



NATURAL HAZARDS ASSESSMENT LESSON PLAN

Do You Want to Risk It?

Theme

Hurricanes

Links to Overview Essays and Resources Needed for Student Research

<http://oceanservice.noaa.gov/topics/coasts/assessment/>

<http://www.csc.noaa.gov/rvat/hazid.html>

Subject Area

Earth Science/Physical Science

Grade Level

9-12

Focus Question

How can coastal residents plan for the potential effects of natural hazards?

Learning Objectives

- Students will define, compare and contrast the terms “risk” and “vulnerability.”
- Students will determine the history of natural disaster events for a given community.
- Students will discuss the relative risk from natural hazard events for selected communities based on the history of such events.
- Students will discuss the impact of population increase on risk from natural hazards.

Materials Needed

- Copies of “Coastal Hazards Vulnerability Assessment Worksheet,” one copy for each student group
- (optional) Computers with internet access; if students do not have access to the internet, download copies of materials

cited under “Learning Procedure” and provide copies of these materials to each student group

Audio/Visual Materials Needed

None

Teaching Time

One or two 45-minute class periods, plus time for student research

Seating Arrangement

Groups of 3-4 students

Maximum Number of Students

30

Key Words

Natural hazard
Hurricane
Risk
Vulnerability

Background Information

Almost half of the people living in the United States live near the coast and the numbers are increasing. As the coastal population continues to grow, more people and property are exposed to hazards caused by hurricanes, tsunamis, shoreline erosion and other natural hazards. Homes and businesses are often built in low-lying areas and on barrier islands that are particularly vulnerable to these hazards. The potentially disastrous consequences of this trend became obvious during the summer of 2004 when residents of Florida were battered by four major hurricanes within six weeks, resulting in billions of dollars’ worth of damage. Similar consequences made global headlines in August of 2005 when Hurricane Katrina wrought havoc on Gulf Coast communities in Alabama, Louisiana, and Mississippi. Much of the cost of these events is eventually borne by American taxpayers through federal government funds for for disaster relief and reconstruction.

These disasters emphasize the importance finding more effective ways to reduce the negative environmental, social, and economic impacts of natural hazards on coastal communities. To assist these efforts, NOAA's National Ocean Service provides essential information on natural hazards to government agencies and members of the general public concerned with lowering the risks associated with natural hazards. This information includes training, methods for assessing vulnerability to natural hazards, and tools that can be used to forecast threats such as floods and harmful algal blooms.

In this lesson, students will use some of NOAA's online resources to make inferences about the relative vulnerability of coastal communities to selected natural hazards.

Learning Procedure

1.

To prepare for this lesson:

- Review information on the NOS Natural Hazards Assessment program (<http://oceanservice.noaa.gov/topics/coasts/assessment/>), as well as the process described on the "Coastal Hazards Vulnerability Assessment Worksheet" found at the end of this lesson plan. You may also want to review information about formal Risk and Vulnerability Assessment (<http://www.csc.noaa.gov/rvat/hazid.html>), though this is a more involved process than students will use for this lesson.
- Make copies of the "Coastal Hazards Vulnerability Assessment Worksheet."
- If students do not have internet access, download information for the selected coastal communities as described on the Worksheet.

2.

Briefly review the issue of coastal hazards. You may want to show some headlines from the 2004 and 2005 hurricanes in Florida and the U.S. Gulf Coast (your school or community library probably has back issues of weekly news magazines that could be used for this). Discuss the types of natural hazards that may pose a risk to coastal communities. The list should include hurricanes, floods, tsunamis, and earthquakes. Be sure students

understand that increasing population in coastal communities means that an increasing number of people and their property are potentially threatened by these hazards.

Some of sources may refer to the “100-year flood plain.” Storms are sometimes characterized by how often a storm having a specific severity is expected to occur. A “100-year storm” would be a storm having a severity that is expected to occur only once every 100 years (in other words, an extremely severe storm). So, a “100-year flood plain” represents the area that would be flooded by a storm having this severity.

Discuss the concepts of “risk” and “vulnerability.” “Risk” is generally used as a measure of the likelihood of being exposed to a particular hazard. “Risk areas” are geographic regions that have a certain probability of being exposed to a given hazard. People and resources located within risk areas are considered to be “at risk” from this hazard. “Vulnerability” is a measure of the likelihood that people and/or resources will be negatively impacted by a given hazard. So, people living in a coastal community might all be at risk of being exposed to a hurricane, but their vulnerability to negative impacts could vary significantly depending upon the extent to which they were prepared to cope with this risk.

3.

Tell students that their assignment is to obtain information about natural hazards that may pose a risk to a specific coastal community, and to make inferences about the relative risk of that community compared to other communities. Distribute copies of the “Coastal Hazards Vulnerability Assessment Worksheet” to each student group. Assign each group one of the following communities (or select other communities that may be particularly relevant to your students):

- Biloxi, MS (Harrison County)
- Charleston, SC (Charleston County)
- Mobile, AL (Mobile County)
- New Orleans, LA (Plaquemines Parish)
- Panama City, FL (Bay County)
- Wilmington, NC (New Hanover County)

Have each group obtain the information described on the Worksheet for their assigned community, and prepare a written report summarizing the results of their research.

