

LESSON: Understanding Geological Time
<p>INSTRUCTOR: Cathryn Sunderland</p> <p>E-MAIL ADDRESS: cathryn.sunderland@canyonsdistrict.org</p> <p>DISTRICT: Canyons</p> <p>GRADE: 5</p>
CORE CURRICULUM
<p>Science Standard 2: Students will understand that volcanoes, earthquakes, uplift, weathering, and erosion reshape Earth's surface.</p> <p>Objective 3: Relate the building up and breaking down of Earth's surface over time to the various physical land features.</p> <p>Intended Learning Outcomes: 1. Use science processes and thinking skills. 2. Manifest scientific attitudes and interests. 3. Understand science concepts and principles. 4. Communicate effectively using science language and reasoning.</p> <p>Lesson Objective: Help students understand the timeline of the earth's geological features.</p> <p>Content Connections: Language Arts Standard 7: Students understand, interpret, and analyze narrative and informational grade level text; Language Arts Standard 8: Students write daily to communicate effectively for a variety of purposes and audiences.</p>
INTRODUCTION
<p>Elementary students have difficulty understanding classifications of time beyond their own lifespan. Ten years, a hundred years, and a million years - all are a long, long time to them. The Science Core requires that they "use a time line to identify the sequence and time required for building and breaking down of geological features on Earth" (Standard 2, objective 3, indicator c). This is difficult when some features change astonishingly quickly, like during an avalanche or earthquake, and other features take millions of years to change. This lesson focuses on the slow changes by introducing the students to the 4.5-billion-year geological history of the earth. Learning the names of the periods and eras is not important, but by using them, students recognize that many features of the earth have changed extremely slowly! Important changes involving plants and animals are also mentioned; these help link student learning to prior and later years' science curricula and engage students who are more interested in biological events than geological ones. Note: The periods of the Earth's geological history have been subdivided into smaller categories than the ones presented here. Because knowing these names is not core-required, this lesson presents only the general categories with occasional subcategory names.</p>

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<b>INVITATION TO LEARN</b>
<p>Pose the following question to students: "What do you know about the history of the earth? Not its people, but the earth itself?" Make a chart listing the students' knowledge, breaking it down into categories of plants, animals, and geology. Lead them to include major events like earthquakes and tsunamis, and anything they know about the formation of the mountains and continents or the earth itself. Decide a way to color code their facts by underlining those that happened during their lifetime one color, during recorded human history another color, and by those that happened before recorded history a third color. (This activity could be done whole class or in small groups, with each group making a chart and presenting it to the entire class.)</p>
<b>INSTRUCTIONAL PROCEDURES</b>
<ol style="list-style-type: none"> <li>1. After discussing the children's knowledge in the Invitation to Learn, take out a rope and string it across the room. Tell the students that we are going to learn what is believed about the history of the earth, most of which happened before humans existed on the planet. Have a folded card with the name of each major geological time period we are studying, and pass out the student literacy readings to the class. Ask students to choral-read the information on each time period and place the folded title card over the rope at appropriate segments. As they read about each time period, ask for any background knowledge they have about that time period. (The time they probably know the most about is the Mesozoic Era, since that is the time period of the dinosaurs.) Particularly recognize that the time of humans is very, very recent, covering only the last tiny segment of the rope.</li> <li>2. Divide the class into 6 or 7 groups, and give each group one classification of geological time. (You decide whether to subdivide the Cenozoic Era into the Paleogenic and the Neogenic Periods.) You may wish to find additional material on each of the classifications for them to research and study. Tell each group that they will have 15 minutes to create an artistic representation of their time period to present to the class. They may write a poem or song, create a dance, draw a picture, or make a simple play. Their presentation must depict the changes to the earth that occurred during their time period. While they are preparing, meet with each group to guide their activities.</li> <li>3. During each group's presentation, have the other students keep the literacy readings available for reference. After each presentation, discuss the artistic representations of the changes to the earth. You may also wish to have a world map available for specific references to continental changes during the time periods.</li> </ol>

