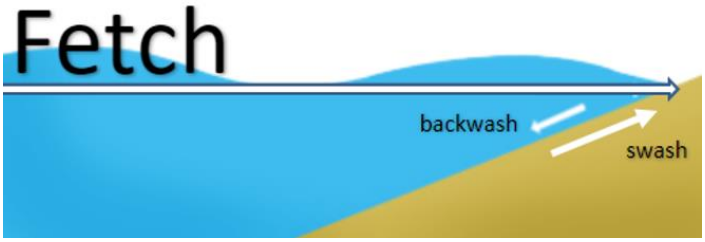
Beach 1

Beach 2

A. Both beaches are formed by recurring destructive waves.
B. Both beaches are formed by recurring constructive waves.
C. Beach 1 is formed by recurring constructive waves while Beach 2 is formed by recurring destructive waves.
D. Beach 1 is formed by recurring destructive waves while Beach 2 is formed by recurring constructive waves.

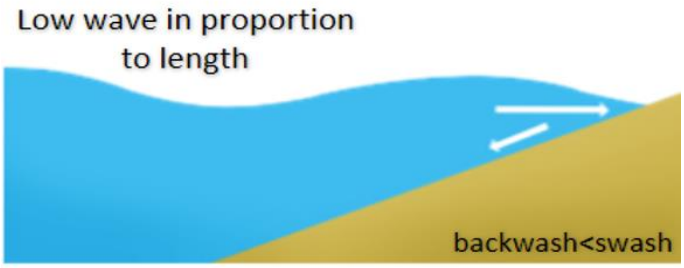
3. Refer to the picture below. Which of the following is TRUE about wave characteristics?

I. A greater fetch results to bigger waves.
II. A greater fetch results to smaller waves.
III. There is no observed relationship between a wave's fetch and the size of a wave.
IV. The relationship between swash and backwash determines what type of wave happens on the coast.



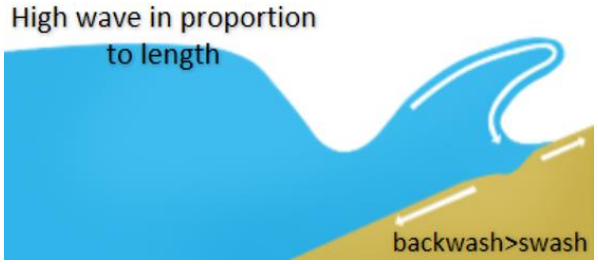
A. I only
B. II only
C. III and IV
D. I and IV

4. The figure below represents a constructive wave. Which of the following is **FALSE** about a constructive wave?



A. It has greater swash than backwash.
B. It has limited energy and deposits materials into shores.
C. These waves result to a beach with shallow and long coastline.
D. It has more energy and drags materials from the shore back to the sea.

5. The figure below represents a destructive wave. Which of the following is **FALSE** about destructive waves?



A. They are observed during calm weather.
B. These waves result to steeper and shorter beaches.
C. They are prevalent when there are vigorous sea or ocean activities.
D. They have more energy and drag materials from the shore back to the sea.

6. Which of the following sentences describes erosion?

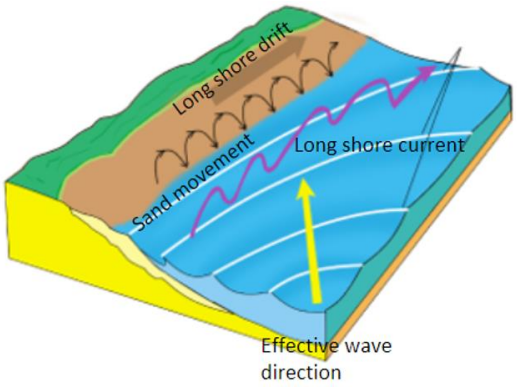
I. It is associated with constructive waves.
II. It is caused by destructive waves along the coast.
III. It is the wearing a way of rocks and other materials.
IV. It is the movement of material in the sea and along the coastline.

A. I and II
B. II and III
C. III and IV
D. I and IV

7. Which of the following correctly describes erosion by **solution**?

A. Rocks, sand, and other sediments grind with cliff materials.
B. Rocks and pebbles transported with wave bump to each other.
C. It cannot be readily observed because it involves chemical activities by the seas.
D. Trapped air reacts to the action of waves resulting to rock detachment from the cliff.

8. Refer to the figure below. Which of the following **DOES NOT** describe longshore drift?



A. It is influenced by swash and backwash.
B. It is the wearing away of land by the sea.
C. It results to zigzag movement of materials.
D. It is the movement of materials along the coast due to wave action.

9. Which of the following happens when tidal activities and wave actions generate sea or ocean water to flood certain parts of the shore?

A. Deposition
B. Storm waves
C. Submersion
D. Coastal erosion

10. Which of the following happens when wave actions destruct the natural rock barriers causing it to wear away?

A. Tidal waves
B. Submersion
C. Coastal erosion
D. Saltwater intrusion

11. Which of the following statements would be economical and effective practices to mitigate submersion?

I. Relocation to safer areas
II. Protection of mangrove fields
III. Construction of new roads and bridges
IV. Planting trees to minimize greenhouse gases

A. I, II and III
B. I, II and IV
C. II, III and IV
D. I, II, III and IV

12. Which of the following is/are TRUE?

I. Coastal erosion is a natural process.
II. Land development may worsen coastal erosion.
III. Coastal erosion can be a induced by human activities.
IV. Coastal land development does not alter the natural landscapes in the coasts.

A. I and II
B. III and IV
C. I, II, and III
D. I, II, III, and IV

13. Which of the following refer to the process of treating wastes to improve the quality of wastewater in coastal areas?

A. coastal erosion
B. coastal development
C. coastal rehabilitation
D. costal wastewater treatment

14. Which of the following was established in compliance to the Clean Water Act of 2004?

A. Mangrove nurseries
B. Waste disposal facility
C. Wastewater treatment facility
D. Coastal engineering structures

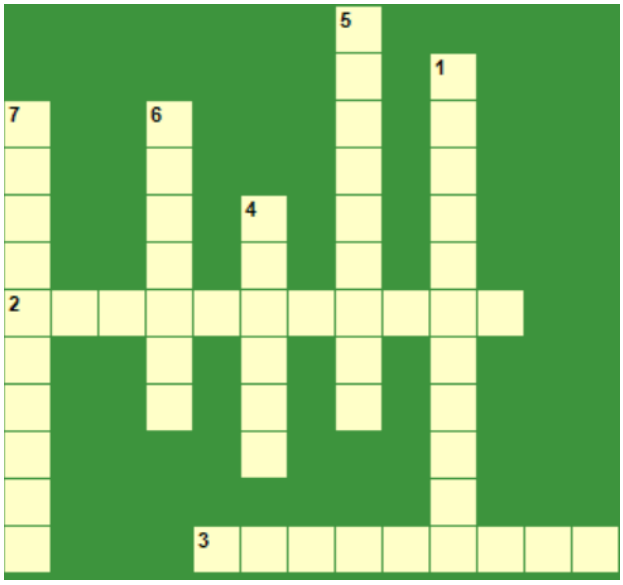
15. Which of the following statements is CORRECT?

