



U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Marine Fisheries Service

Lesson 16: Coastal Dynamics

Overview

Lesson 16 presents some of the natural processes and human activities that shape our coasts. The lecture describes different ways of classifying coasts (e.g., active vs. passive coasts) and the ways in which several types of coasts are formed. In the activity, students observe changes in Ohio's Lake Erie shoreline over time and describe the effects of structures used to control erosion.

Lesson Objectives

Students will:

1. Identify and differentiate active and passive coasts
2. Identify and give examples of primary and secondary coasts
3. Describe how shorelines change over time

Lesson Contents

1. Teaching Lesson 16
 - a. Introduction
 - b. Lecture Notes
 - c. Student activity
2. Student Handout
3. Mock Bowl Quiz

Standards Addressed

National Science Education Standards, Grades 9-12

Unifying concepts and processes

Physical science

Science in personal and social perspectives

Ocean Literacy Principles

The ocean and life in the ocean shape the features of the Earth

DCPS, High School

Environmental Science

E.2.1. Understand and explain that human beings are part of Earth's ecosystems, and that human activities can, deliberately or inadvertently, alter ecosystems.

Lesson Outline¹

I. Introduction



To introduce today's lesson, encourage students to think about the variation in coasts around the world. Show students the images of three coasts (left) as a handout or on a projector². Ask students to describe what they see. Do the coasts look the same or different? Ask students to identify the types of coasts if they can. The first is the Mississippi River Delta off the coast of Louisiana, the second is The Great Barrier Reef off the coast of Australia and the third is a coastal lagoon off the coast of North Carolina. Ask students why they think the coasts look different. They may answer that the coasts are formed by different processes. Different types of coastal formation will be discussed in the lecture.

Next, ask students if they think coasts look exactly the same over time. Encourage students to think about reasons why coasts might be dynamic, constantly changing. Processes that shape coasts over time include both natural and man-made influences. Natural processes include wave action, tsunamis and hurricanes. Examples of anthropogenic (human) influences include development on beaches and construction of ports and navigation channels.

II. Lecture Notes

Use the PowerPoint for Lesson 16 (File: Lesson 16 – Coastal Dynamics.ppt) to present the following information. Distribute the Student Handout before you begin for students to take notes on key information.

¹ Unless otherwise indicated, all websites provided or referenced in this guide were last accessed in November 2010.

² Photos, NASA:

Mississippi Delta (Photo 1): <http://earthobservatory.nasa.gov/IOTD/view.php?id=1257>

Great Barrier Reef (Photo 2): http://eoimages.gsfc.nasa.gov/ve/770/S2000149020341_md.jpg

North Carolina (Photo 3): http://eoimages.gsfc.nasa.gov/ve/1017/S1999360172440_md.jpg

North Carolina (Photo 3): http://eoimages.gsfc.nasa.gov/ve/1017/S1999360172440_md.jpg

The Earth's coasts (slides 2 and 3)

1. Coasts can be classified based on geology as either active or passive.
2. **Active coasts** are those located near a plate boundary, and thus in close proximity to tectonic activity (e.g., earthquakes). **Passive coasts** are located farther from plate boundaries and thus are not associated with the tectonic activity of active coasts.
3. This classification system depends on long-term geological processes, but scientists think that shorter-term processes affect coastal formation as well.

Coasts can also be classified based on the way that they are formed (slides 5-7)

1. **Primary coasts** are formed by more land-driven rather than ocean-driven processes like plate tectonics, land erosion and sedimentation. **Secondary coasts** are formed by more ocean driven processes like wave erosion or growth of a coral reef.
2. Primary coasts include **land-deposition coasts**, formed when rivers flow into the ocean and sediment accumulates along a wide shelf. An example is the Nile River Delta. Volcanic coasts, like the Hawaiian Island hot spot, are also primary coasts.
3. Secondary coasts include **marine-deposition coasts** where sea movement causes accumulation of ocean sediments in a single place. Examples include barrier islands, mud flats and coral reef ecosystems.

Coasts are dynamic, constantly changing (slide 8)

1. Coasts are constantly being shaped by physical processes including erosion of sediment from the movement of wind and waves.
2. Many human societies are located along coasts and their activities also change this environment.