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**.org DISTRICT:** Canyons

**GRADE:** 5

### **LESSON MATERIALS**

- One copy of the student literacy readings for each student
- One title card for each time period, folded
- Rope long enough to stretch across your classroom
- Various art supplies for group artistic productions
- World Map (optional)

### **ASSESSMENT SUGGESTIONS**

1. Evaluate the foldable book for completeness and accuracy.
2. Using their individual foldable books as a reference, have students construct a timeline of only the events relating to the geological features of the earth that are presented in the student literacy. They should include changes to continents and major mountain ranges.
3. Ask students to write a short descriptive essay describing the geological changes to the earth presented in this lesson in sequence without requiring specific period names or dates. Students may also be asked to write a compare/contrast essay after learning about geological events that occur quickly (landslide, avalanche, volcano, earthquake), comparing and contrasting changes that occur quickly with those that take millions of years to occur.

### **POSSIBLE EXTENTIONS/ ADAPTATIONS/INTEGRATION**

1. The current time period could be expanded to include major earthquakes and volcanic eruptions that occurred during the period of human written history. Discuss what written history would have been like if it had occurred earlier. Students could write fictionalized accounts of major prehistoric geological or biological events. These events could also be dramatized.
2. Students could expand the concept of a timeline to include a timeline of their own lives, emphasizing geological events occurring in their own lifespan.

### **RESOURCES: BOOKS, MEDIA, ARTICLES, WEB SITES, AND ORGANIZATIONS**

#### **BOOKS**

<b>LESSON: Understanding Geological Time</b>
<b>E-MAIL ADDRESS:</b> cathryn.sunderland@canyonsdistrict.org <b>DISTRICT:</b> Canyons <b>GRADE:</b> 5
<b>MEDIA</b>
<i>Bill Nye: Earth's Crust</i> , Disney Educational Productions, 1995
<b>ARTICLES</b>
<b>WEB SITES</b>
<ol style="list-style-type: none"> <li>1. Retrieved from the World Wide Web on January 13, 2010:  <a href="http://www.fossils-facts-and-finds.com/earth%20science%20lesson%20plans.html">http://www.fossils-facts-and-finds.com/earth science lesson plans.html</a> (This web site includes lesson plans to teach children about the geological history of the earth using a clock as a marker for the length of each time period).</li> <li>2. Retrieved from the World Wide Web on February 17, 2010:  <a href="http://www.scotese.com/Pangea2d.htm">http://www.scotese.com/Pangea2d.htm</a>. (This website has a virtual globe showing the supercontinent Pangea just before it began to break up.)</li> <li>3. Retrieved from the World Wide Web on February 17, 2010:  <a href="http://geology.about.com/">Http://geology.about.com/</a>. (This website includes all topics related to the geology of the earth.)</li> </ol>
<b>ORGANIZATIONS</b>
<b>FAMILY CONNECTIONS</b>
<ol style="list-style-type: none"> <li>1. Often families visit important geological sites for family vacations. Students could bring in pictures or souvenirs from these places to display and explain.</li> <li>2. Specific geological sites could be chosen to feature on a laminated construction paper placemat designed by students. The placemat could feature a hand-drawn picture of the site with captions and sidebars giving detailed information. A set of these placemats could be given to a student's family for a gift.</li> </ol>
<b>LESSON AND ACTIVITY [TIME SCHEDULE]</b>
<ul style="list-style-type: none"> <li>• The lesson time is 55 minutes, including teacher presentation and cooperative activities.</li> <li>• The foldable activity is 30 minutes.</li> <li>• Total lesson and activity time is 90 minutes.</li> </ul>

**LESSON: UNDERSTANDING GEOLOGICAL TIME****INSTRUCTOR: CATHRYN SUNDERLAND****E-MAIL ADDRESS:** [cathryn.sunderland@canyonsdistrict.org](mailto:cathryn.sunderland@canyonsdistrict.org)**DISTRICT: Canyons****GRADE: 5****ACTIVITY CONNECTED TO LESSON**

Students will make a layered foldable book with a page for each of the seven time periods taught in the lesson. Directions for making a layered foldable are available at <http://www.youtube.com/watch?v=4N0X3DkXNtM>. For this foldable, have students use four whole pages for their books, and have them make a three-column chart for each page. One column is for information about plant life, one column is for information about animal life, and one column if for information about geological events. Allow them to refer to the literacy pages to gather information from their pages, and assign them to illustrate each page and write the name of the geological time period on the tab part of the page at the bottom.

