

Focused Learning Lessons
Science
Grades 9-12
ESS-H-C5

Overview:

This lesson allows students to investigate changes in Earth systems that occur in both human and geologic timeframes. This lesson could be part of a lesson on coastal erosion in Louisiana, or it could be part of a larger study of environmental change.

Approximate Duration:

This lesson will take approximately one 45-minute class period.

Benchmark:

ESS-H-C5 explaining that natural processes and changes in the Earth system may take place in a matter of seconds or develop over billions of years

ES GLE: 22. Analyze data related to a variety of natural processes to determine the time frame of the changes involved (e.g., sedimentary rock layers, ash debris, species found in layers).

Benchmark:

SI-H-A3 using technology and mathematics to improve investigations and communications

SI GLE: 6. Use technology when appropriate to enhance laboratory investigations and presentations of findings.

Objectives:

1. The learner will examine evidence of earth system processes and changes that took place in several different time frames
2. The learner will give examples of earth system processes that happened in different time frames

Teacher Preparation:

Interactions among the solid Earth, the oceans, the atmosphere, and organisms may occur instantaneously, on a human time scale, over thousands, millions, or even billions of years. Although a volcanic eruption or a tornado may produce immediate, violent changes in an Earth system, the slow movement of lithospheric plates is also a natural process. Some processes, like coastal erosion in Louisiana, can be observed in a single lifetime. Others, like the migration of the Mississippi River Delta, take dozens of lifetimes. Each contributes to the recycling of earth materials and most leave a record of what occurred for scientists to discover and interpret. In this activity, learners will construct a chart listing changes and processes in the Earth system that take place on different time scales, from requiring only seconds to millions of years.

This lesson provides learners with an opportunity to examine evidence or data from Earth processes or changes that occur in very different time frames, from seconds or less, to millions or even billions of years. The activity is designed for groups of 3-4 learners, but individual learners can complete this activity if necessary.

In preparation, the teacher will need to link to each of the websites in the reference section, download and print one copy of each image. There are twelve different images. This will accommodate up to ten groups of learners, leaving two additional images to use in the opening of the lesson.

Placing each image or data sheet in a clear sheet protector is recommended, but not required.

Materials/Equipment/Resources:

- pencils, pens,
- markers, or color pencils (optional)
- downloaded images (see Reference Links for image sources)
- newspaper or magazine pictures, and/or an Earth Science textbook for each group (optional)

Lesson Procedures:

Set or Opener:

The teacher can introduce the activity by asking learners to make a list of five events they remember from childhood. Then ask learners to number the events, with number one being the event that took the longest and number five being the event that happened in the shortest amount of time. Several learners can share their lists with the group and a brief discussion can be included here to reinforce the idea that things happen in different time frames.

Next, the teacher should show learners a photo or image of an Earth process or change (Choose one from the images in the references section of this lesson or another of their choice.) and ask how long it took for this change to happen. Follow up with a brief discussion of the time frame for the process or change illustrated. A list of different timeframes can be generated by the group and recorded on the chalkboard or overhead transparency. Use of several images and a brief discussion of the time frame for each can provide added time frames. The list should include time frames from seconds to billions of years.

Body of Lesson

1. Distribute Student Handout 1: Attachment 1. Divide the class into small groups of three to four learners depending upon class size.
2. Each small group should receive one of the earth processes or changes images. Instruct groups to discuss the time frame in which the process or change occurred. They will write a brief description of the process or change and classify it according to time frame.
3. Allow 5-6 minutes for each group to work on their discussion and description, and then tell the groups to trade image or data set with another group and follow the same procedure with that Earth process or change. After each group has examined, described, and classified four processes or changes, stop the activity and have the class analyze and compare their findings.

Note: This exercise is more complex than it first appears. There will be disagreement about the time frames of certain processes and changes. Groups may not classify

certain processes or changes in the same time frame as other groups. Some processes and changes may appear in more than one time frame. This is to be expected during discussion, and decisions may even change during the lesson as more information is shared among groups and members of groups. It will even be open for discussion whether certain processes and changes are natural or human-caused. In the twelve images provided with this lesson, there are Earth processes or changes that occur in a wide variety of time frames. The teacher should view each of the images before the day of the lesson and choose the number equal to the number of learner groups. Then make one copy (color strongly recommended) of each image to be used in the activity. If computers are available, learner groups can view the images on-screen directly from the Internet. As an alternative, images can be downloaded onto computer disks and viewed with computers not connected to the Internet. Other images, photos or illustrations of Earth processes and changes can be substituted for those that accompany this lesson.