III. Additional resources

1. Background information
http://www.ohiodnr.com/LakeErie/ShoreStructure_Groins/tabid/9257/Default.aspx

IV. Student activity

The activity for this lesson is included in the Lesson 16 folder. There is a teacher's edition including an answer key (File: Shoreline Change_Teacher.pdf) and a handout for students with procedures and questions (File:Shoreline Change_Student). This activity from COSEE Great Lakes, Greatest of the Great Lakes curriculum, "How Fast Can a Shoreline Change?" is being used with permission from the Illinois-Indiana Sea Grant Program at the University of Illinois.

Tips for the Bowl - Coasts

Know your Coasts

Some NOSB questions may ask you to differentiate among different types of coasts and/or to identify examples. Remember the following:

Primary coasts are formed by more land-driven rather than ocean-driven processes like plate tectonics, land erosion and sedimentation.

Secondary coasts are formed by more ocean driven processes like wave erosion or growth of a coral reef.

Active coasts are close to plate boundaries while **passive coasts** are far away from active plates.



Barrier Island in the Gulf of Mexico.

³You should also be familiar with some terminology regarding coastal dynamics:

Longshore drift is the movement of sediments along the coast parallel to the shore.

A **spit** is a length of sand that accumulates in the direction of longshore drift.

A **tombolo** is a spit that forms either between two islands or from an island to mainland.

A **barrier island** is a large sediment deposit that forms between the ocean and the shore (See image, left).

Coral Reef Classification

Fringing reefs lie along the coast of an island or mainland.

Barrier reefs are similar but are located farther from land (e.g., The Great Barrier Reef, Australia).

An **atoll** is a ring-shaped reef that surrounds a lagoon.

Fringing Reef



Howland Island

Barrier Reef



Great Barrier Reef, AUS

Atoll



Nukuoru Atoll, Caroline Islands

³ Photo: NOAA, http://www.noaaworld.noaa.gov/conservation/oct2008_conservation_3.html

⁴ Photos: NASA, <http://eol.jsc.nasa.gov>

Coastal Dynamics

1. Short Answer: Barrier islands and mud flats are examples of which type of secondary coast?
Answer: Marine deposition coasts
2. Groins are structures built mainly to:
 - w. Serve as fishing locations
 - x. **Reduce local beach erosion**
 - y. Create a harbor
 - z. Mark property boundaries
3. A ring-shaped reef that surrounds a lagoon is called a(n):
 - w. **Atoll**
 - x. Barrier reef
 - y. Fringing reef
 - z. Barrier island
4. This term refers to the movement of sediments along the coast parallel to the shore:
 - w. Erosion
 - x. **Longshore drift**
 - y. Sedimentation
 - z. Wave action
5. Reminder question: Which of the following best describes water beneath the thermocline:
 - w. Highly variable in temperature
 - x. Warmer than most surface waters
 - y. **Relatively uniform and cold in temperature**
 - z. Variable by latitude
6. Which of the following is true of the Great Barrier Reef:
 - w. **It was built by marine processes**
 - x. It was built by physical processes
 - y. It is located on a plate boundary
 - z. It is associated with volcanic activity
7. Which of the following is **not** characteristic of a delta:
 - w. **Presence of structures built by marine organisms**
 - x. Nearby river flowing into the sea
 - y. A triangular shape formed by sediment deposition
 - z. A wide continental shelf

ANSWER

The Earth's coasts can be classified by geology or by the way that they are formed. Answer the questions about coastal classification below.

1. Name and define two coastal classifications based on geology. (6pt)
Coasts can be classified according to geology as active or passive coasts (2pt). Active coasts are located near plate boundaries and thus in close proximity to tectonic activity (2pt). Passive coasts are located farther from plate boundaries and thus are not associated with the tectonic activity of active coasts (2pt).
2. Coasts can be classified as primary or secondary coasts based on the way that they were formed. What is the difference between primary and secondary coasts? (4pt)
Primary coasts are formed by more land-driven than ocean driven processes like plate tectonics, land erosion and sedimentation (2pt). Secondary coasts are formed by more ocean-driven processes like wave erosion or growth of a coral reef (2pt).
3. Give one example of a primary coast and a secondary coast. (2pt)
Examples of primary coasts include deltas like the Nile River Delta and volcanic coasts like the Hawaiian Islands. Examples of secondary coasts include marine deposition coasts like the Barrier Island in Mexico and coasts formed by organisms like the Great Barrier Reef in Australia.