Science Concept:

Rivers create deltas, causing significant changes to Earth's surface.

Objectives:

The student will:

- describe how a river creates a delta and what changes occur at the mouth of the river over time;
- make predictions about the future of a city using knowledge about the effects a river is having on the city's delta; and
- write a letter to persuade city officials to take action to protect the city.

GLEs Addressed:

Science

[9] SD1.2 The student demonstrates an understanding of geochemical cycles by applying knowledge of the water cycle to explain changes in the Earth's surface.

[9] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating.

Writing

[9] W4.2.2 The student writes for a variety of purposes and audiences by writing in a variety of nonfiction forms (e.g., letter, report, biography, autobiography, and/or essay) to inform, describe, or persuade.

Vocabulary:

alluvium - a deposit of loose sand, mud, gravel, silt, etc., laid down by flowing water, especially in the valleys of large rivers or on deltas

barrier island - a broadened barrier beach, or sand ridge that rises slightly above the surface of the sea and runs roughly parallel to the shore, from which it is separated by a lagoon; habitable in places, that provides a measure of protection for the mainland, as during hurricanes and tidal waves

channel - (1) a natural stream that conveys water; a natural or artificial watercourse with definite bed and banks to confine and conduct flowing water; a ditch or channel excavated for the flow of water. River, creek, run, branch, anabranch, and tributary are some of the terms used to describe natural channels, which may be single or braided. Canal, aqueduct, and floodway are some of the terms used to describe artificial (man-made) channels. (2) The bed of a single or braided watercourse that commonly is barren of vegetation and is formed of modern alluvium. Channels may be enclosed by banks or splayed across and slightly mounded above a fan surface and include bars and dumps of cobbles and stones. Channels are landform elements

delta - an alluvial deposit, usually triangular in shape, at the mouth of a river, stream, or tidal inlet

groundwater -(1) water that flows or seeps downward and saturates soil or rock, supplying springs and wells. (2) Water stored underground in rock crevices and in the pores of geologic materials that make up Earth's crust

levees - a natural or manmade earthen barrier along the edge of a stream, lake, or river. Land alongside rivers can be protected from flooding by levees

particle size - the measurement of a minute portion, piece, fragment, or amount; in physics, the measurement of one of the extremely small constituents of matter, as an atom or nucleus

river mouth - the place where a river flows into a larger body of water, such as a lake or an ocean

sediment - the word geologists use for loose pieces of minerals and rock that come in a variety of sizes and go by common names like sand, boulders, clay, silt, pebbles, and cobbles

subsidence - a gradual lowering or settling of a portion of Earth due to dynamic causes (such as permafrost thaw, earthquakes, etc.), mining operations, or the like; a fall in the level of the ground

water dam - a barrier to obstruct the flow of water, especially one of earth, masonry, etc., built across a stream or river

watershed - the land area that drains water to a particular stream, river, or lake. It is a land feature that can be identified by tracing a line along the highest elevations between two areas on a map, often a ridge. Large watersheds, like the Mississippi River basin contain thousands of smaller watersheds

wetlands - those areas where water saturation is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the surrounding environment. The single feature that all wetlands have in common is a soil or substrate that is saturated with water during at least a part of the growing season. Other common names for wetlands are sloughs, ponds, swamps, bogs, and marshes

Materials:

- Slant board, waterproof (one per group)
- Large container to be placed at bottom of the slant table (one per group)
- Moist soil/dirt (five gallons per group)
- Silt (10 pounds per group)
- Sand (10 pounds per group)
- Gravel (10 pounds per group)
- Water (five gallons per group)
- Empty plastic ice cream bucket (one per group)
- Nail, or drill with small drill bit
- Toy houses (approximately 50 per group)
- Sponges (four per group)
- Wood (several pieces cut to various size per group)
- Computer with Internet access and PowerPoint software or OVERHEAD: "Mississippi Delta Coastline" [Graphics: All slides except the last one on the teacher-created PPT. These images are from http://www.lacoast.gov/landchange/basins/mr/ at USGS and are usable with credit.]
- OVERHEAD: "Mississippi Basin Trends" [Graphics: This is the last slide in the PPT created by the teacher. The image is from http://www.lacoast.gov/landchange/basins/mr/ at USGS and is usable with credit.]
- OVERHEAD: "Images of Alaskan River Deltas" [Graphics: 5-6 images of Alaskan river deltas with location information.]
- Map of the United States
- STUDENT WORKSHEET: "Can You Save New Orleans?"

