**Science**
**California Institute of Technology / US Dept of the Interior / US Geological Survey**

## Land and People: Finding A Balance

**Time** As needed to complete desired sections **Grades** 7-12

**California Science Standards**
Grade 7
Investigation and Experimentation
7b. Use a variety of print and electronic resources (including the World Wide Web) to collect information and evidence as part of a research project.
7c. Communicate the logical connection among hypotheses, science concepts, tests conducted, data collected, and conclusions drawn from the scientific evidence.
7d. Construct scale models, maps, and appropriately labeled diagrams to communicate scientific knowledge
**Earth Science**
4a. Students know Earth processes today are similar to those that occurred in the past and slow geologic processes have large cumulative effects over long periods of time.

Grade 8
Investigation and Experimentation
9a. Plan and conduct a scientific investigation to test a hypothesis.
9b. Evaluate the accuracy and reproducibility of data.
9c. Distinguish between variable and controlled parameters in a test.
9e. Construct appropriate graphs from data and develop quantitative statements about the relationships between variables.
9f. Apply simple mathematic relationships to determine a missing quantity in a mathematic expression, given the two remaining terms (including speed = distance/time, density = mass/volume, force = pressure x area, volume = area x height).
9g. Distinguish between linear and nonlinear relationships on a graph of data.

Grades 9–12
Earth Science
3a. Students know features of the ocean floor (magnetic patterns, age, and sea-floor topography) provide evidence of plate tectonics.
3b. Students know the principal structures that form at the three different kinds of plate boundaries.
3c. Students know how to explain the properties of rocks based on the physical and chemical conditions in which they formed, including plate tectonic processes.
3d. Students know why and how earthquakes occur and the scales used to measure their intensity and magnitude.
6a. Students know weather (in the short run) and climate (in the long run) involve the transfer of energy into and out of the atmosphere.
6b. Students know the effects on climate of latitude, elevation, topography, and proximity to large bodies of water and cold or warm ocean currents.
6c. Students know how Earth's climate has changed over time, corresponding to changes in Earth's geography,
9a. Students know the resources of major economic importance in California and their relation to California's geology.

9b. Students know the principal natural hazards in different California regions and the geologic basis of those hazards.
9c. Students know the importance of water to society, the origins of California's fresh water, and the relationship between supply and need.
9d. Students know how to analyze published geologic hazard maps of California and know how to use the map's information to identify evidence of geologic events of the past and predict geologic changes in the future.
Investigation and Experimentation
1a. Select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data.
1d. Formulate explanations by using logic and evidence.
1f. Distinguish between hypothesis and theory as scientific terms.
1h. Read and interpret topographic and geologic maps.

**Indicators of Achievement**

- Student successfully explores the unique geology of the Los Angeles area
- Student understands the area's natural hazards and explores how human impact on the environment increases the effects of these hazards
- Student learns how to use a variety of maps (geologic, topographic) to answer questions about safety risks.
- Student creates a presentation discussing what he/she believes are the most serious geologic and hydrologic hazards in the La Crescenta area, how those hazards affect school children, and whether the schools should be left where they are, closed, or relocated. provides justification for their analysis, based upon the information received during the unit of study, their understanding of geologic and hydrologic hazards, and the lessons they learned as they completed the activities assigned.

**Materials**

A packet of the Land and People student materials for each student and one Teacher Packet (easily copied from the second web site below); a topographic map of model area (Teacher Packet, page 4) for each group; thick cardboard boxes, scissors, tracing paper, glue

**Resources**

Our Changing World
http://interactive2.usgs.gov/learningweb/teachers/lesson_plans.htm#changingworld

Land and People: Finding a Balance (grades 7-12)
http://interactive2.usgs.gov/learningweb/teachers/landpeople.htm
Land and People: Finding a Balance is an environmental study project that engages high school students in studying earth science resource issues. The project focuses on the interaction between people and the environment in three regions of the United States: Cape Cod, Los Angeles, and the Everglades. Each section of this project is devoted to one of the three regions. The La Crescenta materials available on this web site contain everything needed to make a curriculum packet for teacher and students to complete this project. See “How to Use This Packet” later in this document.

**Vocabulary**

topographic, geologic, hydrologic

**Introduction**

The La Crescenta project in the curriculum packet asks students to consider the following Focus Question: You and your classmates are members of a La Crescenta civic group that has been formed to evaluate the safety of your community's school children in the event of the following geologic and hydrologic hazards: earthquakes, and landslides (including mud and debris flows). Using the maps, tables, and other information in this packet, your job is to present the study of geologic hazards to children that attend the following schools: Monte Vista School, Valley View School, and Rosemont Junior High School. Once your group has discovered what the hazards are, you will decide whether school children are safe attending the three schools in their present locations, or if new sites for the schools must be found. Your group will make a presentation at a La Crescenta "community meeting" in which you will describe your analysis about how the community can guarantee children's safety during school.

**Preparation / Background**

Students often have difficulty visualizing topography from two-dimensional contour maps. In the following activity, students will build a topographic model of Shields Canyon and the area south into La Crescenta. They will be able to see and feel the steep slopes in the area and the sharp change in topography from the San Gabriel Mountains to the nearly flat valley where the population is concentrated. “Building a Topographical Model” describes a preparatory lesson to be completed and assessed before beginning the activity packet described in the materials section and at the end of this lesson.

