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

Earth As Home: "An Island Home"

Time: 45 to 60 minutes for 2 or 3 days **Grades** 4-6

California Science Standards
Grade 4
Earth Science
5a. Students know some changes in the earth are due to slow processes, such as erosion, and some changes are due to rapid processes, such as landslides, volcanic eruptions, and earthquakes.
5b. Students know natural processes, including freezing and thawing and the growth of roots, cause rocks to break down into smaller pieces.
5c. Students know moving water erodes landforms, reshaping the land by taking it away from some places and depositing it as pebbles, sand, silt, and mud in other places (weathering, transport, and deposition).
Investigation and Experimentation
6d. Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.
6f. Follow a set of written instructions for a scientific investigation.

Grade 5
Earth Science
3a. Students know most of Earth's water is present as salt water in the oceans, which cover most of Earth's surface.
3c. Students know water vapor in the air moves from one place to another and can form fog or clouds, which are tiny droplets of water or ice, and can fall to Earth as rain, hail, sleet, or snow.
3d. Students know that the amount of fresh water located in rivers, lakes, under-ground sources, and glaciers is limited and that its availability can be extended by recycling and decreasing the use of water.
Investigation and Experimentation
6f. Select appropriate tools (eg. thermometer, meterstick, balances, graduated cylinder) and make quantitative observations.
6g. Record data by using appropriate graphic representations (inc. charts, graphs, and label diagrams) and make inferences based on those data.

Grade 6
Earth Science
1a. Students know evidence of plate tectonics is derived from the fit of the continents; the location of earthquakes, volcanoes, and mid-ocean ridges; and the distribution of fossils, rock types, and ancient climatic zones.
1b. Students know Earth is composed of several layers: a cold, brittle lithosphere; a hot, convecting mantle; and a dense, metallic core.
1c. Students know lithospheric plates the size of continents and oceans move at rates of centimeters per year in response to movements in the mantle.
1d. Students know that earthquakes are sudden motions along breaks in the crust called faults and that volcanoes and fissures are locations where magma reaches the surface.

1e. Students know major geologic events, such as earthquakes, volcanic eruptions, and mountain building, result from plate motions.
1f. Students know how to explain major features of California geology (including mountains, faults, volcanoes) in terms of plate tectonics.
1g. Students know how to determine the epicenter of an earthquake and know that the effects of an earthquake on any region vary, depending on the size of the earthquake, the distance of the region from the epicenter, the local geology, and the type of construction in the region.
Physical Science
4a. Students know the sun is the major source of energy for phenomena on Earth's surface; it powers winds, ocean currents, and the water cycle.
4b. Students know solar energy reaches Earth through radiation, mostly in the form of visible light.
Investigation and Experimentation
7a. Develop a hypothesis.
7b. Select and use appropriate tools and technology (including calculators, computers, balances, spring scales, microscopes, and binoculars) to perform tests, collect data, and display data.
7c. Construct appropriate graphs from data and develop qualitative statements about the relationships between variables.
7d. Communicate the steps and results from an investigation in written reports and oral presentations.
7e. Recognize whether evidence is consistent with a proposed explanation.

Indicators of Achievement
Student understands the effects people can have on their natural environment.

Materials
For each group of three to five students: large physical map of the world,
graph paper, drawing paper, colored pencils, reference materials on rain forests and coral reefs (see “Resources” below)

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

Global Change (Grades 4-6)
http://interactive2.usgs.gov/learningweb/teachers/globalchange.htm

Earth as Home
http://interactive2.usgs.gov/learningweb/teachers/globalchange_earth.htm

Landau, Elaine, 1990, *Tropical rain forests around the world*: New York, Franklin Watts

Arnold, Caroline, 1988, A *walk on the Great Barrier Reef: Minneapolis*, Carolhoda Books, Inc.

Vocabulary
global environment, global change, chemical pollutants, ecological systems

Preparation/Background
The Earth is constantly changing. Weather and seasons are clear examples of regular changes in the global environment. Other changes are not as evident because they occur over intervals longer than a human lifetime or because the changes are not easily seen. Much of the change takes place on Earth is part of natural cycles. Human activity, however, can also cause environmental changes.

People are being asked to limit activities that change the environment, but before sensible limits can be adopted, we need information. Questions include:

- What are current environmental conditions and how are they changing?
- Are environmental changes caused by natural variation or by human activity, or both?
- How will local changes affect other parts of the Earth and its systems?

Scientists study global change to help answer these questions. The Earth is our home. We can take better care of our home when we better understand how it works and what changes it is undergoing. Before global change can be studied, we must be able to observe it. These images are evidence of Global Change.

"Suddenly from behind the rim of the Moon . . . there emerges a sparkling blue and white jewel, a light, delicate sky-blue sphere laced with slowly swirling veils of white, rising like a small pearl in a thick sea of black mystery. It takes more than a moment to fully realize this is Earth . . . home." - Edgar Mitchell, astronaut, USA, 1971

Since the Soviet Union launched the tiny satellite called Sputnik in 1957, hundreds of men and women and thousands of electronic "eyes" have looked back at Earth, capturing images that reveal certain effects of human activity on the Earth's natural systems. People have increased the use of air, water, and other natural resources by a factor of 10 in the last 200 years. This activity has in turn affected the atmosphere, the water cycle, and the climate, and has altered ecological systems. Scientists have begun to monitor these effects both from the ground and from space, to identify problems, as well as to predict the future health of the planet.