Resources:

Montagne, R. (2005, September 8). Saving New Orleans, a sinking city [Radio broadcast episode]. In E. McDonnell (Producer) Morning Edition. Washington, DC: National Public Radio. Retrieved from http://www.npr.org/templates/story/story.php?storyId=4837031

Montagne, R. (2006, June 1). Satellite imagery shows a sinking New Orleans [Radio broadcast episode]. In E. McDonnell (Producer), Morning Edition. Washington, DC: National Public Radio. Retrieved from http://www.npr.org/templates/story/story.php?storyId=5443951

NASA. (2009). NASA Earth Observatory: Home. Retrieved from http://earthobservatory.nasa.gov

U.S. Geological Survey. (2009). USGS National Wetlands Research Center. Retrieved from http://www.nwrc.usgs.gov/

LaCoast. (2009). LaCoast.gov – The Louisiana Coastal Wetlands Conversation and Restoration Task Force website. Retrieved from http://www.lacoast.gov

Bourne Jr., J. K. (2004). Gone with the water. National Geographic, 206(4), 88-105.

Dutch, S. (1999). Erosion and landscape evolution. University of Wisconsin-Green Bay. Retrieved from http://www.uwgb.edu/DutchS/EarthSC202Notes/erosion.htm

Activity Procedure:

Prepare a "rain bucket" for each group by using a nail or a drill with a small drill bit to poke holes in the bottom of each empty plastic ice cream bucket.

Gear Up

Process Skills: observing, inferring, and communicating

1. Ask students to write what they know about rivers entering the ocean in their science journals.
2. Without identifying the location, show OVERHEAD: "Mississippi Delta Coastline" or navigate to http://www.lacoast.gov/landchange/basins/mr/ and display the animation toward the bottom of the page.
3. Review the vocabulary list by locating each feature described on the first satellite image. Play the animation, or click through the OVERHEAD, and ask students for ideas about what is happening. Write all ideas on the board.
4. Instruct students to write in their journal and describe what they think is happening in the pictures.
5. On the map, point out the location of New Orleans.

Explore

Process Skills: developing models, communicating, collecting data, predicting, and observing

6. Explain students will be building a model of a river with the provided materials. Divide students into groups and distribute slant board, a large container, moist soil/dirt, silt, sand, gravel, water, an empty plastic ice cream bucket with holes punched in it (see Activity Preparation), toy houses, four sponges, and several pieces of wood to each group.
7. Distribute STUDENT WORKSHEET: "Can You Save New Orleans?"
8. Instruct groups to use the silt, sand and gravel to make a landscape with a river on their slant board. Instruct them to draw the river model on the back of their worksheet. As a group, tell them to decide where they want the river to flow and create a small pathway using moist dirt.
9. As a group, ask them to discuss what impact rain will have on their landscape. On the worksheet, each student should make a prediction about what will happen when the river begins to flow, even if it is different from the group's discussion and prediction.
10. Allow groups to fill the rain bucket and begin "raining" on the model.
11. Instruct groups to observe what happens as sediments hit the coastline and record their observations on their worksheets. Make sure groups keep the river running and record any changes they observe as the delta forms.
12. After a delta has formed, groups may stop "raining" and use their other materials to create a town above the delta. Instruct groups to discuss how the river might affect their town and why. Students should record their prediction on their worksheets.
13. Groups may start their river again, this time with the goal of protecting the town. Groups may use any materials at hand to protect the town. Ask them to record any observations. Groups should keep the river running as long as possible. If they lose their town, groups should rebuild and continue until they can find a way to protect it.