Building a Topographic Model

1. Begin by deciding what kinds of models the students will create. They could work in groups to construct models by using different vertical exaggerations (2:1, 4:1, 1:1) or, you may want to divide the map into smaller areas and have each group construct a model of an area. After constructing the individual models, students would then assemble the models and create a model of the entire area.

2. You may want to invite your students to devise their own method of making a three-dimensional representation of the area. They may want to use modeling clay, Styrofoam, or sheets of acrylic. The model-making activity explained below uses heavy cardboard.

3. After deciding what area students will create a model of, explain the model-building process to the students. They will begin by tracing the outlines created by individual contour lines, starting with the lowest elevation. Using the traced shape as a template, students will then cut out cardboard to match the shape. Students will trace each subsequent (and higher) contour, reproduce the shape in cardboard, and stack it on top of the last cardboard shape. Students should glue each piece in place. They will need to refer to the topographical map to see how to place each layer of cardboard.
4. Once they have built the models, have the students compare the topographic map to their model. Comparing the model to the map will help students see that when the topography is steep, the contour lines are close together. When the topography is relatively flat, the contour lines are far apart. Ask students if the model surprises them in any way. Ask students to focus on the Shields Canyon area. Can they now see why in Shields Canyon the contour lines make upside down v's.

5. Ask students a variety of questions that will help them interact with the model. Have them place markers on the map to represent the schools in the focus question. Ask them to indicate the necessary path of a debris flow.

6. Have students locate the debris retention basins on their models. Ask students to consider the following questions:
    - ß Why were the basins placed where they are?
    - ß What areas do the basins protect?
    - ß What developed areas are not protected by a debris-retention basin?

7. Have students measure the slopes in their model area by using the clinometer they constructed in Activity 1 or a contact goniometer. How do the slopes in the model compare with the slopes of their sand castles? If the slopes in the model are steeper than the ones in the sand castle, ask students to explain why.

8. Display the models prominently during this unit. Have students refer to the models as they answer the Focus Question.

**Assessment**
Evaluate the student's topographical model. Did the student successfully complete the according to directions given by the teacher? Is the student able to use the model as a reference in answering questions such as those in number 6 above?

**Extension**
- Students could construct a series of topographic profiles, which are perpendicular, then connect the profiles.
- Students could pick new sites for debris retention basins that would protect development upstream, from existing basins.

**For the Teacher: How to Use This Packet**
The Teaching Guide provides an overview of the project as well as a list of references for teachers, by region. The references cited in this list were used as background information for the sections of the Packet.

The poster presents a variety of visual images from each region with explanatory text about each one. Use the poster to begin a general discussion about human impact on the environment as well as to discuss the specific consequences of human actions in each region.

Each section contains a set of student materials and a set of teacher materials for either Cape Cod, the Everglades, or Los Angeles. Each section is divided into two parts: "For the Student" and "For the Teacher." The student materials present students with a Focus Question to answer and also provide them with several types of information they should use to answer the question. Student materials include some or all of the following:
- a reading about the region
- a description of the "Interested Parties" so students can role-play as they answer the Focus Question
- maps
- population data
- geologic information
- water use data

- photographs

The teacher materials include a brief explanation of what students will learn as they work on answering the Focus Question and a description of what form their answer might take. The teacher materials also present three Activities that will help students answer the Focus Question. Each Activity clearly describes what students will need to complete the Activity, explains the procedure, and in some cases, suggests extension activities. Any maps or other information students will use to complete the Activities are included in the teacher materials.

The sections can be studied in any order. A class could complete all three sections or just one. The sections can be used in whole or in part. Students might read the entire set of student materials for a region then complete all the Activities in the teacher materials, or just complete selected Activities.

Each student will need a copy of the student materials. These materials are designed to be photocopied clearly and easily. Students will also need copies of the maps and other data that accompany the Activities in the teacher materials.

**References, Los Angeles**

Cooke, R.U. *Geomorphological Hazards in Los Angeles (London research series in geography)* George Allen & Unwin, Winchester, MA, 1984.

Gore, Rick, 1995 *Living With California's Faults*, National Geographic Magazine, vol. 187, no. 4, p. 2-35 (with double map supplement, Earthquakes).

National Geographic Society, 1997, Restless Earth, *Nature's Awsome Powers:* National Geographic Society, Washington, D.C.

*Recent Reverse Faulting in the Transverse Ranges, California.* U.S. Geological Survey Professional Paper 1339, 1987.

Troxell, Harold C., and Peterson, John Q., 1937, *Flood in La Canada Valley, California:* U.S. Geological Survey, Water Supply Paper 796-C, p. 53-98.

Ziony, J.I., editor, 1985. *Evaluating Earthquake Hazards in the Los Angeles Region - An Earth-Science Perspective*. U.S. Geological Survey Professional Paper 1360.

**Contact and Field Trip Information**

The USGS Learning Web
http://www.usgs.gov/education/

Earthquakes for Kids:
http://earthquake.usgs.gov/4kids/

Ask a Geologist:
http://walrus.wr.usgs.gov/ask-a-geologist/

Field trip information:
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