4.

Have each group present an oral summary of their results. When all groups have presented results for their assigned communities, each student or student group should prepare a written statement about the relative risk of their assigned community compared to the other communities. Lead a discussion of students' data and inferences. The following points should be included:

Biloxi, MS (Harrison County)

- Approximate portion of community within the “100-year flood plain:”
There are no data on the ESRI/FEMA map for Biloxi. Less than 10% of the surrounding portion of Harrison County is within the 100-year flood plain.
- Natural hazard events experienced since 1970:
2 tornadoes, Fujita magnitude 1
1 windstorm, 60-80 mph; 1 windstorm, 80-100 mph
2 hurricanes, category 3, 1 hurricane category 4
- Hurricanes category 3 or stronger:
Hurricane Frederic, category 4 1979;
Hurricane Elena, category 3 1985
Hurricane Ivan, category 3 2004
- Trend in frequency of hazard events:
major hurricane every 6-9 years since 1970
- Population trend since 1970:
increasing; about 135,000 to 188,000 during this period

Charleston, SC (Charleston County)

- Approximate portion of community within the “100-year flood plain:”
more than half

- Natural hazard events experienced since 1970:
 - 9 earthquakes; 2 magnitude 5-6, 2 magnitude 3-4,
4 magnitude 2-3
 - 2 windstorms, 80-100 mph
 - 1 hailstorm, 2-4 inches
 - 1 hurricane, category 4
- Hurricanes category 3 or stronger:
 - Hurricane Hugo, category 4 1989
- Trend in frequency of hazard events:
 - none evident
- Population trend since 1970:
 - increasing; about 245,000 to 310,000 during this period

Mobile, AL (Mobile County)

- Approximate portion of community within the “100-year flood plain:”
 - more than half
- Natural hazard events experienced since 1970:
 - 1 windstorm, 80-100 mph
 - 1 hailstorm, 2-4 inches
 - 3 hurricanes, category 3; 1 hurricane, category 4
- Hurricanes category 3 or stronger:
 - Hurricane Frederic, category 4 1979;
 - Hurricane Elena, category 3 1985
 - Hurricane Opal, category 3 1995
 - Hurricane Ivan, category 3 2004
- Trend in frequency of hazard events:
 - major hurricane every 6-10 years since 1970
- Population trend since 1970:
 - increasing; about 315,000 to 395,000 during this period

New Orleans, LA (Plaquemines Parish)

- Approximate portion of community within the “100-year flood plain:”
 - almost all

- Natural hazard events experienced since 1970:
 - 5 tornadoes, Fujita magnitude 1
 - 1 windstorm, 60-80 mph; 5 windstorms, 80-100 mph;
 - 1 windstorm 100-120 mph
 - 2 hailstorms, 2-4 inches; 1 hailstorm, 4-6 inches
 - 1 hurricane, category 3
- Hurricanes category 3 or stronger:
 - Hurricane Elena, category 3 1985
- Trend in frequency of hazard events:
 - none evident
- Population trend since 1970:
 - slowly increasing, about 25,000 to 26,500 during this period

Panama City, FL (Bay County)

- Approximate portion of community within the “100-year flood plain:”
 - about 25%
- Natural hazard events experienced since 1970:
 - 1 tornado, Fujita magnitude 1
 - 2 hurricanes, category 3
- Hurricanes category 3 or stronger:
 - Hurricane Eloise, category 3 1975
 - Hurricane Elena, category 3 1985
- Trend in frequency of hazard events:
 - none evident
- Population trend since 1970:
 - increasing, about 74,000 to 147,000 during this period

Wilmington, NC (New Hanover County)

- Approximate portion of community within the “100-year flood plain:”
 - very little

- Natural hazard events experienced since 1970:
 - 2 windstorms, 60-80 mph; 1 windstorm 80-100 mph
 - 1 hailstorm, 2-4 inches
 - 2 hurricanes, category 3; 1 hurricane category 4
- Hurricanes category 3 or stronger:
 - Hurricane Diana, category 3 1984
 - Hurricane Fran, category 4 1996
 - Hurricane Bonnie, category 3 1998
- Trend in frequency of hazard events:
 - 3 major hurricanes since 1984
- Population trend since 1970:
 - increasing, about 80,000 to 160,000 during this period

Ask students which of these communities faces the greatest risk from the natural hazards listed on the worksheet. Charleston and New Orleans experienced the greatest total number of natural hazard events since 1970. But these events consisted primarily of relatively low magnitude earthquakes and windstorms respectively; both communities only experienced one major hurricane during this period. Biloxi, Mobile, and Wilmington (on the other hand) have all experienced three major hurricanes since 1970. Mobile has a much larger population than the other two, and a greater portion of this community lies within the “100-year flood plain.” These considerations might suggest that of the six communities investigated, Mobile is at greatest risk from the natural hazards considered. It is also worth noting, however, that the population of Wilmington and Panama City doubled since 1970; a trend that means increasing numbers of people are at risk from natural hazards.

