



## Dynamic Earth



### Earth Science TEKS for Activities and Presentation

Third Grade: 3.7(A), 3.7(B), 3.7(C)

Fourth Grade: 4.7(B)

Sixth Grade: 6.10(A), 6.10(C), 6.10(D)

Eighth Grade: 8.9(A), 8.9(B), 8.10(A)

### Program Vocabulary

Asthenosphere, Convection, Convergent plate boundary, Density, Divergent plate boundary, Earthquake, Erosion, Eruption, Fossil, Friction, Landslide, Layers of the Earth, Lithosphere, Magma, Pangea, Plasticity, Plate boundary, Plate Tectonics Theory, Ring of Fire, Sediments, Subduction, Volcanoes, Tidal wave, Transform plate boundary, Weathering

### Pre-Visit Activity: Imagining the Inside of the Earth

#### Students will:

- Understand that people used stories to explain natural phenomenon based on their own experiences
- Create a unique mythology to explain the phenomenon of earthquakes
- Know that as understanding of science improves the use of mythologies to explain natural phenomena decreases

#### Materials:

Butcher paper, Markers or crayons, Scissors

#### Procedure:

1. Discuss how different cultures over time explained earthquake phenomenon. There are many resources on earthquake myths available online that you can share with the class.
2. Encourage students to brainstorm what the inside of the Earth looks like. What might be inside the earth that could cause an earthquake?
3. Instruct students to draw a large circle on a piece of butcher paper.
4. Tell students that they will create their own mythology with regards to what the interior of the Earth looks like and what causes earthquakes. Encourage students to let go of



scientific explanations of why there are earthquakes and to think like a person who lived when this information was unknown.

5. Allow students to use markers or crayons to illustrate their ideas of what the center of the Earth looks like according to the mythology that they created.
6. Instruct students to create a written explanation of their mythologies to accompany their drawings.

### Pre-Visit Activity: Layers of the Earth

#### Students will:

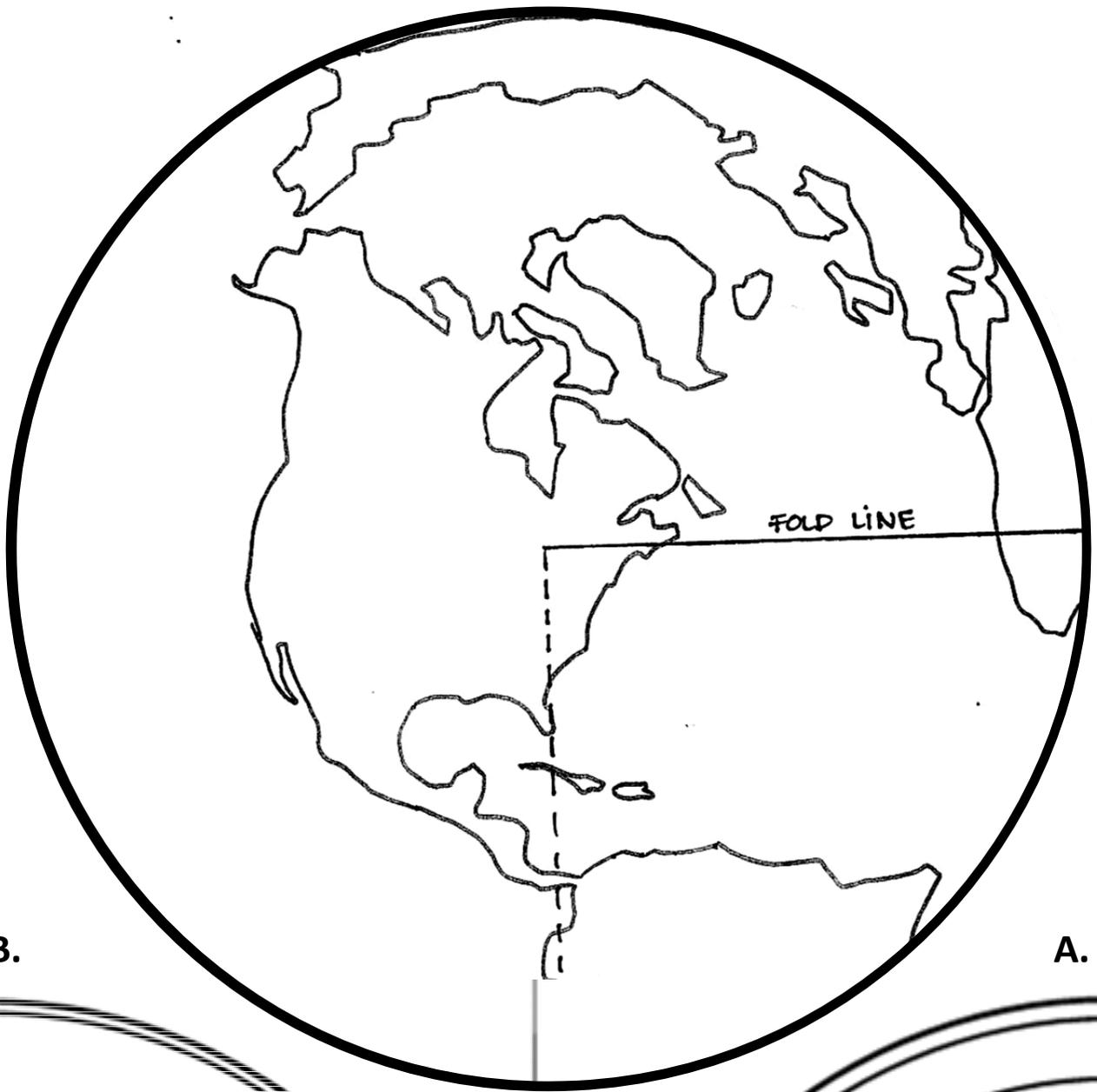
- Be able to identify the three compositional layers of the Earth
- Be able to identify the five mechanical layers of the Earth
- Be able to use a model to identify and explain the compositional and mechanical layers of the Earth to the teacher

