

**[Geology – Layers of the Earth]
[Basic: Grade 2-3]
[Advanced: Grade 5: Introduction to Plate Tectonics]**

BACKGROUND

Scientists and geologists have been able to do some drilling on Earth. They are also able to measure sound (seismic) waves caused by earthquakes and nuclear explosions and then are able to determine the composition of the layers. Scientists have not been able to reach the center of Earth because of the extreme temperatures.

The earth is made of four different layers: crust, mantle, outer core, and inner core.

1. The crust is the outer most layer. The temperature ranges from 0°F on the surface to 1600°F below. Its thickness is about 3-5 miles under the oceans and 25 miles under the continents. The crust is relatively cold compared to the other Earth layers so therefore it can crack, causing earthquakes. It is made up of many pieces, called plates which float on the mantle located below the crust. Composition is common rock silicate compounds.
2. The mantle is located below the crust. The temperature is 1600°F at the top and 4000°F near the bottom. It is approximately 1800 miles thick. The mantle is the largest layer of Earth and is composed of very hot, dense rock. This layer of rock moves like thick, hot asphalt due to the extreme temperature differences between the top and bottom of the layer. This movement causes the plates in the crust to move. Composition is iron, magnesium, aluminum, silicon, oxygen, and silicate compounds.
3. The outer core is the next layer. The temperature is 4000°F to 9000°F and its thickness is 1400 miles. The outer core is in liquid form because the material is so hot. It is composed of liquid iron and nickel. As the Earth rotates the liquid core spins creating the Earth's magnetic field.
4. The inner core is the center most layer. The temperature is around 9000°F. It is approximately 800 miles thick and is made of solid iron due to extreme pressure. The inner core does not move but vibrates in place. The pressure on the inner core is 45,000,000 pounds per square inch which is 3,000,000 times more than air pressure.

BASIC LESSON

Objective(s)

Students will be able to... recognize and name the layers of the Earth. (Knowledge, comprehension)

State Science Content Standard(s)

- 4.1: Describe and give examples of Earth's changing features
4.2: Describe the physical properties of the Earth's materials

Materials

Safety

From the Kit

Provided by Teacher

- Earth Layer Poster
- Earth Layer Model
- Earth Layer Diagram
- Earth Layer Cross Section

- ¼ or ½ apple for each student

- None

Key Vocabulary

Mastery Questions

- Geologist
- Crust
- Mantle
- Outer Core
- Inner Core

- How many layers of Earth are there?
- What are the layers made of?
- How do scientists and geologists know what the layers of Earth are?
- Have scientists been able to reach the

center of the Earth?

Detailed Plan

Activity 1: Earth Layer Introduction

To introduce the different layers of Earth, display the poster somewhere in your classroom so students can see the picture. Explain the poster is a cross section of the Earth's layers. Use the two laminated diagrams to help you with the explanation. Using the information found in Background, identify and describe the four different Earth layers to your students. Have the layer's words written or displayed on the board. Use the soft 3-D model to point out the different layers. Point out the continents on the model. (You can explain they are plates "floating" on the crust which can be a transition to a plate tectonics discussion for the advanced lesson.)

<http://ed101.bu.edu/StudentDoc/Archives/fall05/malily/LayersofEarth.html> – Website you can share with your students that describe and show the different layers.

Activity 2:

After teaching the layers of the Earth, help students review the location of the layers by using an apple. Prior to class, have enough apples for each student to have their own piece. Cut the apples in half or quarters (representing a cross section) and have them ready to distribute to the students. The instructor then places an apple on each student desk and then covered them with a paper towel and instructed the students not to look. You can use an aluminum pie plate or another paper towel to place the apple on. Have the students uncover the apple and tell them to look at it and notice any similarities between the apple and the Earth's layer. Ask them to find each part of the apple that corresponds with an Earth's layer. This can be done as a discussion or they can record their findings by drawing and labeling the apple as if it were the inside of the Earth.

Assessment

Students will be assessed throughout the lesson by how they answer questions, how they participate in group discussions, and whether they completed their apple diagrams correctly. There is also an Earth Layer Assessment found on the website to use to check for students learning of the Earth layers.

Resources

- www.kidsgeo.com/geology-for-kids/0020-crust-mantle-core.php (Great interactive website for exploring the layers of the earth)
- Background Information: Booklet from kit – Cross Section Earth Model
- Background Information: Poster from kit

ADVANCED LESSON

Objective(s)

Students will be able to... define the role that plate tectonics play in changing the Earth's features. (Knowledge, comprehension)

State Science Content Standard(s)

- 4.1: Describe and give examples of Earth's changing features
- 4.2: Describe the physical properties of the Earth's materials

Materials

Safety

From the Kit

- See Basic Lesson
- Plate tectonic quiz found on our website

Provided by Teacher

- See Basic Lesson
- Hard Boiled Egg for each student or a team of two.
- Paper plates
- Plastic knives
- Napkins or paper towels

- Awareness of students with an egg allergy

Key Vocabulary	Mastery Questions
<ul style="list-style-type: none"> • See Basic Lesson • Plate Tectonics • Plate movement • Pangea • Topography 	<ul style="list-style-type: none"> • See Basic Lesson • What is a globe? • How do scientists know what the interior of Earth looks like?

Detailed Plan

Parts or the entire basic lesson can be used to review the layers of Earth and introduce the concept of the continents are on plates moving on the earth's mantle. The movement is caused by the mantle's high temperature causing its layer to be somewhat fluid.

