Watershed Activity 3

Region: Eastern Coastlines

Grade Level(s): 5-8

Time Required: One 45-minute class period

Learning Objectives:

- The students will be able to describe how changes in water level distribute over different land features.

Materials:

- Model habitats prepared in Activity #1
- Clear acetate pages for students to write on
- Grease pencils or overhead markers – one per student team
- Tracing paper
- A source of water
- One watering can with a sprinkle opening or other water pouring container per student team
- Topographic map of the Chesapeake Bay region (these can be obtained from USGS)

Background:

- Shaped for thousands of years by the crashing waves and weather of the Atlantic Ocean, the eastern coastline has developed wonderfully diverse landscapes set in equally varied climates. From warmer tropical ecosystems such as Florida's beaches, barrier islands, bays, estuaries, and tidal marshes, to the colder reaches and rocky coastline of Maine, each of these landscapes has its own set of plants and animals that call these places home. These varied landscapes have developed through a combination of processes. As the sea level continues to rise due to melting of continental glaciers left by the Ice Age and the effects of climate change, most of the eastern coastal region has experienced, and continues to experience, submergence. At the same time, rivers and streams deposit sediment surrounding their mouths as they open to the ocean. In addition, the harsh waves of the Atlantic Ocean, which are weakened by the wide continental shelf jutting out into the ocean, slow and deposit the sediment that they carry near the shoreline. Thus, as glaciers melt, the ocean rises, and sediments are deposited along the shoreline. These processes have been happening concurrently for thousands of years and have marked the eastern shoreline by thick deposits of sediment and sea level rise. Those who live along this coastline must cope with its unique environmental issues. Low-lying land juxtaposed with the vast Atlantic Ocean leads to issues of flooding and erosion. These issues are compounded by the effects of climate change.

Procedures/Instructional Strategies:

1. Using the model habitats the students prepared in Activity #1, have students pour exactly 1 cm of water into the "Chesapeake Bay" part of the model (up to the first line on the inside of the basin).

2. Close the lid over the model, and have students tape a piece of clear acetate to the lid. The students will use grease pencils or overhead markers to draw on the acetate.

3. By looking through the top of the lid, have the students draw a contour line on the acetate wherever the water touches the land. Mark this line as "zero altitude" (sea level).
    - Repeat this procedure with 2 cm of water in the basin, marking the second contour line as 68.28 meters or 224 feet.
    - Repeat this procedure with 3 cm of water marking the third contour line as 136.56 meters or 448 feet.
    - Continue adding one cm of water at a time, marking the appropriate units on the contour lines, until the mountain is covered with water and no more contour lines can be drawn. Each contour line equals an additional 68.28 meters or 224 feet of elevation.

4. Have the students remove the acetate pages from the lid. Have the groups place tracing paper over the acetate to trace the contour lines so that each student has a copy of the data. They will use their contour map to answer questions on the data and analysis sheet.

5. Have the students empty the water out of their model habitats.

6. Show the students a topographic map of the Chesapeake Bay region. These maps may be obtained from the U.S. Geological Survey (USGS).
    - Point out that the blue area is the water, but all the land that extends out to the highest point on the topographic map is the watershed. Note how much bigger the land area is that drains into the water than the actual water itself. This means that people far away from the Bay are impacting its water.
    - Point out the spread-out contours around the Bay and lead the students to discovering how level the land is.

7. Evaluate students with the following questions, and have them attach their land contour map to their answers:
    - Describe how the pattern of contour lines models the landscape.
      (The lines make circular patterns indicating mountains and V-shaped patterns in valleys. The lines are nearly parallel along the coast.)
    - What do lines that are close together indicate?
      (The land is steeper where the lines are closer together.)
    - What do lines that are far apart indicate?
      (The land is flatter where the lines are far apart.)
    - What part of the land is the lowest?
      (The shoreline of the Bay is the lowest point. This is "sea level".)

National Science Education Standards:

Earth Science

- Water is a solvent. As it passes through the water cycle it dissolves minerals and gases and carries them to the oceans.
- Living organisms have played many roles in the earth system, including affecting the composition of the atmosphere, producing some types of rocks, and contributing to the weathering of rocks.
- The sun is the major source of energy for phenomena on the earth's surface, such as growth of plants, winds, ocean currents, and the water cycle. Seasons result from variations in the amount of the sun's energy hitting the surface, due to the tilt of the earth's rotation on its axis and the length of the day.