#### Materials:

Layers of the Earth template, Construction paper, Scissors, Glue, Pencils, Colored pencils or crayons

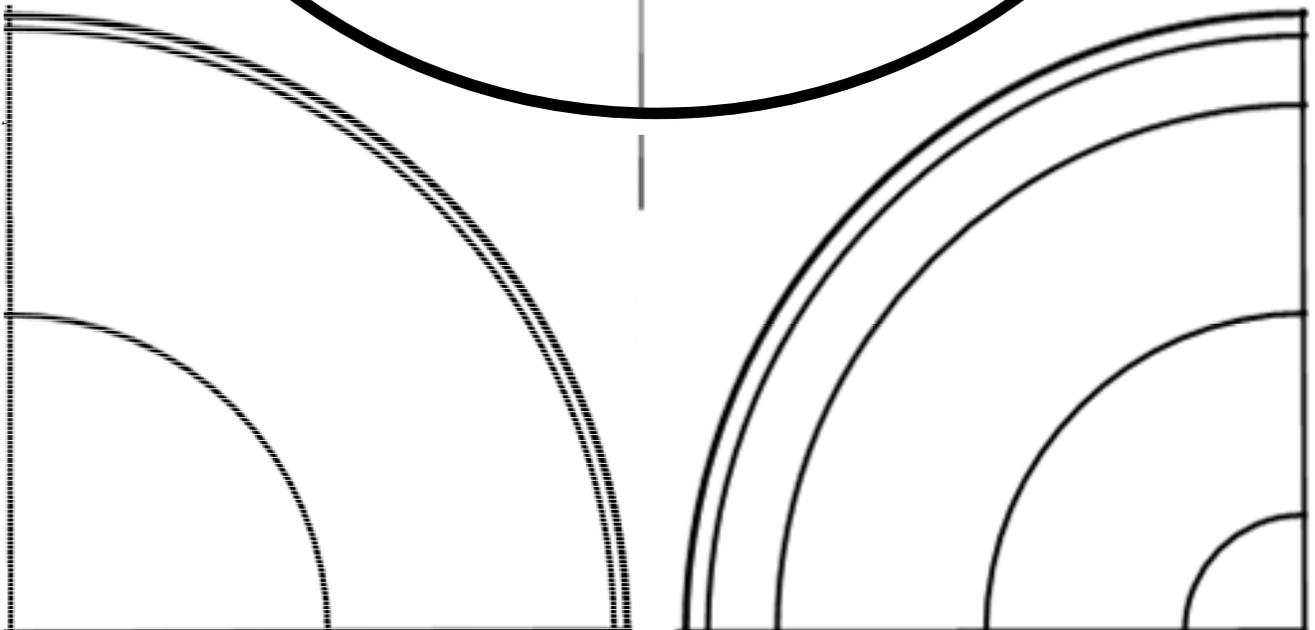
#### Procedure:

1. Pass out a template to each student.
2. Instruct students to cut out the Earth along its perimeter. Then, instruct them to cut along the dashed line that says “cut here.”
3. Next, have students fold along the “fold line” and then, set the Earth aside.
4. Now, tell students to cut out the quarter circle labeled **A**. This will represent the mechanical layers of the Earth.
5. Invite students to color each of the areas in the quarter circle a different color starting from the inside. Have students set aside the mechanical layers (**A**).
6. Instruct students to cut out the second quarter circle (**B**). This will represent the compositional layers of the Earth. Invite students to color each of the sections a different color. Have students set aside the compositional layers (**B**).
7. Instruct students to glue the earth, to the background paper. Remind them to not glue down the flap.
8. Tell students to place the mechanical layers (**A**) on the background paper underneath the flap and glue it to the paper.
9. Now, instruct them to take the quarter circle representing the compositional layers (**B**), and glue it on the backside of the flap.
10. Once completed, show students how to flip up the flap to see the mechanical layers under the inner flap and the compositional layers on the back of the flap. Students may add notes to the layers.



B.

A.





Background:

From the core to the crust, the Earth is a pretty big deal. It has a diameter of about 6,400 km, and it is made of various layers that help change the surface of the earth. These layers are defined by what they are made of or how they move. When we look at the chemical composition of each layer, we are defining them as compositional layers. The compositional layers are the crust, the mantle, and the core. When we look at the mechanical properties of the layers, we are defining them as the mechanical layers. The five mechanical layers are the lithosphere, asthenosphere, mesosphere, inner core, and outer core. Although we only see the outermost layer of the earth, we have learned a lot about the layers underneath by looking at seismic waves and various rocks on the surface.

The three compositional layers of the earth are defined by significant changes in chemical composition. The outermost layer is the crust. It is the thinnest layer making up only about 1 percent of the Earth. The majority of the crust is comprised of elements like silicon (Si), aluminum (Al), potassium (K), calcium (Ca), oxygen (O), sodium (Na) and minerals made of these elements. The crust can be subdivided into two types – oceanic crust and continental crust. Oceanic crust tends to be thinner (approx. 5-10km thick) than continental crust and younger too! Continental crust is on average 30 km thick, and contains the oldest rocks and minerals. Both types of crust cover the entire outer portion of the earth. Below the crust lies the mantle (approximately 2,890 km thick.) The mantle is made of silicon (Si) and oxygen (O), like the crust, but it also contains large amounts of iron (Fe) and magnesium (Mg). The final compositional layer of the earth is the core (approx. 3,480 km thick). The core is iron (Fe) and nickel (Ni). It is under intense pressure and high temperatures, as such, it is the densest layer of the Earth. Although these layers may share common elements, the contents differ enough to create distinct layers.

The five mechanical layers of the earth are defined by how they move. The layers are described as rigid, plastic, or liquid in consistency. The outermost mechanical layer is the lithosphere. The lithosphere is rigid. It includes the crust and the uppermost part of the mantle. The lithosphere is divided into tectonic plates, areas of continental crust and/or oceanic crust, that move and shift over time. The tectonic plates of the lithosphere move and shift on the asthenosphere, which is plastic in nature. The asthenosphere is under more pressure than the lithosphere and has a higher temperature. It is considered plastic because the rock has the ability to flow unlike the rigid lithosphere, but not as easily as a liquid. The rock in the asthenosphere can melt if exposed to the surface, but it is under extreme pressure causing it to flow like a plastic.

The mesosphere is the layer below the asthenosphere. The mesosphere is hotter than the asthenosphere, but it is rigid because it is under more pressure than the layers above. The last mechanical layers of the earth are found in the core. The core is split into the outer core and the inner core because the two layers differ in rigidity.