**ACTIVITY MATERIALS**

- Four different colored sheets of copy paper for each student
- Stapler
- Literacy reading about geological time for each student (in binder)
- Pencils
- Various coloring tools: crayons, colored pencils, thin markers, etc.

## **Earth's Time Periods**

### **Hadean Time (4,500 to 3,800 million years ago)**

Humans have always wondered how the earth was formed. Many myths and legends attempt to tell the story of its creation. Scientists believe in the beginning of Earth's history it was dark and cold, and then great collisions occurred. Elements that would become our sun came together and created light and heat, gas and dust. Collisions away from the sun became baby planets. As the gas cooled it became hot liquid.

At a perfect distance from the sun, our planet Earth formed a crust around a hot liquid center. Cracks in the crust allowed the hot liquid to spurt out, forming the oldest rocks on our planet. They made the first layer of the crust. These rocks tell us that our earth is billions of years old. There are not many places where these rocks exist today, because most of them melted back into the liquid center.

Ancient volcanoes filled the atmosphere around the new planet with cloud-forming dust. Rain from the clouds fell and created the oceans. There was no life on the earth during the Hadean time. It was a time of preparation. The Hadean time lasted 700,000,000 years.

### **Archaean Time (3,800 to 2,500 million years ago)**

At the end of the Hadean time, the earth was covered with thick, soupy seas. The atmosphere was made of hydrogen, ammonia and methane, not oxygen. It wasn't a place you or I could survive yet. But the first cells of living things began existing in the oceans. They are called cyanobacteria and they are able to make oxygen from the sun's energy.

Most of the rocks that formed our continents were being built during this time period. Most of them don't exist anymore, because they were changed by immense pressure or returned to the molten core of the earth. Those rocks that still survive, telling about this time, are found in Western Australia, Canada, India, and South Africa. The forming of these continents probably began as lava flows under the ocean. The Archaean time lasted for 1,300,000,000 years.

### **Proterozoic Era (2,500 to 543 million years ago)**

Many important changes to the earth happened during the Proterozoic Era. The atmosphere was filling with oxygen, thanks to the work of cyanobacteria during the Archaean period. The earth was cooling. But the oceans were too salty for much life to survive. During this era, a new type of cell appeared that could eat the poisonous salts. The new animal used the salts to build shells for their bodies. These animals are called foraminiferans, and more than a third of the ocean bottom is made up of their remains. Rocks on the ocean floor contain fossils of their shells, preserving this important part of history. The Proterozoic era lasted for 1,957,000,000 years.

### **Paleozoic Era (543 to 248 million years ago)**

After the foraminiferans made the oceans less salty, there was an explosion of life on earth! Because of so much change, the Paleozoic Era is split into six different periods. The first of these is called the Cambrian Period, or the Cambrian Explosion, since it introduced so many new life forms. Arthropods, mollusks, and echinoderms existed during this period. The most famous animal of the Cambrian Period was the trilobite. Plants during the Cambrian period were simple, one-celled algae.

New species of animals developed all through the Paleozoic Era. Fish developed during the middle part of the era. Cephalopods were mollusks that had feet growing out of their heads. By the end of the Paleozoic Era, lichens, a partnership between fungi and algae lived out of the water, breaking down rocks and making soil.

Something catastrophic happened at the end of the Paleozoic Era, causing mass extinction. As much as 95% of life on Earth died. The Paleozoic Era lasted 295,000,000 years.