A. Marine biodiversity is not affected by improper waste disposal.
B. It is okay to throw some garbage into the sea. The sea is big after all.
C. Proper waste disposal includes avoiding the disposal of wastes in inland waters.
D. The government must do something about waste management without involving the community.

Lesson 1 Coastal Erosion, Submersion, and Saltwater Intrusion

Activity 1.1. Hydrometeorological Hazards

The crossword puzzle below contains some terms you encountered in the previous module. Copy and answer the puzzle on a clean sheet of paper.



Across

2. usually accompanies tropical cyclones
3. a map describing the areas at risk of a hazard

Down

1. rise in inland water caused by heavy rainfall
4. part of the map with an explanation
5. massive movement of a large mass of soil down a slope
6. a seasonal shift in the prevailing wind direction
7. also known as micro-tornadoes

What's New

Activity 1.2. Picture Analysis

The picture below shows a coast from Agoo, La Union. Study it. What do you think are the factors that determine the shape of the coast? Use the mind map below to answer this question.

Figure 1.1. Agoo, La Union

Source: *Agoo, La Union. Wikimedia Commons. Accessed August 31, 2020. https://commons.wikimedia.org/wiki/File:AgooLaUnionjf313.JPG*

Copy and answer on a clean sheet of paper.

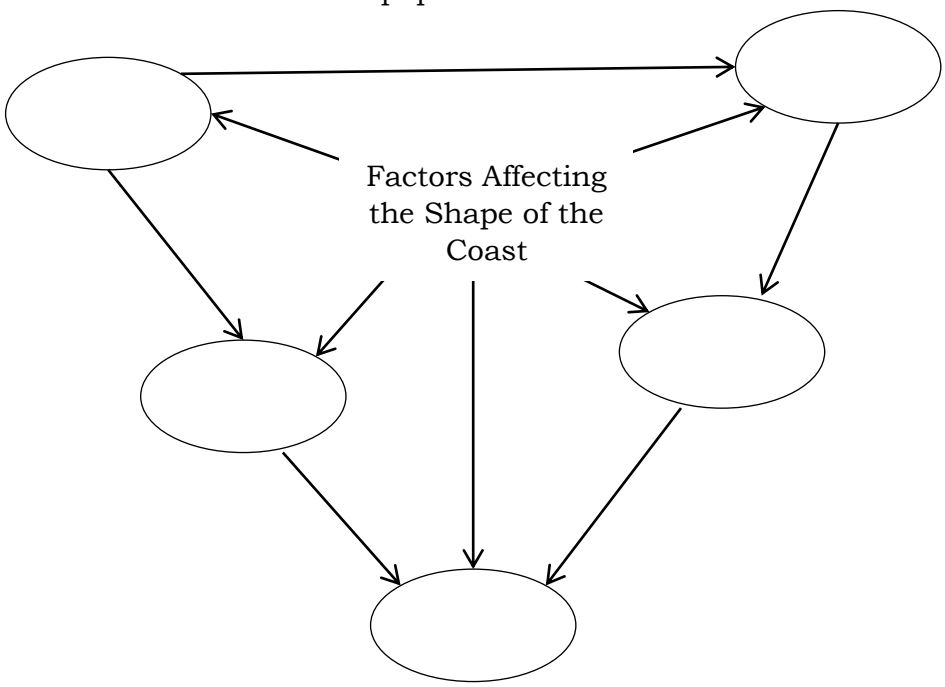


Figure 1.2. Factors Affecting the Shape of the Coast

What Is It

The **coast** is the general term for the region of land near bodies of water. There are three main processes involved in coast formation: erosion, transportation, and deposition. The figure below shows the causes and effects of coastal processes.

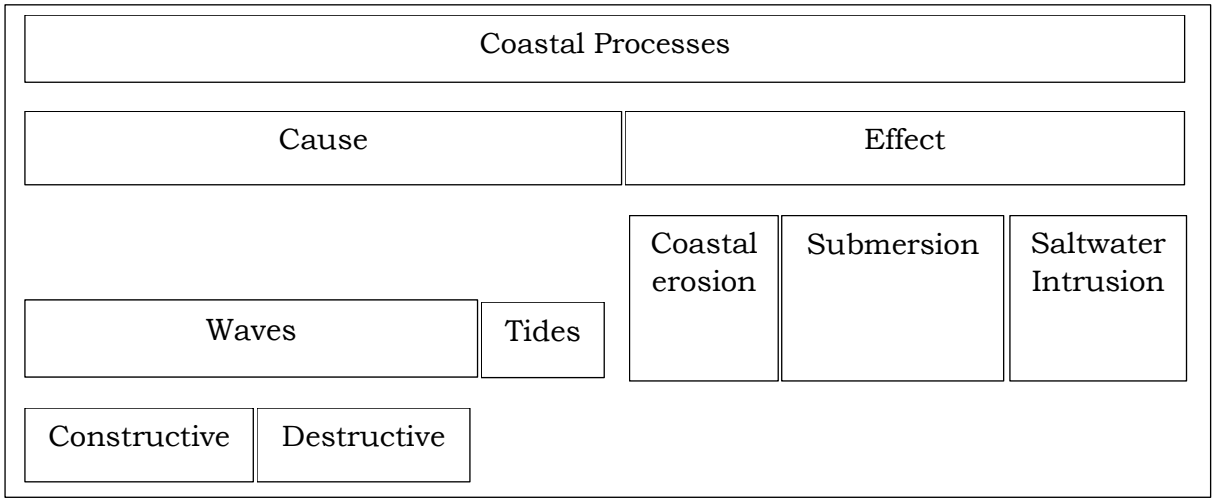


Figure 1.3. Coastal Processes

Tides. Recall that tides are created due to Earth's lithosphere reacting to the gravitational pull of sun, moon, and other planets. Tidal force is affected by the mass of the attracting body (moon, sun, and other planets) and the distance between Earth and these bodies. The sun is massively bigger than the moon, but it has less gravitational pull on Earth because it is farther away. Tidal wave is the collective term used for the extreme surges of high and destructive water level observed in shores.

Waves. Waves are formed due to wind activity.
See the picture below for a diagram of the parts of a wave.