The outer core is liquid iron (Fe) and nickel (Ni). The flow of the outer core creates and sustains the Earth's magnetic field. Unlike the outer core, the inner core is solid. The inner core is made



primarily from iron (Fe), but also contains nickel (Ni) and trace amounts of precious elements like gold (Au). It is extremely hot, and under extreme pressure from the layers above and atmosphere around it. All of these layers work together to make our dynamic earth.

### Post Visit Activity: Plate Tectonics

#### Students will:

- Construct a model illustrating the basic principles of plate tectonic theory
- Demonstrate how tectonic plates move on the asthenosphere
- Understand that the plates that make up the lithosphere are constantly moving

#### Materials:

Clean 2 liter bottle – to mix borax and water, Borax, Water, Zip top baggies, Craft foam, Scissors, Paper, and Pencils

#### Prep Work:

- Create a super-saturated solution by dissolving Borax in water. Place a small amount of this solution into a plastic baggie for each student.
- Pre-cut craft foam in to 3 x 5 inch pieces. You will need one for each student.

#### Procedure:

1. Give each student a 3 x 5 inch piece of craft foam and have them cut it in half using a zig zag pattern. Ask the class what they think the two pieces of foam represent. They represent two plates of the lithosphere.
2. Distribute baggies with the super-saturated solution to the class. Add diluted white glue to each bag and instruct students to seal the bag and mix the two substances by massaging the bag.
3. Once well mixed, direct students to carefully empty the extra liquid into the sink.
4. Tell students to take the putty out of the bag and knead it for several minutes, until it is no longer sticky.
5. Now, tell students to fashion the putty into a flat shape. Do they know what this flat putty represents? It represents the asthenosphere.
6. Next, direct students to place the foam pieces onto the putty being sure the zig-zag edges are together (like a puzzle).
7. Have students observe for five minutes. What happens over time? The “plates” move further apart as the putty slowly flattens.



Post Visit Activity: Use an Orange to Model Plate Tectonics

Students will:

- Understand that the tectonic plates fit together at their boundaries somewhat like a puzzle
- Experiment with a model of tectonic plates and how they fit
- Understand that Pangea was a supercontinent made up of all of the continents

Prior Knowledge:

- Five layer structure of the Earth (mechanical layers)
- Pangea was a supercontinent that included all the world's landmasses in the late Paleozoic

Materials:

Oranges, Toothpicks, Paper plates, Paper towels

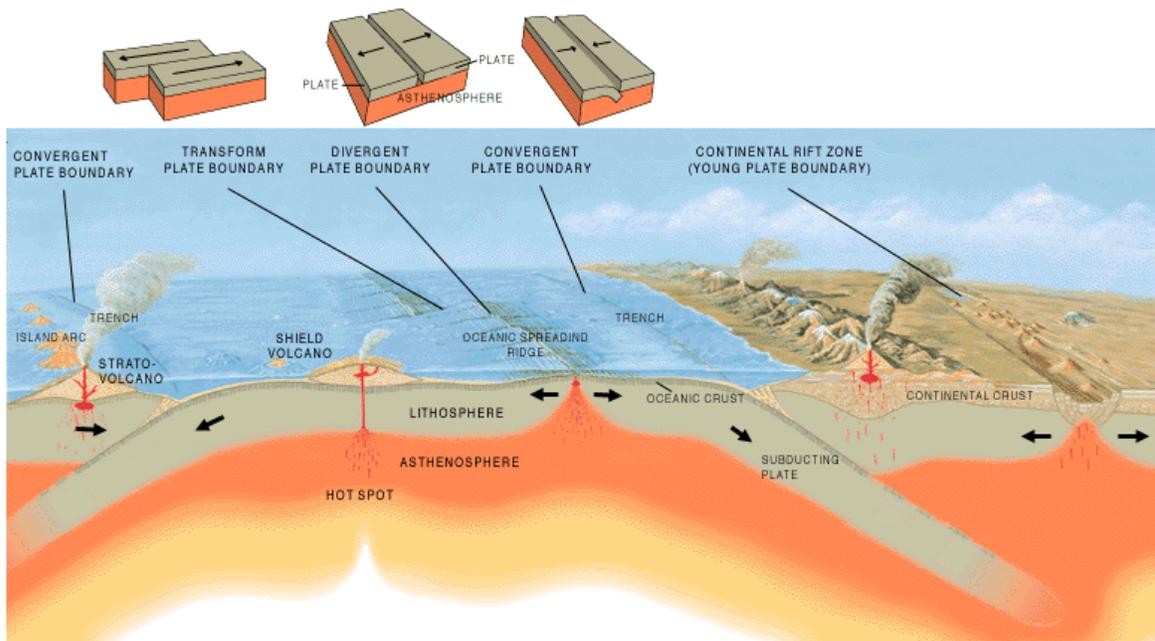
Procedure:

1. Tell the students that plate tectonics is the theory that Earth's lithosphere is made up of rigid plates that glide over the asthenosphere, the plastic layer above the mesosphere. Tell students that they will be experimenting with how these plates may fit together on the surface of the Earth by experimenting with an orange.
2. Hold up the orange so the class can see. Tell the class that the orange is going to represent the Earth. Ask what part of the orange might be used to represent the crust (lithosphere) of the Earth (the peel, of course). Ask why an orange makes a good model for the Earth and what makes it an imperfect model of the Earth.
3. Distribute oranges and a paper plates to the class. Instruct students to peel the orange into four or five sections of skin. Work over the paper plate to contain the mess.
4. Direct students to place the peeled orange next to the pieces of skin. Tell students that each piece of the peel represents a plate that forms the crust of the Earth. Explain there are both large and small plates.
5. Challenge students to fit the pieces together on a flat surface to form their own version of Pangea.
6. When done, instruct students to try to fit the peel pieces back onto the surface of the orange, using toothpicks to secure the plates in place.
7. Draw their attention to the cracks between each of the pieces. These cracks, or boundaries, are called fault lines. It is here that the plates that form the crust may rub against one another or move away from each other.

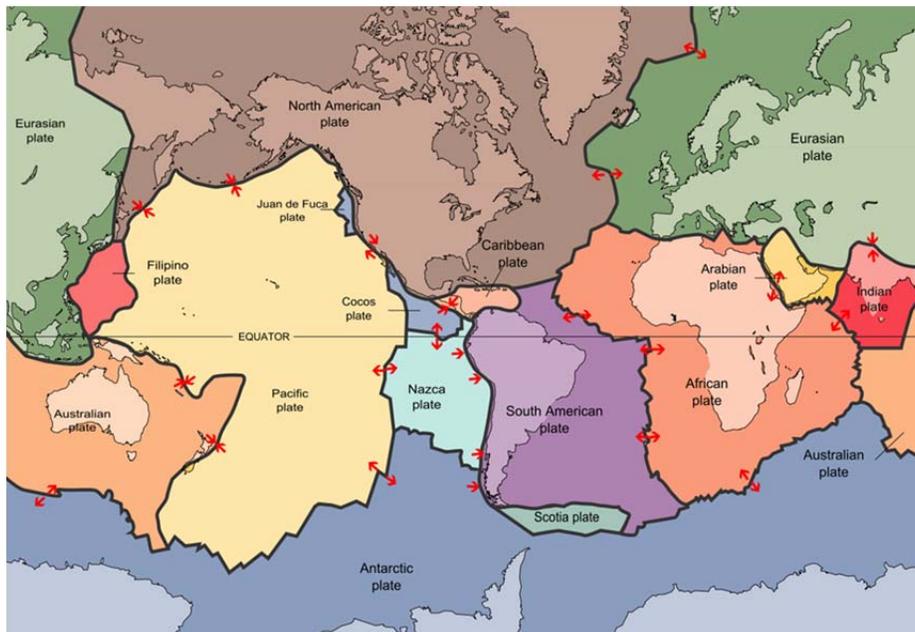


Background:

Plate tectonics theory states that the lithosphere, the outer most layer of the Earth, is composed of large plates and several smaller ones. These plates move atop the asthenosphere. The plates are moving in different directions and at different speeds. This movement means the plates collide, pull apart, or sideswipe each other creating different types of plate boundaries, such as convergent, divergent, and transform boundaries.



Three types of plate boundaries and a hot spot



The tectonic plates of the world were mapped in the second half of the 20th century