### **Mesozoic Era (238 to 65 million years ago)**

It took most of the Mesozoic Era for life on Earth to recover from the extinction that occurred at the end of the Paleozoic Era. The earth now looked very different. The seas were lower, and places on Earth had tropical forests, marshlands and deserts. Life began existing on dry land. Plants developed stems and seeds. Animals developed tough outer skin to hold in moisture and cold-blooded circulation systems to adapt to extreme temperatures. Reptiles became giant species, living on land, in the seas, and in the air. Mammals existed, but they were small and not very influential during the Mesozoic Era.

During the Mesozoic Era, continents did not look like they do now. Originally all the continents were hooked together into one giant landmass, called Pangea. It was shaped like the letter "C" and it straddled the equator, so all the land was warm. The interior of the supercontinent was dry and desert-like. But Pangea began breaking up almost as soon as it was formed. The part of Pangea north of the equator was called Laurasia. It was formed by what is now North America and Eurasia. The part of Pangea south of the equator was called Gondwana. It was made up of South America, Africa, India, Australia, and Antarctica. Mountains were beginning to be pushed up through the crust, and continents were beginning to break apart. By the end of the Mesozoic Era, South America and Africa had broken apart.

Another catastrophic event caused mass extinction at the end of the Mesozoic Era. Many scientists think the earth was hit by a giant meteor or a huge volcano erupted. The time of the giant reptiles was over. The Mesozoic Era lasted 173,000,000 years.

### **Cenozoic Era (65 million years ago to present)**

The Cenozoic Era began 65 million years ago. It is the time in which we now live, although human existence represents only a tiny sliver of Earth's timeline. Its most important life form is the mammal. Other life forms appearing during the Cenozoic Era are flowering plants, insects, fish with bones, and modern birds. During the Cenozoic Era, landmasses moved into new locations on the globe. Great ice ages caused the seas to recede. We are still in the Cenozoic Era.

There are two main classifications within the Cenozoic Era. The earlier classification of the Cenozoic Era is the Paleogene Period, lasting from 65 to 24 million years ago. At the beginning of this period, the earth was mostly tropical or semi-tropical. Palm trees grew as far north as Greenland! But the earth continued to cool. At this time, Europe was connected to North America, Australia was connected to Antarctica, and India was a continent all by itself. The Atlantic Ocean was forming. Gradually, Europe and North America separated, Australia and Antarctica separated, and Antarctica became covered with ice.

The most recent classification of the Cenozoic Era is called the Neogene Period, lasting from 24 million years ago and continuing to the present time. During this time, the earth became cooler and drier. Grasslands replaced forests in many places. Continents crashed into each other, pushing up mountains in many places. India continued its push in to Asia, creating the Himalayan Mountain Range. Italy moved north into Europe, raising the Alps. Spain crashed into France to form the Pyrenees



Mountains. Africa closed off the Mediterranean Sea. The Rocky Mountains in North America and the Andes Mountains in South America all formed during this time period.

Colliding continents caused lower sea levels, and the North and South Poles began to have ice caps. New mountains trapped ice and snow, causing the sea level to become even lower. Land bridges opened between continents and animals began migrating between continents. South America moved to the north, merging with North America and forming the Isthmus of Panama. Armadillos, porcupines, ground sloths, and opossums migrated from South America to North America. Dogs, cats, bear and horses from North America migrated to South America.

The earth continued to cool during the Neogene Period. Eventually it was locked in an ice age. The lower sea levels, new mountains, and changing ocean currents all contributed. Glaciers reached down as far as Ohio in the United States from the polar ice caps. Great mammals adapted to live in these colder times, including the woolly mammoth, mastodon, woolly rhinoceros, and the reindeer. Other great carnivorous mammals were the saber tooth tiger, cave bear, and dire wolf. The climate did not stay cool through the entire Neogene Period. Scientists have calculated many periods of warming and cooling throughout this time.

The greatest mammal to appear during the Neogene Period is the human. Yet, if the entire history of the earth were placed on a clock, and every hour represented 375,000,000 years, the history of humans on Earth would represent only 7 seconds.