It is also worth noting that New Orleans had the smallest population of the six communities investigated as well as the smallest rate of population increase (only about 6% since 1970). The significance of the fact that most of New Orleans is within the 100-year flood plain was dramatically demonstrated by Hurricane Katrina. The latter experience also shows that a scarcity of hurricanes over a 35-year period does not necessarily serve as a reliable indicator of future events. In this case, “it only takes one.”

Ask students to discuss what measures could be taken to reduce vulnerability to natural hazards. You may want to have students research appropriate preparation and response for selected hazards, particularly if students' own communities are at risk from one or more of these hazards.

The Bridge Connection

<http://www.vims.edu/bridge/> – In the “Site Navigation” menu on the left, click on “Ocean Science Topics,” then “Atmosphere,” then the “Storms” link on the “Climate and Atmosphere” page for links to information and activities related to a variety of coastal hazards including flooding, erosion, hurricanes, and tsunamis.

The Me Connection

Have students write a brief essay describing the extent to which potential risk from natural hazards might influence their choice of a community in which to live, and which natural hazards they consider to be most dangerous to residents.

Extensions

1. Use information on risk and vulnerability assessments (RVAs) at <http://www.csc.noaa.gov/rvat/hazid.html> to develop a detailed RVA for a selected community.
2. Have students research what might be done to reduce vulnerability to selected natural hazards (see, for example, www.csc.noaa.gov/products/tsunamis/html/cascadia/mitigate.htm).

Resources

http://www.educationworld.com/a_lesson/lesson/lesson015.shtml

– Education World article with ideas and Web links for hurricane-related classroom activities

<http://www.miamisci.org/hurricane/index.html> — Miami Museum of Science Web page, “Hurricane: Storm Science,” including how storms happen, how storms are tracked, and how to make a weather station

<http://www.cln.org/themes/hurricanes.html> – The Community Learning Network’s Hurricanes Theme Page with links to curricular resources and instructional materials (lesson plans) on the topic of hurricanes

<http://hurricane.csc.noaa.gov/hurricanes/pop.jsp> — NOAA’s Coastal Services Center Coastal Population Tool

<http://www.esri.com/hazards/> – Online Hazard Maps produced through a partnership between the Federal Emergency Management Agency and Environmental Systems Research Institute to assist in building disaster resistant communities across the country by sharing geographic knowledge about local hazards

National Science Education Standards

Content Standard B: Physical Science

- Motions and forces

Content Standard D: Earth and Space Science

- Energy in the Earth system

Content Standard E: Science and Technology

- Abilities of technological design
- Understandings about science and technology

Content Standard F: Science in Personal and Social Perspectives

- Personal and community health
- Population growth
- Natural resources
- Environmental quality
- Natural and human-induced hazards
- Science and technology in local, national, and global challenges

Links to AAAS “Oceans Map” (aka benchmarks)

5D/H2 – Like many complex systems, ecosystems tend to have cyclic fluctuations around a state of rough equilibrium. In the long run, however, ecosystems always change when climate changes or when one or more new species appear as a result of migration or local evolution.

5D/H3 – Human beings are part of the Earth’s ecosystems. Human activities can, deliberately or inadvertently, alter the equilibrium in ecosystems.



NATURAL HAZARDS ASSESSMENT WORKSHEET

Coastal Hazards Vulnerability Assessment Worksheet

In this exercise, you will use historical information about natural hazards that have impacted a coastal community to make inferences about the risk of that community to future exposure to these hazards. Use the following tools to obtain information about your assigned community:

- National Ocean Service Coastal Population Tool
(<http://hurricane.csc.noaa.gov/hurricanes/pop.jsp>)
- Online Hazard Maps prepared by Environmental Systems Research Institute and Federal Emergency Management Agency (<http://www.esri.com/hazards/>)
- NOAA Historical Hurricane Tracks tool
(<http://hurricane.csc.noaa.gov/hurricanes/viewer.html>)

Answer the following questions about your assigned community:

1. Approximately how much of this community is within the “100-year flood plain?” [Hint: use the ESRI/FEMA Online Hazard Maps Web site]
2. What natural hazard events have been experienced by this community since 1970, and what was the magnitude of these events? Consider earthquakes, hail storms, wind storms, tornadoes, and hurricanes. [Hint: you can change the topic of an ESRI/FEMA Online Hazard Map by scrolling down the “Current Map View” box on the left side of the page, then clicking the “Change View” button. If you click the “Make New Map” button you will be taken back to the page on which you specify the community to be mapped.]

3. What was the name and year of occurrence for any hurricane of category 3 or stronger?
4. Does there seem to be any trend in how often these hazards occur?
5. What is the population trend in this community since 1970?