Science and Technology

- Science and technology are reciprocal. Science helps drive technology, as it addresses questions that demand more sophisticated instruments and provides principles for better instrumentation and technique. Technology is essential to science, because it provides instruments and techniques that enable observations of objects and phenomena that are otherwise unobservable due to factors such as quantity, distance, location, size, and speed. Technology also provides tools for investigations, inquiry, and analysis.
- Technological designs have constraints. Some constraints are unavoidable, for example, properties of materials, or effects of weather and friction; other constraints limit choices in the design, for example, environmental protection, human safety, and aesthetics.

Science in Personal and Social Perspectives

- When an area becomes overpopulated, the environment will become degraded due to the increased use of resources.
- Internal and external processes of the earth system cause natural hazards, events that change or destroy human and wildlife habitats, damage property, and harm or kill humans. Natural hazards include earthquakes, landslides, wildfires, volcanic eruptions, floods, storms, and even possible impacts of asteroids.
- Human activities also can induce hazards through resource acquisition, urban growth, land-use decisions, and waste disposal. Such activities can accelerate many natural changes.
- Natural hazards can present personal and societal challenges because misidentifying the change or incorrectly estimating the rate and scale of change may result in either too little attention and significant human costs or too much cost for unneeded preventive measures.
- Risk analysis considers the type of hazard and estimates the number of people that might be exposed and the number likely to suffer consequences. The results are used to determine the options for reducing or eliminating risks.
- Students should understand the risks associated with natural hazards (fires, floods, tornadoes, hurricanes, earthquakes, and volcanic eruptions), with chemical hazards

(pollutants in air, water, soil, and food), with biological hazards (pollen, viruses, bacterial, and parasites), social hazards (occupational safety and transportation), and with personal hazards (smoking, dieting, and drinking).

- Individuals can use a systematic approach to thinking critically about risks and benefits. Examples include applying probability estimates to risks and comparing them to estimated personal and social benefits.
- Important personal and social decisions are made based on perceptions of benefits and risks.
- Science influences society through its knowledge and world view. Scientific knowledge and the procedures used by scientists influence the way many individuals in society think about themselves, others, and the environment. The effect of science on society is neither entirely beneficial nor entirely detrimental.
- Societal challenges often inspire questions for scientific research, and social priorities often influence research priorities through the availability of funding for research.
- Science cannot answer all questions and technology cannot solve all human problems or meet all human needs. Students should understand the difference between scientific and other questions. They should appreciate what science and technology can reasonably contribute to society and what they cannot do. For example, new technologies often will decrease some risks and increase others.
- Scientists formulate and test their explanations of nature using observation, experiments, and theoretical and mathematical models. Although all scientific ideas are tentative and subject to change and improvement in principle, for most major ideas in science, there is much experimental and observational confirmation. Those ideas are not likely to change greatly in the future. Scientists do and have changed their ideas about nature when they encounter new experimental evidence that does not match their existing explanations.
- In areas where active research is being pursued and in which there is not a great deal of experimental or observational evidence and understanding, it is normal for scientists to differ with one another about the interpretation of the evidence or theory being considered. Different scientists might publish conflicting experimental results or might draw different conclusions from the same data. Ideally, scientists acknowledge such conflict and work towards finding evidence that will resolve their disagreement.
- It is part of scientific inquiry to evaluate the results of scientific investigations, experiments, observations, theoretical models, and the explanations proposed by other scientists. Evaluation includes reviewing the experimental procedures, examining the evidence, identifying faulty reasoning, pointing out statements that go beyond the evidence, and suggesting alternative explanations for the same observations. Although scientists may disagree about explanations of phenomena, about interpretations of data, or about the value of rival theories, they do agree that questioning, response to criticism, and open communication are integral to the process of science. As scientific knowledge evolves, major disagreements are eventually resolved through such interactions between scientists.

Additional Resources:

- U.S. Geological Survey
  http://www.usgs.gov
- Watershed Workbook

http://www.nps.gov/anac/forteachers/upload/watershedkit.doc

- Wetland Education through Maps and Aerial Photography
  http://www.wetmaap.org/index.html
- Sea Level Rise Maps and GIS Data
  https://www.cresis.ku.edu/research/data/sea_level_rise/index.html
- Chesapeake Bay Seminar Series
  http://ian.umces.edu/seminarseries/
- "An Earth Day Perspective: NASA Satellites Aid in Chesapeake Bay Recovery", April 22, 2008
  http://www.nasa.gov/topics/earth/features/chesapeake.html