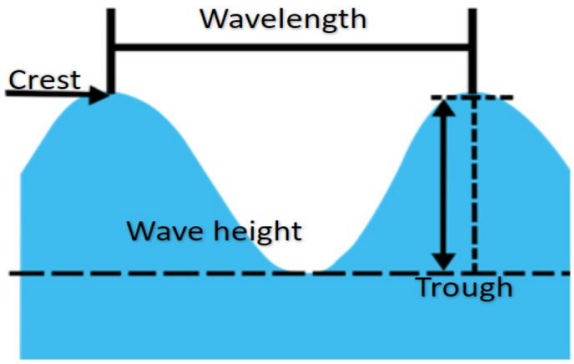


Figure 1.4. Waves

Source: *Waves. Digital image. FrontLearners. Accessed August 31, 2020. www.frontlearners.com*

Remember that a wave maybe described by its crest, trough, wavelength, and wave height. A crest is the wave's highest point while a trough is the wave's lowest point. Wavelength is the distance between crest to crest or trough to trough. Wave height is the vertical distance of a wave from crest to trough.
Another characteristic of waves is the fetch. See the diagram below:

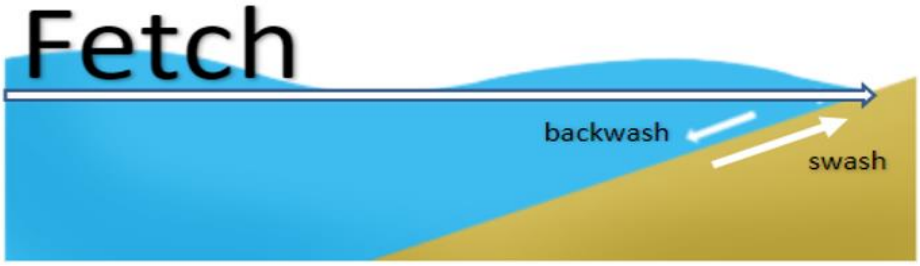


Figure 1.5. Fetch, Swash and Backswash
Source: *Fetch. Digital image. FrontLearners. Accessed August 31, 2020. www.frontlearners.com*

The size of a wave depends on the fetch, or the distance traveled by the wave. It has been observed that a greater fetch would result to bigger waves. The movement of water towards the shore is called a **swash** and the retraction of water from the shores back to the sea is called a **backwash**. The relationship of these movements defines what types of waves happens on the coasts.

The two types of waves based on these movements are constructive waves and destructive waves. A **constructive wave** is observed during calm weather. It has greater swash than a backwash. It has limited energy and deposits materials into the shores. Occurrence of constructive waves result to the formation of shallow, longer beaches. The picture below shows the formation of a beach with shallow and long coastline due to recurring constructive waves.

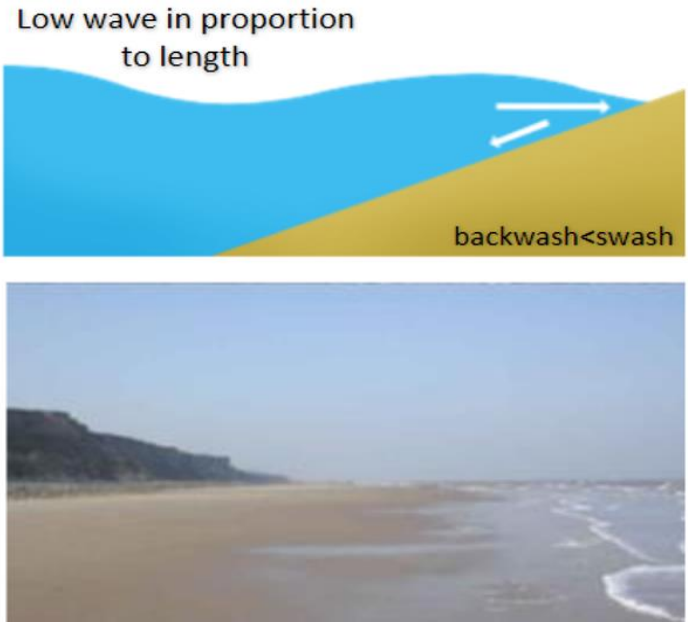


Figure 1.6. Constructive Wave
Source: *Constructive Wave. Digital image. FrontLearners. Accessed August 31, 2020. www.frontlearners.com*

Destructive waves are prevalent when there are vigorous sea or ocean activities. Compared with a constructive wave, it has a weaker swash and a stronger backwash and has greater energy. This type of wave has more energy and drags materials from the shore back to the sea. Occurrence of destructive waves result to formation of steeper and shorter beaches as shown in the pictures below.

Figure 1.7. Destructive Wave
Source: *Destructive Wave. Digital image. FrontLearners. Accessed August 31, 2020. www.frontlearners.com*

Coastal Formation Processes-Erosion, Transportation, and Deposition

Erosion is the coastal formation process that involves the wearing away of rocks and other materials due to destructive waves along the coast. There are four causes of erosion: hydraulic action, abrasion (or corrosion), attrition, and solution.

Figure 1.8. Erosion
Source: *Erosion. Digital image. FrontLearners. Accessed August 31, 2020. www.frontlearners.com*

Table 1.1. Causes of Erosion

Causes of Erosion	How Erosion Happens
Hydraulic Action	• trapped air reacts to the action of waves • trapped air is compressed due to the penetration of water • compression results to cracking • cracking result to detachment of rock from the cliff
Abrasion	• rocks, sand, and other sediments grinds with cliff materials • materials carried by waves crashes to beach, damaging cliffs, and shores
Attrition	• rocks or pebbles are transported with wave • bump to each other • break down or smooth out
Solution	• involves chemical activity • dissolution or disintegration of materials due to reactions with weak acids in saltwater

Transportation

Material movement in the sea and along the coastline is called **transportation**. See the illustration below of **longshore drift**, the main process in transportation.

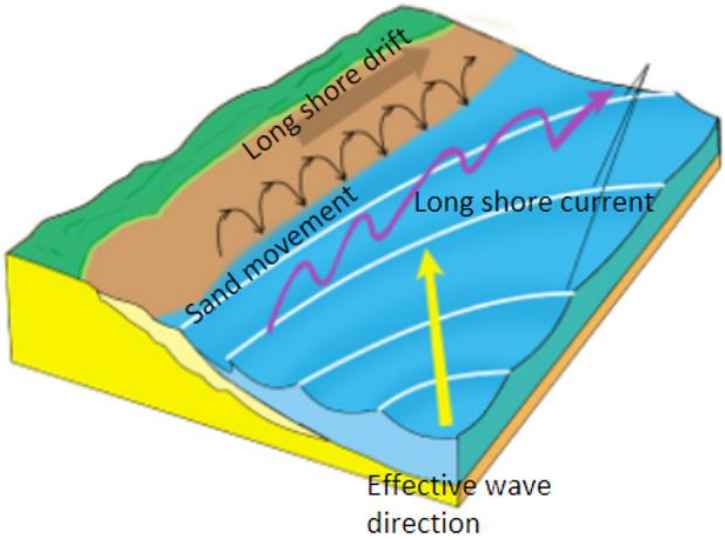


Figure 1.9. Longshore Drift

Source: *Longshore Drift. Digital image. FrontLearners. Accessed August 31, 2020. www.frontlearners.com*

Longshore drift happens when materials move parallel to the orientation of the coast. The movement of materials is influenced by the constant upward drive of the swash at an angle and the vertical drag back to the sea by the backwash. These result in zigzag movement of materials. Depending on the size of transported

materials, coastal transport can either be solution, suspension, saltation or traction. The table below describes the types of coastal transport:

Table 1.2. Types of Transportation

Types	Description
Solution	dissolved minerals are carried with the solution
Suspension	minute particles are dragged with water giving the water muddy to cloudy appearance
Saltation	rocks appear skipping on seabed as they are dragged since current cannot keep heavy sediment afloat
Traction	pebbles and other larger sediments are dragged along the seabed

Deposition

Deposition happens due to the reduced energy of waves as it hits the shores. The result of such action is accumulation of rocks, sand and other materials deposited on the shore. Deposition occurs when waves enter a shallow water or any sheltered area, the wind breeze is soft and there are enough materials to be deposited.