Background for the Advanced Lesson

Geologists have distinguished three main internal subdivisions of the Earth, based on the behavior of seismic waves and laboratory experiments. These divisions are based on the composition of each layer. The outermost layer is the crust. The Earth has two types of crust. Continental crust underlies much of the Earth's land surface and is what we live on. The ocean floors are underlain by oceanic crust. These materials are composed of different kinds of minerals. The continental crust is like the igneous rock granite, and the oceanic crust is like basalt, another igneous rock.

Underlying the crust is the second layer, the mantle. It comprises the largest portion of the Earth. Like the crust, it is also composed of silica

te minerals. The innermost portion of the Earth is the core. It is composed of metallic elements, primarily iron and nickel. The core is subdivided into two parts. The outer core is liquid metal, while the inner core is solid.

The plates are composed of the crust and the uppermost part of the mantle. These two layers are often called the lithosphere because they are both composed of solid rock. The underlying, partially molten part of the mantle, on which the plates slide, is called the asthenosphere. In contrast to the crust-mantle-core division, which was based on composition, the lithosphere and asthenosphere are separated based on strength. The lithosphere is strong, rigid rock, while the asthenosphere is a weaker, very viscous fluid.

Students have learned that the locations of earthquakes and volcanoes provide clues (or data) that help understand plate tectonics. The causes of these movements are complicated, but at this level students should begin to recognize that some of the stresses come from within the Earth. In particular, one reason for the movement of the plates may be convection currents within the upper part of the mantle. Convection is the heat-driven circulation of a fluid. In the mantle, heat from deeper in the Earth causes the overlying mantle to circulate. The upper mantle can circulate because it contains a little magma (molten rock) and behaves like a very hot mush. Mantle convection currents move very, very, slowly. It is possible that as the mantle convects, it drags the overlying plates along with it. It is possible that as the mantle convects, it drags the overlying plates along with it. Where convection currents come together, a converging plate boundary is present. Where they move apart, a diverging plate boundary forms.

Activity – Earth Egg

Introduction

1. Ask students what a globe is. Explain a globe is a model of Earth and that models are used to represent an object or item. Show them the soft earth model found in the kit or a globe if you have one.
2. Using the information from the basic lesson present a model of the Earth's interior.
3. Ask students how they think scientists are able to predict what the inside of our Earth looks like. Explain the concept of inferences (conclusions and predictions) and use an example the students can relate to such as guessing what is inside a wrapped package by shaking, smelling, or weighing it. Explain that scientists drill into the Earth, study energy waves from earthquakes,, and study material released from volcanoes to learn more about what is in the interior or Earth.
4. Explain the concept of plate tectonics. The crust is like a jigsaw puzzle made of approximately 20 huge slabs of

rock called tectonic plates. These plates have moved through history and are still moving today. (http://www.youtube.com/watch?feature=player_embedded&v=Utl9WGfcEc) This is a simple simulation of the continents separating from the super continent Pangea into the individual continents they are today. There are many good simulations on the internet if you want something more complicated.

5. Explain plate movement has formed the topography of our continents and has created mountains when they crashed into each other. Plate movement also causes volcanoes to erupt when they dive under another plate and melt. Plate movement causes earthquakes when they scrape past each other.
6. Explain to students just as the globe is a model of the Earth, they will be using an egg as a model of the Earth's interior and will get a better understanding of how plates move.

Procedure

1. Distribute the eggs, plates, napkins, and plastic knives. Instruct the students to set their egg on their plate and wait for step-by-step directions to be given.
2. Ask the students, based on what was reviewed, what part of Earth they believe the shell of the egg represents. Discuss answers.
3. Demonstrate how to GENTLY tap the egg on all sides, cracking the shell. Ask what part of the plate tectonic theory the cracked egg represents. Discuss answers.
4. Ask students what layer of the Earth is showing through the egg.
5. Have the students gently push the cracked shell on the egg towards each other. This simulates the plates colliding. What does this form? (A "mountain or mountain range" might form.) This also gives a better understanding of how an earthquake might occur when two plates scrape off or resist each other to create sudden movement.
6. Using the egg shell, have students manipulate the shell to simulate the plate colliding.
7. Demonstrate to the students how to cut the egg in half through the middle. (Not end to end)
8. Ask the students to name the layers of the Earth's interior by using the egg as a model.

You can also refer to the poster included in the kit which has an egg activity with an alternate approach and questions.

Assessment

- Observe students during the activity and listen to discussion for understanding.
- Students understanding can be checked with a short quiz. An example is provided on the website.

Resources

- <http://www.msnuclous.org/membership/html/k-6/pt/> : Plate Tectonic Cycle – Great source for more activities grades K-6
- Earth Egg Activity – USGS (United States Geological Society) – Science for a Changing World
- Surface and Interior of the Earth
http://www.windows.ucar.edu/tour/link=/earth/Interior_Structure/overview.html
- Sixth Grade Plate Tectonics Home Page – Excellent interactive website teaching plate tectonics
<http://eastslip.k12.ny.us/jfkes/sixthgrade/6thplatetectonics/platequest.html>

EXPLORE MORE

Found on the back of the Earth Layer poster is an edible earth activity where different layers of earth can be created using graham crackers, ice cream, and different food coloring. The result of the activity can be eaten. The title is "Edible Earth." Precaution: Be aware some students maybe lactose intolerant or have a nut allergy.

Plate Tectonic Extension Lesson

Assign the students to write a one page paper to answer the following questions:

1. What is Pangea?
2. How do we know it existed?
3. Who is Alfred Wegener?
4. Explain continental drift theory. How is it different from plate tectonic theory? How is it the same?
5. Describe convergent, divergent, and transverse plate boundaries.

<http://earthpopupbook.weebly.com/pangea.htm> - This website has a project for grade 4-5 where the students create a popup book explaining layers, plate tectonics or whatever topic you would adapt the project for. It is a nice integration of science, art, and writing.