Generalize

Process Skills: making generalizations, communicating, inferring, and predicting

14. Ask the following questions and discuss as a class:
    a .What happened to your slope?
    b. What were some of your variables?
    c. What happened that you didn't expect? What was it and why do you think it happened?
    d. How was your delta different or the same as other groups' deltas?
    e. Find a delta from OVERHEAD: "Images of Alaskan River Deltas" that resembles your delta.
    f. How did the sand, gravel, and mud act as it was flowing in the river? Relate this to particle size.
    g. How did the sand, gravel and mud behave as it formed the delta?
    h. What would have happened if your river ran slower or faster?
    i. What are some of the things you did to save your town?
    j. What could you add to create a model that represents the Mississippi Delta?
    k. How could you make your delta sink?
    l. What might make a real delta sink? Use prior knowledge and your own ideas.
    m. How would dams affect a delta and city built below them?
    n. What happens if you divert the river around the town?
    o. If you were an engineer hired to solve this problem, how would you save New Orleans?

Apply

Process Skills: describing and communicating

15. Instruct students to complete one of the following:
    a. Research the coastal regions around Skagway and Juneau. What makes those coastal regions different or the same as the Mississippi delta area? Why are they rising? Write a report on your findings.
    b. Research and incorporate knowledge of barrier islands and coastal wetlands to the New Orleans problem. Be able to recognize and give examples of natural and human activities that affect wetlands. Add them to your model and simulate a hurricane. In your science journal, explain how gas and oil development might affect a delta.

Teacher Background:

New Orleans is a city below sea level. The shifting land is about 250 miles long and 180 miles wide, encompassing the delta of the Mississippi, which was built up from river deposits over the last 8,000 years. Most scientists agree that subsidence, or sinking, has taken place. As sediment accumulates and the delta thickens, the crust of Earth gets pressed down. It is also thought that by damming the river and diverting channels, new sediment is not being laid down. Levees protecting the city are also changing the water and sediment movement. Other scientists believe that faults are breaking away in the bedrock under the weight of sediment. Scientists also recognize human impacts as oil, gas and groundwater are pumped out from beneath the delta. Sea levels are rising, dams are being built to control the river, and levees are constructed between the city and the ocean. There is also oil drilling off the coast, causing long troughs dug in the ocean floor, which has a negative impact on the wetlands in the delta. Wetlands and barrier islands are natural protection against storms. In 2005, Hurricane Katrina hit the coast, levees broke, and water poured into New Orleans, flooding much of the city; more wetlands were destroyed.

CAN YOU SAVE NEW ORLEANS?

RUBRIC

Assessment Task:

Write a letter to the city planner of your town (or another town with a river delta). Describe how a river creates a delta and at least one change that can occur in a delta over time. Explain what current effects the river is having on the city's delta. Make at least one prediction about the future of the city if nothing is changed. Provide the city planners with at least one suggestion and at least one strategy they can implement to protect the city from any problems identified.

Rubric:

Objective	GLE	Below Proficient	Proficient	Above Proficient
The student describes how a river creates a delta and what changes occur at the mouth of the river over time.	[9] SD1.2	The student describes how a river creates a delta, but is not able to describe how a river changes the delta over time.	The student describes how a river creates a delta and at least one change that can occur in the delta over time.	The student describes how a river creates a delta and at least two changes that occur in the delta over time.
The student makes predictions about the future of a city using knowledge about the effects a river is having on the city's delta.	[9] SA1.1	The student makes no predictions.	The student makes at least one prediction about the future of the city if nothing is done about the effects a river is having on the city's delta.	The student makes two or more predictions about the future of the city if nothing is done about the effects a river is having on the city's delta.
The student writes a letter to persuade city officials to take action to protect the city.	[9] W4.2.2	The student writes a letter that provides city planners with one suggestion or one strategy they can implement to protect the city from any problems identified. Spelling and grammar are incorrect.	The student writes a letter that explains what current effects the river is having on the city's delta and provides city planners with at least one suggestion and one strategy they can implement to protect the city from any problems identified. Spelling and grammar are correct.	The student writes a letter that explains what current effects the river is having on the city's delta and provides city planners with more than one suggestion and more than one strategy they can implement to protect the city from any problems identified. Spelling and grammar are correct.

CAN YOU SAVE NEW ORLEANS?

STUDENT WORKSHEET

Members of Group_____
Your Name_____
Date_____

Your Prediction	How the River Changed When it Rained	Effect of Change On Town	Changes Made to Model to Protect the Town