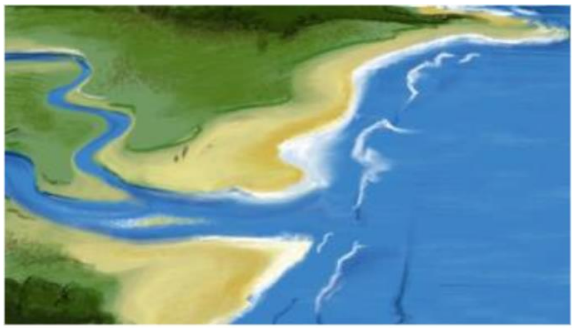


Figure 1.10. Deposition

Source: *Deposition. Digital image. FrontLearners. Accessed August 31, 2020. www.frontlearners.com*

Effects of Coastal Processes-Coastal Erosion, Sublimation and Saltwater Intrusion

Coastal erosion happens when the surface area for erosion is increased due to coastal processes. Primarily it is influenced by the process of transportation wherein materials are displaced from one place to another encouraging erosion. Human activities also contribute to coastal erosion. Because of human activities, the amount of greenhouse gases is increasing causing climate change. Countries experience sea level rise and more storms or more intense storms. Studies show that sea level rise and storms contribute to erosion.

Coastal erosion causes damage to house and other infrastructure along the coast and eventually to the livelihood of people living near the coast. An example is what happened in Zambales in 2013. Below is a picture showing coastal erosion.

Figure 1.11. Coastal Erosion
Source: *Coastal Erosion. Flick. Accessed August 31, 2002. https://www.flickr.com/photos/106853342@N04/12045534665*

Planting mangroves will prevent erosion since mangroves stabilize sediments with their tangled root systems.

Submersion is the complete flooding of previously dry areas due to natural and human activities. Natural causes of submersion are tectonic plate movements, tidal activity, and coastal erosion. Human activities such as building infrastructures or residences in coastal areas expose the coastal area to erosion, thereby accelerating submersion. Submersion is intensified by coastal processes of erosion, transportation, and deposition.

Figure 1.12. Submersion
Source: *Submersion. Digital image. FrontLearners. Accessed August 31, 2020. www.frontlearners.com*

Saltwater intrusion is the contamination of freshwater aquifer with saltwater. It is intensified by surface submersion or excessive ground water extraction. When there are too many people living near the coast, there is an increase in demand for water and sometimes people get water from the ground. There should be proper regulation of groundwater extraction to avoid saltwater intrusion.

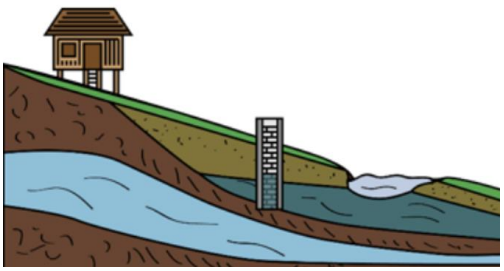
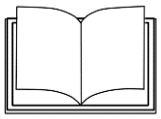


Figure 1.13. Saltwater Intrusion
Source: *Submersion. Digital image. FrontLearners. Accessed August 31, 2020. www.frontlearners.com*



What's More

Activity 1.3. Coastal Hazards Graphic Organizer

Organize what you have learned by answering the graphic organizer below. Copy and answer on a clean sheet of paper.

Coastal Erosion

- What is it? _____
- What coastal process influences it? _____

Submersion

- What is it? _____
- What are natural causes of it? _____

Saltwater intrusion

- What is it? _____
- How do human activities contribute to it? _____

What I Have Learned

Activity 1.4. Summary of Lesson 1

Summarize what you have learned by answering the questions below. Copy and answer on a clean sheet of paper.

1. Describe the following coastal processes: erosion, transportation, and deposition.
2. Describe coastal erosion, submersion, and saltwater intrusion.

What I Can Do

Activity 1.5. How can I help?

Coastal erosion can be intensified by human activities. What do you think are somethings that may help lessen coastal erosion?
Copy and answer the following on a clean sheet of paper.

As a Senior High School student, the thing/s I can do to lessen coastal erosion is/are _____.
This/These will help lessen coastal erosion by _____.

Assessment

Read the question carefully and encircle the letter of the correct answer.

1. Which of the following is **FALSE** about deposition?
   A. It happens due to increased energy of waves as it hits the shore.
   B. It happens due to the reduced energy of waves as it hits the shore.
   C. It happens when waves enter shallow water or any sheltered area.
   D. It is the accumulation of rocks, sand, and other materials deposited on the shore.

2. How do erosion and deposition differ?
   I. Erosion is associated with destructive wave while deposition is associated with constructive wave.
   II. Deposition is associated with destructive wave while erosion is associated with constructive wave.
   III. Deposition results from reduced energy.
   IV. Deposition results from increased energy.

   A. I only
   B. II only
   C. I and III
   D. II and IV

3. Which of the following is **NOT TRUE** about coastal erosion?
   A. It is caused only by natural processes.
   B. It causes damage to infrastructure along the coast.
   C. It is primarily influenced by the process of transportation.
   D. It happens when the surface area for erosion is increased due to coastal processes.

4. Which of the following describes submersion?
   I. It is the complete flooding of previously dry areas.
   II. Human activities do not contribute to submersion.
   III. When the area is exposed to erosion, submersion accelerates.
   IV. It is caused by tectonic plate movement, tidal activity, and coastal erosion.

   A. I and II only
   B. III and IV only
   C. I, II and III
   D. I, III and IV

5. Which of the following describes saltwater intrusion?

I. It is lessened by surface submersion.
II. It results from too much ground water extraction.
III. It happens when there are too many people living near the coast.
IV. It happens when ground water extraction is not properly regulated.

A. I and II only
B. II and III only
C. II, III, and IV
D. I, II, and III

Additional Activities

Create an infographic about the different coastal processes, their causes, and effects. Write your answer on a clean sheet of paper. Be guided by the following rubric.