Earth is surrounded by a delicate envelope of air, part and product of life on the planet. Human beings have changed the composition of this atmosphere. Tons of carbon dioxide and methane, among other compounds, are added annually to the atmosphere from the burning of fossil fuels. These and other chemical pollutants raise concerns about the effects a changing atmosphere may have on life.

Most life on Earth owes its existence, directly or indirectly, to photosynthesis, the "greening" process by which plants convert sunlight, carbon dioxide, and soil nutrients to energy. Green plants cover much of Earth's land area, and microscopic plants known as phytoplankton inhabit its waters. More than 35 percent of the planet's surface is used, at least indirectly, for harvesting food and other materials.

Grazing, agriculture, and timber harvesting disturb topsoil, increasing soil erosion. More than 75 million tons of soil are blown or washed into the oceans each year. Natural ecosystems shrink in the face of society's need to use land. Fragmentation of many

ecosystems has created a series of ecological "islands." Some species, unable to survive in such reduced areas, become extinct.

Life requires water. On land, the amount and frequency of rainfall determine the success of crops, as well as the survival of natural ecosystems. It takes about 10 days, on average, for a drop of water that becomes airborne vapor in one place to return to Earth's surface as rain or snow in another. Precipitation varies by both season and geographic area. As one result, highly specialized ecosystems have developed, from deserts to rain forests.

In the event of global warming, regional rainfall patterns may shift. Similarly, the removal of forest cover may alter rainfall distribution because of reduced evaporation of water from plants. Changes in patterns of precipitation could have dramatic effects, positive or negative, on all life on Earth.

Throughout most of the Earth's history, Earth's systems have functioned unmonitored, but not unrecorded. Climate records can be found in the types of pollen in lake-bottom sediments; in the patterns of tree-ring growth; in air bubbles frozen in glaciers; in the growth rings of coral; and in many other places.

These records indicate that significant environmental changes have occurred throughout Earth's history. Even moderate changes in global temperature can freeze or melt significant amounts of fresh water, building or shrinking glaciers and the polar ice caps. This affects sea levels.

Inasmuch as 50 percent of the world's people live within 50 kilometers of the sea, the effects of even a moderate rise in sea levels, on the order of a meter or less, would be significant. This is one reason why understanding past climate changes, and their effects on plant and animal life, is crucial. Studies of past climates, then, can help determine what processes may have caused changes, giving us some clues as to which human activities might induce similar changes.

The environments surrounding marshes, dunes, and reefs can be unbalanced by many human activities such as fishing, building, highway construction, and the use of chemical fertilizers. Ecosystems weakened by such activity may not withstand major storms. Although occupying just 8 percent of the Earth's surface, these coastal environments produce 90 percent of the world's seafood.

Global environmental change concerns us all. Scientists are using instruments borne on satellites to gain new perspectives on previously unknown linkages between the Earth's land, air, and water. Monitoring, however, can only show that changes are taking place. Halting or reversing changes, if necessary, will test the will and the ingenuity of humankind.

Activity
The students will act as owners and developers of a lush, 14-square kilometer tropical island. Groups of students will select the forms and extent of development on their island by considering the benefits of the development and the risks their actions pose for the island and the planet.

1. Say to the class: Congratulations. You have just been awarded ownership of a tropical island in recognition of your concern for the environment and your wisdom in management. As owners of this island, you have some responsibilities.

2. First, it is important to create jobs for your fellow citizens. There is a native population living in thatch-roofed huts and subsisting on fish, fruit, and nuts. Second, you must develop your island as a model environment for business and for natural habitats.

3. The island is covered by virgin rainforest and is surrounded by well-developed coral reefs. Both of these types of ecological systems are in danger all over the world. The island is in your care. Consider your actions carefully.

4. Brainstorm the possible range of businesses that could be developed on a tropical island. A few suggestions to get the class thinking: Scuba diving resort; timber company; pharmaceutical research station; golf resort; naval base.

5. Write the students' suggestions on the board. Have them select a topic of interest.

6. Discuss the ways the outcomes of this project could be presented, for example: a scale map of the island using graph paper; a physical map of the island using white drawing paper, a brochure, with a map, advertising the company and island; a group report about the island and its efforts to protect the environment.

7. Form interest groups of three to five students. Provide resources from the suggested list or from your school library for discussions about the characteristics and importance of rain forest and coral reef ecosystems. Discuss rain forest destruction. What is the benefit? What are the immediate and long-term costs? Who pays?

8. Focus the students' thoughts on the business opportunities these environments offer and the risks associated with these enterprises in a fragile environment. Have students complete the third column on the following chart as they explore the impacts of their particular businesses. The chart can be duplicated to hand out.

9. Have each team report on the specific solutions that they propose to counter the risks presented by their development plans.

Assessment
Evaluate the student's island project. Does the student's project that contain all of the elements required in the assignment (see above)? Does the project demonstrate the student's understanding of the effects people can have on their natural environment?

Extensions/Homework
This exercise can be done using other environments including wetlands, deserts, polar regions, etc. Adjust the text of the story and the project requirements accordingly.

Ask teams of students what components would be necessary to create a habitable environment on another planet. What unique equipment and risks would have to be considered for such a project? For example, what would it take to transform an area on the planet Mars to make it acceptable for human habitation? (Mars has no ocean and four times the land area of the Earth.)

Groups of students can create a model of their island.

Contact 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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