Closure:

Learners should conclude this activity with a basic list of Earth processes and changes that occur in several very different time frames. They should be able to write a short statement of that fact and support it with appropriate examples.

Attachments:

Attachment 1: Student Handout 1

Attachment 2: Key for data analysis questions

Sample Assessment Items:

1. Which of the following natural processes would probably **not** occur in a single human lifetime?
 - A. Folding.
 - B. Faulting
 - C. Weathering
 - D. Erosion
4. Using tree rings as a means of age dating would usually be most effective in which time frame?
 - A. Minutes
 - B. Days
 - C. Years
 - D. Centuries

Sample Assessment Item Key:

1. *A is the correct answer because of the four choices, the only one which takes a very long time, sometimes millions of years to occur, is folding.*
2. *C is the correct answer because the rings measure years of the tree's age. While some trees live for hundreds of years (a few even thousands!), most trees cannot measure time in longer time frames than years.*

Reference Links and Technology Connections:

Image #1

<http://www.ces.clemson.edu/semaps/jpeg/9eno/9e6ful.jpg>

This is a set of four images of the lower Mississippi River delta taken over a number of years. It illustrates the loss of coastal wetlands that Louisiana has experienced. The time frame is one human lifetime.

Image #2

http://landslides.usgs.gov/html_files/landslides/slides/slide10.htm

This is an image of a sinkhole in Florida. The time frame is one day.

Image #3

http://www.priweb.org/ed/TFGuide/SE/se_geohist/se_geohist_pdfs/Pangea_breakup.pdf

This document is two pages. Scroll down to the second page, and learners can use either figure 1.30 or 1.31. The time frame is millions of years.

Image #4

<http://www.ncdc.noaa.gov/img/satellite/satelliteseye/hurricanes/andrew92/hurricane-andrew-ir2.gif>

This is a satellite image of Hurricane Andrew as it crossed the coastline of Homestead, Florida. The time frame for the hurricane is about two weeks, while the timeframe for crossing the coastline is a few hours. This should generate some discussion.

Image #5

<http://mam.er.usgs.gov/scripts/PortWeb.dll?query&catalog=dynamic&template=Details&field=filename&op=matches&value=andreas.psd>

This is an image of the San Andreas Fault, a frequent site of earthquake activity. The time frame for an earthquake is seconds or minutes.

Image #6

<http://mam.er.usgs.gov/scripts/PortWeb.dll?query&catalog=msh&template=Details&field=filename&op=matches&value=074.pcd>

This is an image of the eruption of Mt. St. Helens, May 18, 1980. The time frame may generate discussion as the initial eruption was in a time frame of minutes, but went on for hours, and was followed by more activity for days.

Image #7

<http://ny.water.usgs.gov/pubs/fs/fs05797/html2/FS057-97.html>

This is an example of using tree rings as a geologic dating tool. The life span of the tree is provided for the learner. The time frame is years or decades.

Image #8

http://pubs.usgs.gov/gip/ice_age/ice_age.pdf

This is a United States Geological Survey booklet about the (last) Great Ice Age. Scroll down to page three for a black and white photo of the “Blue Glacier” of Olympic National Park, Washington. There is an accompanying description of the time frame for the ice age. The time frame is millions of years.

Image #9

http://pubs.usgs.gov/of/2003/of03-398/posters/pdf/id_atlas.pdf

This is a set of three images of the Isle Dernieres Barrier Island Arc in Terrebonne Parish, Louisiana. It illustrates land lost by coastal erosion 1887-1996. The time frame is years or decades or a human lifetime.

Image #10

<http://www.nps.gov/arch/gallery/lowres/arches3.jpg>

This image of a natural arch comes from Arches National Park in Utah. The time frame is hundreds or thousands or millions of years.