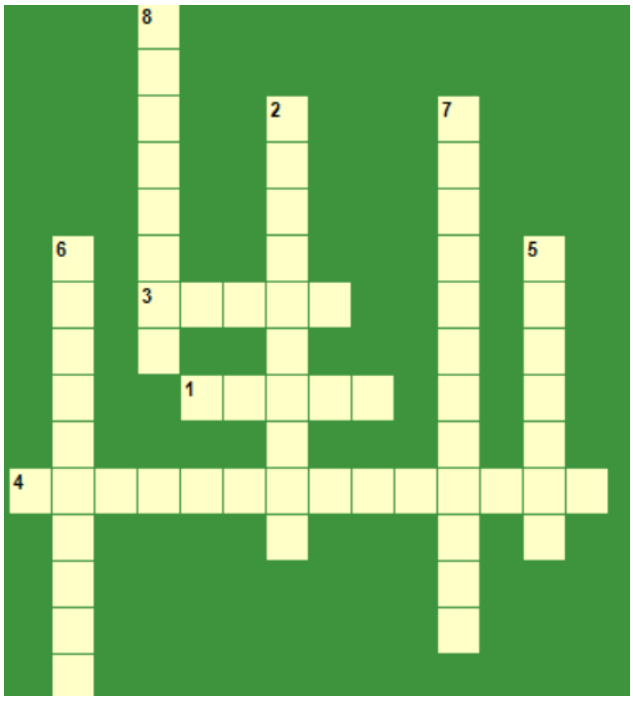
Criterion	3 points	2 points	1 point	0 point
Content	Accurate explanation on the different coastal processes, their causes and effects.	Most of the information presented is accurate.	Half of the information presented is accurate.	Less than half of the information presented is accurate.
Visual Appeal	Has all these elements: 1. originality, 2. creativity. 3. pleasantness achieved with the use of color, design, and space	Has two of the required elements.	Has one of the required elements.	Does not have any of the required elements.
Neatness	Incredibly neat, with no tears or smudges	Neat, with a few smudges or tears	With several smudges or tears	With many smudges or tears

Lesson 2

Preventing or Mitigating the Impact of Land Development, Waste Disposal and Construction of Structures on Coastal Processes

Activity 2.1. Coastal Processes Crossword Puzzle

The crossword puzzle below contains some terms you encountered in the previous module. Copy and answer the puzzle on a clean sheet of paper.



Across:

1. distance traveled by a wave
3. movement of water towards the shore
4. material movement in the sea and along the coastline

Down:

2. accumulation of rocks, sand, and other materials on the shore
5. wearing away of rocks and other materials
6. complete flooding of previously dry areas
7. wave observed during calm weather
8. retraction of water from the shores back to the sea

What's New

Activity 2.2. Song Analysis

Have you heard of the song, "*Masdan Mo ang Kapaligiran*" by the group, Asin? If you have not, you may ask your parents/older family members about this song. You can read below the lyrics of the song.

Wala ka bang napapansin sa iyong mga kapaligiran?
Kay dumi na ng hangin, pati na ang mga ilog natin.
Hindi na masama ang pag-unlad
At malayu-layo na rin ang ating narating
Ngunit masdan mo ang tubig sa dagat
Dati'y kulay asul ngayo'y naging itim
Ang mga duming ating ikinalat sa hangin
Sa langit huwag na nating paabutin
Upang kung tayo'y pumanaw man, sariwang hangin
Sa langit natin matitikman
Mayron lang akong hinihiling
Sa aking pagpanaw sana ay tag-ulan
Gitara ko ay aking dadalhin
Upang sa ulap na lang tayo magkantahan
Ang mga batang ngayon lang isinilang
May hangin pa kayang matitikman?
May mga puno pa kaya silang aakyatin
Hindi na masama ang pag-unlad
Kung hindi nakakasira ng kalikasan
Bakit di natin pagisipan
Ang nangyayari sa ating kapaligiran
Darating ang panahon mga ibong gala
Ay wala nang madadapuan
Masdan mo ang mga punong dati ay kay tatag
Ngayo'y namamatay dahil sa 'ting kalokohan
Lahat ng bagay na narito sa lupa
Biyayang galing sa Diyos kahit nong ika'y wala pa
Ingatan natin at 'wag nang sirain pa
Pagkat pag Kanyang binawi, tayo'y mawawala na
Mayron lang akong hinihiling
Sa aking pagpanaw sana ay tag-ulan
Gitara ko ay aking dadalhin
Source: Musixmatch Songwriter: Carbon Lolita

After listening to the song, answer the following questions. Copy and answer on a clean sheet of paper.

1. What is the message of the song?
2. Do you agree with what the songwriter says in the following phrase?

"Lahat ng bagay na narito sa lupa
Biyayang galing sa Diyos kahit nong ika'y wala pa
Ingatan natin at 'wag nang sirain pa
Pagkat pag Kanyang binawi, tayo'y mawawala na"

   Explain your answer.
3. How do we take care of our natural resources especially our bodies of water?

What Is It

Effects of Coastal Land Development

Coastal land development, good as it may seem, has adverse effects on the environment. This in turn pose threats to humans. Some impacts of coastal land development are presented below:

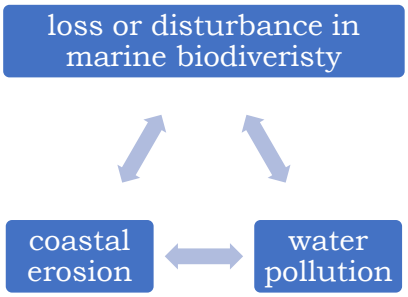


Figure 2.1. Impacts of Coastal Land Development

Land development (including construction of structures such as buildings, roads, and bridges) disturbs the habitat of marine species. Improper waste disposal leads to contamination of the sea. Marine species near the coast (species living in coral reefs, near shorelines and estuaries) are the most vulnerable. Thus, this may also affect their biodiversity. In addition, since coastal development changes the natural landscape and processes in the coasts, abnormal coastal erosion may take place.

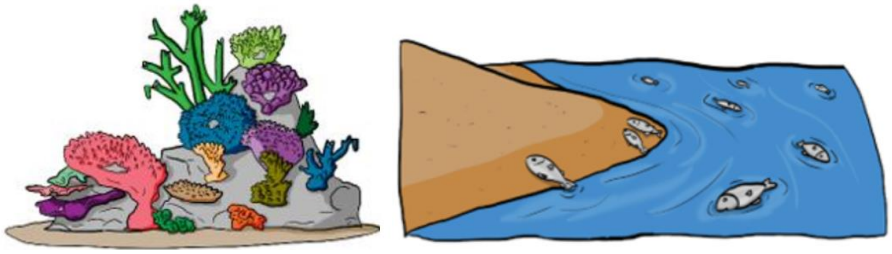


Figure 2.2. Effects of Coastal Land Development
Source: *Effects of Coastal Land Development. Digital Image. FrontLearners. Accessed August 28, 2020. www.frontlearners.com*

Preventing or Mitigating the Impact of Land Development

Some of the ways to reduce these impacts are presented below:

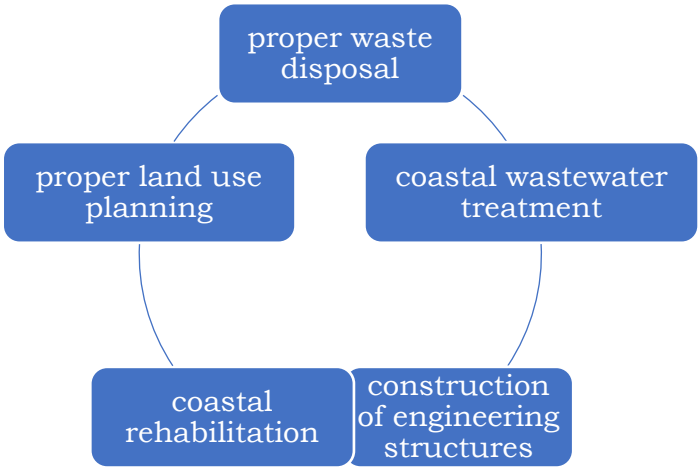


Figure 2.3. Preventing or Mitigating the Impact of Land Development

Proper waste disposal plays a great role in reducing water pollution. Avoid throwing gargabe to the sea or even in any other body of water. Practice proper solid waste management. Segregate waste properly and remember the three Rs: Reduce, Reuse, Recycle.

Figure 2.4. Proper Waste Disposal

Source: *(From left to right)*
(1) Effects of Coastal Land Development. Digital Image. FrontLearners. Accessed August 28, 2020. www.frontlearners.com
(2) reduce-reuse-recycle-repeat. Flickr. Accessed August 28, 2020. https://www.flickr.com/photos/145038280@N04/28851285664
(3) Trash Recycling with Disposal Containers. Wikimedia Commons. Accessed August 28, 2020. https://commons.wikimedia.org/wiki/File:Trash_Recycling_with_Disposal_Containers.jpg

In the picture below, local residents participate in a massive cleanup drive on Boracay Island on June 27, 2018, as part of the 6-month rehabilitation program to bring back the tourist destination's beauty.

Figure 2.5. Cleanup Drive
Source: *Boracay cleanup by residents. Wikimedia Commons. Accessed August 28, 2020. https://commons.wikimedia.org/wiki/File:Boracay_cleanup_by_residents.jpg*

Coastal wastewater treatment is the process of treating wastes to improve the quality of wastewater, completely eradicating or lessening the contaminants directed to the open sea. In the Philippines, the establishment of wastewater treatment facilities is in compliance to RA 9275, commonly known as the Clean Water Act of 2004.

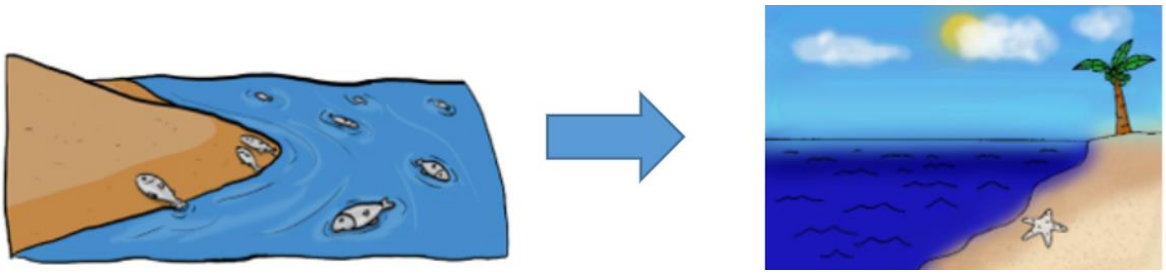


Figure 2.6. Coastal Wastewater Treatment
Source: *Coastal Wastewater Treatment. Digital Image. FrontLearners. Accessed August 28, 2020. www.frontlearners.com*

Adopting effective land-use regulations and land-use planning also is essential before any development is established in coastal areas. This will not only prevent any damage to the natural environment but also prevent any future harm to people. This includes assessing the possible effects of any structure to be built on the coast.

Coastal rehabilitation is the process of restoring or bringing the coasts to a healthier or improved condition. This includes mangrove tree plantation and other coastal revegatation measures. There are many advantages from mangroves. They protect the shorelines from storms, winds, waves and floods. They prevent erosion with the help of their tangled root system. They also filter pollutants.

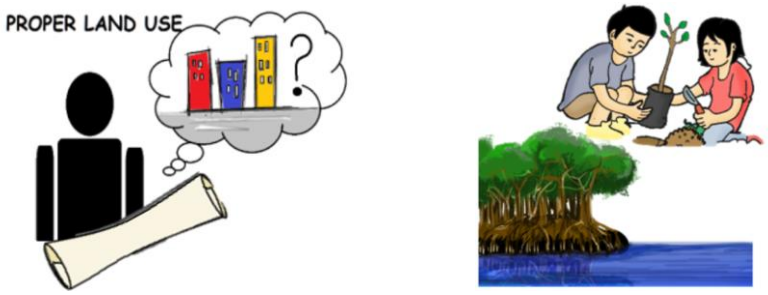


Figure 2.7. Proper Land Use Planning and Coastal Rehabilitation
Source: *Proper Land Use Planning and Coastal Rehabilitation. Digital Image. FrontLearners. Accessed August 28, 2020. www.frontlearners.com*

Construction of engineering structures includes the construction of groins/groynes, sea walls, off-shore breakwater etc. These structures are meant to protect people and structure against the devastation attributed to either erosion or storm waves.

Figure 2.8. Construction of Engineering Structures
Source: *Construction of Engineering Structures. Digital Image. FrontLearners. Accessed August 28, 2020. www.frontlearners.com*

What's More

Activity 2.3. What Will You Do?

Mang Romy is about to establish a beach resort. He learned that the area he is going to utilize is rich in marine biodiversity. If you were Mang Romy, what would you do? Choose from the options below and explain your choice briefly.

Source: *Puka Beach Boracay. Wikimedia Commons. Accessed August 28, 2020. https://commons.wikimedia.org/wiki/File:Puka_Beach_Boracay_-_panoramio_-_Tuderna_(1).jpg*

A. Establish a restaurant instead.
B. Utilize the area into a beach resort.
C. Survey the area and extract all potential resources.
D. Conduct an environmental impact assessment and consider moving to another area far from it.

Copy and answer the following on a clean sheet of paper.

If I were Mang Romy, I would choose option _____ (the letter of your choice) because _____ .

What I Have Learned

Activity 2.4. Summary of Lesson 2

Summarize what you have learned by answering the questions below. Copy and answer on a clean sheet of paper.

1. What are the adverse effects of coastal land development?
_____, _____, and _____
2. How do we prevent or mitigate the impact of land development?
_____, _____, _____, _____, and _____.

What I Can Do

Activity 2.5. Boracay Rehabilitation

The following is an article from the Philippine News Agency. Read it and answer the questions that follow:

Tourists satisfied with Boracay rehab
By Gail Momblan July 19, 2019, 4:41 pm

ILOILO CITY -- The Boracay Inter-Agency Rehabilitation Management Group (BIARMG) has drawn positive feedback from tourists since the world-famous Boracay Island reopened in October last year.

"The tourists coming in are happy that Boracay is no longer a cesspool and the traffic congestion was addressed," Natividad Bernardino, general manager of the BIARMG, said in a phone interview Thursday.

She said the Department of Public Works and Highways' (DPWH) project phase 1 has widened road network from the Cagban Jetty Port to the semi-central Boracay district and has cut the travel time of tourists.