Image #11

<http://www.nps.gov/grca/photos/canyon1.jpg>

This image is a black and white photograph of the Grand Canyon of the Colorado River from the south rim. Because the Igneous and Metamorphic formations at the bottom of the canyon are almost two billion years old learners may think the canyon is that old, but in fact the canyon was carved by the Colorado River in the last 20-35 million years.

Image #12

<http://www.nps.gov/band/photos2.htm>

The second image on this page shows the results of a forest fire in Bandelier National Monument in New Mexico. The time frame is days or weeks.

Image three is used in this lesson with the permission of The Paleontological Research Institution and author/editor Jane Picconi and illustrator J Houghton as per Molly Stapleton, 01-20-04. The reference is below:

Picconi, Jane E., editor, "The Teacher-Friendly Guide to the Geology of the Southeastern U.S.". Paleontological Research Institution: Ithaca, NY. Retrieved January 20, 2004 from http://www.priweb.org/ed/TFGuide/SE/se_main.htm.

Attachment 1: Student Handout 1

Earth Processes and Changes Over Time

Examining the Evidence

Materials:

- Student Handout 1
- Image of earth process or change
- Pencil or pen

Instructions:

1. As a group, examine the image your group has been given. Discuss the Earth process or change in the picture and determine a time frame.
2. Using the data chart on the following page, describe the process or change in the picture. Then write the time frame and a brief explanation of why your group thinks the process or change happened in that time frame. You will have 5-6 minutes to finish examining this image and writing about it.
3. When instructed to do so, trade images with another group. Follow steps one and two with the new image.
4. Repeat this procedure for each of the other images your group has time to examine.
5. Make a list of the different time frames you identified using the images.
6. Answer the analysis questions that follow the data chart.

Student Handout 1 Data Chart

Image #*	Description of Earth Process or Change	Time frame

**Identify the images using the numbers assigned to them by your teacher.*

List the time frames of the images your group examined.

Attachment 2

Key for Data Analysis Questions

Possible answers to data analysis questions are below.

1. *Answers will vary according to the image used, but the answer should address the uncertainty of the time frame or which part of the process or change is being used, or lack of agreement among the group. Some reasonable explanation should be used.*

2. *Two time frames not used on the group chart should be listed and an acceptable example of an Earth process or change should be used with each one.*

3. *There are many earth processes that occur very quickly and yet are part of a longer cycle of change. The answer should be accompanied with a reasonable explanation of how the process or change fits into each of the different time frames. Some examples are listed on the following page.*

Sample responses for question three are below.

Earth System Change	Timeframes
<i>Carving of a river channel</i>	<i>River channels are carved gradually over long periods of time, but the process may accelerate to a matter of hours during a flood.</i>
<i>Coastal erosion</i>	<i>Louisiana's coastline is gradually disappearing due in part to natural subsidence, but the process is hastened by the affects of tropical storms and hurricanes, and by human activities.</i>
<i>Cloud development</i>	<i>Clouds may bubble up in a matter of minutes on a warm summer day or take hours or days to form under other weather conditions. They may also be part of larger, longer lasting air masses which travel long distances over many days or even weeks.</i>
<i>Tectonic plate movements</i>	<i>Tectonic plates may shift in seconds during an earthquake or slowly grind against or past one another for decades or even centuries or longer</i>
<i>Volcanic eruption</i>	<i>Volcanic eruptions may take only seconds or minutes to occur, such as the eruption of Mt. St Helens in 1980, and yet be part of a longer cycle of tectonic plate movement (as Mt. St. Helens results from the subduction of the Juan de Fuca plate under the North American plate).</i>
<i>Igneous Rock formation</i>	<i>Using the same mineral composition a fine-grained basalt rock will form during fast cooling of lava at the earth's surface, while during the slow underground cooling of magma a coarse-grained gabbro will result, a similar situation exists for fine-grained rhyolite and coarse-grained granite.</i>
<i>Deposition of sediment layers</i>	<i>Layers of sedimentary material may be deposited by water or wind over long periods of time resulting in thick, homogeneous beds, or may be interrupted by the sudden eruption of a volcano which deposits a layer of volcanic ash between many subsequent layers of sediment.</i>