Phase 2, which includes the completion of Boracay's drainage system, is expected to be finished in mid-2020.

"If tourists experience traffic congestion, it is because of the ongoing road works of the phase 2 project of DPWH," she said.

The flooding in the villages of Manoc-Manoc and Balabag on Wednesday was also seen to have been caused by the ongoing DPWH project.

Bernardino assured the task force works to implement mitigating measures in the reported flooding.

"We deployed pumps to flush out rainwater," she said.

Meanwhile, Boracay vendors, who were the fixture of the beachfront before the rehabilitation, are now more organized in their designated areas.

This is also considered one of the notable achievements of the rehabilitation, Bernardino said.

More developments are to be seen in the economic part of the island as the local government of Malay is also considering to relocate the vendors to a better tourism market.

"But in the meantime, our vendors are here on the beachfront," she said.
Bernardino said the task force has seen more and more commercial establishments on the island being compliant with environmental laws.
These environmental laws include the Clean Air Act; Clean Water Act; Hazardous Waste Law; Ecological Solid Waste Management Act (Republic Act 9003); and Presidential Decree 1586 or the establishment of an environmental impact system.

Aside from the establishments, she said tourists also obey the local ordinances.
Bernardino said violations of the smoking and liquor drinking ban on the beachfront are "very seldom" recorded. President Rodrigo Duterte ordered the environmental rehabilitation of the island in April 2018. ***(PNA)***

Copy and answer the following on a clean sheet of paper.

1. Why was there a need to rehabilitate Boracay?

2. What was the secret of the success of the rehabilitation of Boracay? Explain your answer.

Assessment

Read the question carefully and encircle the letter of the correct answer.

1. Which of the following are impacts of land development and waste disposal to coasts and coastal processes?
   I. increase in water pollution
   II. disturbance to coastal biodiversity
   III. occurrence of abnormal coastal erosion
   IV. intervention with natural coastal processes

   A. I and II
   B. III and IV
   C. I, II, and III
   D. I, II, III and IV

2. Which statement is TRUE?
   A. Marine biodiversity is not affected by improper waste disposal.
   B. It is okay to throw garbage into the sea. The sea is big after all.
   C. Proper waste disposal includes avoiding the disposal of wastes in inland waters.
   D. The government must do something about waste management without involving the community.

3. Which of the following is NOT a strategy to prevent the impact of land development on coastal processes?
   A. proper waste disposal
   B. mangrove tree planting
   C. construction of sea wall
   D. construction of new roads and bridges

4. What are groins, sea walls and breakwater examples of?
   A. coastal areas
   B. coastal processes
   C. coastal rehabilitation measures
   D. coastal hard engineering structures

5. Which of the following are TRUE about mitigating the effects of land development and waste disposal to coastal processes?
   I. Practice proper solid waste management.
   II. Mangrove tree plantation brings coasts to improved condition.
   III. Proper waste disposal plays a great role in reducing water pollution.
   IV. Construction of engineering structures like sea walls and breakwater does not lessen effects of coastal hazards.

   A. I, II, and III
   B. II, III, and IV
   C. I, II, and IV
   D. I, II, III and IV

Additional Activities

Write your reflection on Preventing or Mitigating the Impact of Land Development by answering the questions inside the box. Express your critical and creative thinking skills in your answers. Have fun and enjoy!

The topic,"Preventing or Mitigating the Impact of Land Development" guides me to ponder on ...

What learnings have I found from this lesson?

What other examples can I contribute to explore and think more?

What learnings can I share with my family and peers?

What positive values have I developed from this lesson?

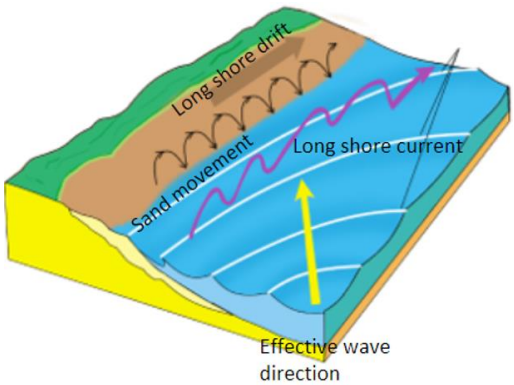
What is my conclusion on the lesson?

Posttest

Read the question carefully and encircle the letter of correct answer.

1. Which of the following happens when tidal activities and wave actions generate sea or ocean water to flood certain parts of the shore?
   A. storm waves
   B. submersion
   C. coastal erosion
   D. saltwater intrusion

2. Refer to the figure below. Which of the following **DOES NOT** describe longshore drift?



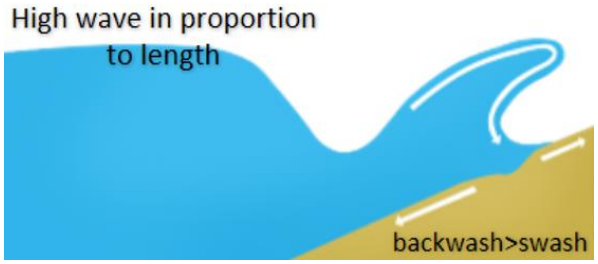
   A. It is influenced by swash and backwash.
   B. It is the wearing away of land by the sea.
   C. It results to zigzag movement of materials.
   D. It is the movement of materials along the coast due to wave action.

3. Which of the following correctly describes erosion by **solution**?
   A. Rocks, sand, and other sediments grind with cliff materials.
   B. Rocks and pebbles transported with wave bump to each other.
   C. It cannot be readily observed because it involves chemical activities by the seas.
   D. Trapped air reacts to the action of waves resulting to rock detachment from the cliff.

4. Which of the following sentences describes erosion?
   I. It is associated with constructive waves.
   II. It is caused by destructive waves along the coast.
   III. It is the wearing away of rocks and other materials.
   IV. It is the movement of material in the sea and along the coastline.

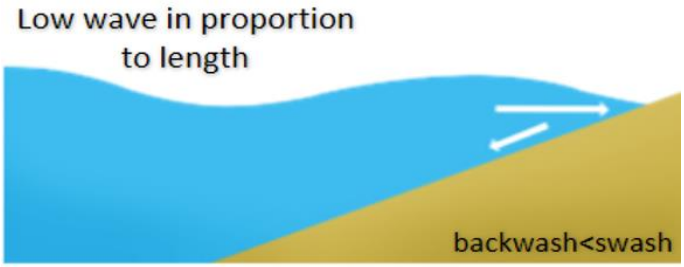
   A. I and II
   B. II and III
   C. III and IV
   D. I and IV

5. The figure below represents a destructive wave. Which of the following is **FALSE** about destructive waves?



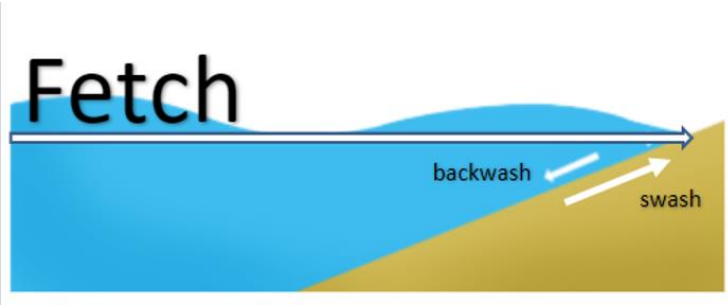
   A. They are observed during calm weather.
   B. These waves result to steeper and shorter beaches.
   C. They are prevalent when there are vigorous sea or ocean activities.
   D. They have more energy and drag materials from the shore back to the sea.

6. The figure below represents a constructive wave. Which of the following is **FALSE** about a constructive wave?



   A. It has greater swash than backwash.
   B. It has limited energy and deposits materials into shores.
   C. These waves result to a beach with shallow and long coastline.
   D. It has more energy and drags materials from the shore back to the sea.

7. Refer to the picture below. Which of the following is TRUE about wave characteristics?



I. A greater fetch results to bigger waves.
II. A greater fetch results to smaller waves.
III. There is no observed relationship between a wave's fetch and the size of a wave.
IV. The relationship between swash and backwash determines what type of wave happens on the coast.

A. I only
B. II only
C. III and IV
D. I and IV

8. What can you infer from the pictures below?

Beach 1

Beach 2

A. Both beaches are formed by recurring destructive waves.
B. Both beaches are formed by recurring constructive waves.
C. Beach 1 is formed by recurring constructive waves while Beach 2 is formed by recurring destructive waves.
D. Beach 1 is formed by recurring destructive waves while Beach 2 is formed by recurring constructive waves.

9. What type of wave is illustrated based on the intensity of backwash and swash?

A. Constructive
B. Destructive
C. Tidal
D. Tsunami

10.Which of the following statements is CORRECT?

A. Marine biodiversity is not affected by improper waste disposal.
B. It is okay to throw some garbage into the sea. The sea is big after all.
C. Proper waste disposal includes avoiding the disposal of wastes in inland waters.
D. The government must do something about waste management without involving the community.

11. Which of the following was established in compliance to the Clean Water Act of 2004?

A. Mangrove nurseries
B. Waste disposal facility
C. Wastewater treatment facility
D. Coastal engineering structures

12. Which of the following refer to the process of treating wastes to improve the quality of wastewater in coastal areas?

A. coastal erosion
B. coastal development
C. coastal rehabilitation
D. costal wastewater treatment

13. Which of the following is/are **TRUE**?

I. Coastal erosion is a natural process.
II. Land development may worsen coastal erosion.
III. Coastal erosion can be induced by human activities.
IV. Coastal land development does not alter the natural landscapes in the coasts.

A. I and II
B. III and IV
C. I, II, and III
D. I, II, III, and IV

14. Which of the following statements would be economical and effective practices to mitigate submersion?

I. Relocation to safer areas
II. Protection of mangrove fields
III. Construction of new roads and bridges
IV. Planting trees to minimize greenhouse gases

A. I, II and III
B. I, II and IV
C. II, III and IV
D. I, II, III and IV

15. Which of the following happens when wave actions destruct the natural rock barriers causing it to wear away?

A. Tidal waves
B. Submersion
C. Coastal erosion
D. Saltwater intrusion

Answer Key

Lesson 1

What's In
Activity 1.1

Across
2. strong winds
3. hazard map

Down:
1. inland flood
4. legend
5. landslide
6. monsoon
7. mini-swirls

What's New
Activity 1.2

Expected Answers:
wind waves tides storms sea level climate weather plate movement

What's More Activity 1.3

Coastal Erosion
It happens when the surface area for erosion is increased due to coastal processes. Primarily it is influenced by the process of transportation

Submersion
It is the complete flooding of previously dry areas due to natural and human activities. Natural causes of submersion are tectonic plate movements, tidal activity, and coastal erosion.

Saltwater intrusion is the contamination of freshwater aquifer with saltwater. It is intensified by surface submersion or excessive ground water extraction.

What I Can Do Activity 1.5

As a Senior High School student, the thing/s I can do to lessen coastal erosion is/are practice proper waste management, save electricity/gas.
This/These will help lessen coastal erosion by lessening greenhouse gases. Greenhouse gases cause increase in storms and sea level rise.

What I Have Learned Activity 1.4

1. Erosion is the coastal formation process that involves the wearing away of rocks and other materials due to destructive waves along the coast. Material movement in the sea and along the coastline is called transportation. Deposition happens due to the reduced energy of waves as it hits the shores. The result of such action is accumulation of rocks, sand and other materials deposited on the shore.
2. Coastal erosion happens when the surface area for erosion is increased due to coastal processes. Submersion is the complete flooding of previously dry areas due to natural and human activities. Saltwater intrusion is the contamination of freshwater aquifer with saltwater. It is intensified by surface submersion or excessive ground water extraction.

Lesson 2

What's In
Activity 2.1

Across
1. fetch
3. swash
4. transportation

Down:
2. deposition
5. erosion
6. submersion
7. constructive
8. backwash

What's New
Activity 2.2

Answers may vary. Sample answers:
1. The song advises us to consider what we have done to our environment.
2. Yes, I agree. If something bad happens to our environment, it will have an impact on all of us.
3. Proper waste management, proper land use planning.

What's More
Activity 2.3

If I were Mang Romy, I would choose option D because I want to protect marine life. Land development has adverse effect on marine life.

Additional Activities	What I Can Do Activity 2.5	What I Have Learned Activity 2.4
Answers may vary. Sample Answer: This lesson guides me to ponder on sustainable development.	1. Too many people visiting the beach, too much waste 2. Discipline. Commercial establishments became more compliant to environmental laws. Tourists also obey local ordinances like smoking and liquor drinking ban.	1. loss or disturbance in marine biodiversity, coastal erosion, and water pollution. 2. proper waste disposal, proper land use planning, coastal wastewater treatment, coastal rehabilitation, and construction of engineering structures

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Development Team of the Module

Writer: Evangeline C. Agtarap (THS)

Editors: Reynald Alfred A. Recede (MHS)
Russel S. Berador (SEHS)
Maria Carmina R. Martin (MHS)
Emily G. Santos (PSDS)
Jessica S. Mateo (EPS – Science)

Illustrator: Evangeline C. Agtarap (THS)

Layout Artists: Christine Ann G. Faraon (BNHS)
Jemwel Dela Paz (CISSL)

Management Team:

Sheryll T. Gayola
Assistant Schools Division Superintendent
OIC, Office of the Schools Division Superintendent

Elisa O. Cerveza
Chief, Curriculum Implementation Division
OIC, Office of the Assistant Schools Division Superintendent

Jessica S. Mateo
Education Program Supervisor – Science

Ivy Coney A. Gamatero
Education Program Supervisor – Learning Resource Management Section

For inquiries or feedback, please write or call:

Schools Division Office- Marikina City

191 Shoe Ave., Sta. Elena, Marikina City, 1800, Philippines

Telefax: (02) 8682-2472 / 8682-3989

Email Address: sdo.marikina@deped.gov.ph