



Forces That Shape and Change the Earth's Surface

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Grades: 3-5

Geographic Theme

Place and Location

Purpose

Students will do activities that provide a general overview of information relating to the earth's continually changing surface. These five lessons are designed to give students a better understanding of forces that have changed the earth's surface. (These could also be presented as 30-minute activities on five different days.)

Activity/Purpose Day 1: To demonstrate the theory of plate tectonics with a hands-on activity.

Activity/Purpose Day 2: To demonstrate continental separation and introduce the theory of Pangaea.

Activity/Purpose Day 3: To demonstrate the expansion of the Atlantic Ocean as an example of sea floor spreading.

Activity/Purpose Day 4 and 5: To use a desk atlas to identify the locations of volcanoes. To make a "volcano." (This activity may be done as two separate activities or a one-hour lesson.)

ACTIVITY/ DAY 1: Earth- Cracking the Crust

Objectives

- To understand how movement in general emits heat energy.
- To understand that the earth's crust is constantly moving.
- To understand that sections of the earth's crust move and produce heat.
- To understand that crustal changes cause earthquakes and volcanoes.
- To understand the source of magma and how it moves up through the asthenosphere.

Materials

- Globe*
- Brown, blue, red, and yellow crayons*
- Red food coloring*
- Clear plastic container 3/4ths full of water (shoe box size works great)*
- Large Styrofoam dinner plate*
- Scissors*
- Glue*
- Plate boundaries map*
- Picture cards of earthquakes and volcanoes
- *Plate Tectonics* CD by Tasa Graphics

** enough for every group of 5 students*

Procedures

In this activity students will demonstrate the theory of plate tectonics.

1. Before class, mix red food coloring into the tub of water and place at stations for each group activity.
2. Giving students a cross section diagram of the earth, have them color the crust brown, blue to fill in the oceans, red for the mantle, yellow for the inner core and yellow mixed with red for the outer core.

3. Display the tub of red water and ask if anyone can tell what section of the earth the colored water represents (the hot liquid mantle).
4. Cut the Styrofoam dinner plate into 3 or 4 puzzle shaped pieces.
5. Lay the pieces of Styrofoam (fitted together) on top of the "mantle" water. Mention to students not to move the table, the water must be still to begin activity. Ask the students to pretend they have gone back in time millions of years. Now these plates fit together like a jigsaw puzzle. Do the children think the pieces will fit together like this forever?
6. Next, have the students stamp their feet to cause and stimulate energy and movement in the mantle.
7. Observe what happens to the plate sections.
8. Have students look at the map of the major plates on the earth's surface.
9. Discuss types of plate boundaries and causes of plate movement:

Information for Classroom Discussion

Plate tectonics is based on the theory that the surface of the earth is composed of about a dozen major, rigid, moving crustal plates, and several smaller plates. These crustal plates move because they are driven by convection cells circulating within the mantle. (Show diagram of convection cell movement and cross section of the earth.) The rigid portion of the plates, including the crust and a small part of the upper mantle, is known as the lithosphere. Explain that the plates float on a molten portion of the mantle called the asthenosphere. Temperature changes within the earth also support the convection model of plate motion. These convection cells bring material to the surface at the ocean ridges and pull it back into the earth at the trenches. The ocean ridges are places where up-welling pushes heated material toward the earth's surface. The CD *The Theory of Plate Tectonics* will provide information and give a graphic view to hot spots, trenches, subduction zones, and volcanic regions of the world. Use this media to provide a clear picture of an abstract theory.

ACTIVITY/ DAY 2: Making Pangaea

Objectives

- To observe how the continents of the earth fit together.
- To observe the relationship between continents' coastlines.
- To understand that the pressure within the earth may have broken a large land mass into pieces.
- To identify what continents fit together like a puzzle.
- To introduce the theory of Pangaea.

Materials

- One flat basketball or similar sized ball (cut into sections that remain joined only around the "equator", so that it lies flat).
- 2 world map worksheets*
- Glue*
- Blue construction paper*

**for each group of 5 students*

Activity A. Procedures

This is a demonstration activity to introduce the theory of Pangaea.

1. Show the students the cut-apart ball and ask them to visualize how the ball looked before it was cut.
2. Have them look at the flat outline of the world map and ask if anyone can explain how continents on a map of the world might relate to one another.
3. Use the desk atlas and label the continents on the blank world map.

Activity B. Procedures

In this activity students will put together a map that supports the theory of Continental Drift. The students will relate this to the theory of Pangaea.

1. Give students a copy of the continental worksheet.

2. Students are to cut out the following land masses: North America, South America, Africa, Australia, Europe, Asia, and Antarctica.
3. Students are to fit all these landmass cutouts together like a jigsaw puzzle.

Information for Classroom Discussion

The continents look like large jigsaw-puzzle pieces. Explain that the coastlines of the continents have irregular shapes that appear to fit together. Use the globe to identify where the continents look like they do fit together. Alfred Wegener, a German meteorologist and astronomer, proposed that the earth's continents have separated and collided as they have moved over the surface of the earth for millions of years.

Discuss evidence such as:

1. South America and North America would fit into the shoreline with Africa and Europe.
2. Fossil species have been found on widely separated parts of the earth.
3. Ancient continental rocks and fault and fold structures do match if America was moved next to Africa and Europe.
4. Ancient climates, such as coal beds, fossil coral reefs, glacial polish, and till deposits left by glaciers, have been found in areas where the climate is now very different from when they formed. This is a good explanation that the continents have moved.

ACTIVITY/DAY 3: Sea Floor Spreading

Objectives

- To understand the relationship between the movement of magma and the ocean floor's surface.
- To understand the movement of the old floor and its relationship to the new floor.
- To identify the Atlantic Ocean as an example of sea floor expansion.
- To draw a model of sea floor spreading.

Materials

- Scissors*
- Shoe box
- Modeling clay*
- 2 sheets of paper
- Pencil
- Transparencies showing examples of the Mid-Atlantic ridge, ocean floor spreading, and molten rock movement under the earth's surface.
- Video clip of molten rock movement under the ocean floor.
- World Map Identifying the Mid-Atlantic Ridge.

**for each group of 5 students*

Activity Procedures

In this activity students will make a model to represent sea floor spreading.

1. Cut two 3 in. X 11 in. strips from a sheet of paper (do prior to activity).
2. Cut out a 0.5 in. X 3.5 in. section from the center of the bottom of the shoe box.
3. Cut out a section in the center of one of the box's largest sides.
4. Put the paper strips together and run them up through the slit in the box.
5. Pull the strips out about 3.5 in. and fold them back on opposite sides.
6. Press a flattened strip of modeling clay about the size of a pencil on the end of each strip.
7. Hold the papers under the box between your index and second finger.
8. Slowly push the strips up through the slit in the shoe box.
9. **Results:** The clay pieces move away from each other as more paper moves upward. This movement demonstrates the motion of the ocean floor's surface along the Mid-Atlantic Ridge.

Information for Classroom Discussion

Why? The clay represents continents bordering the Atlantic Ocean. The rising paper acts like the hot, molten rock moving out of the crack in the mid-ocean ridge. When liquid rock pushes through the ocean floor's surface, it forms a new layer on both sides of the crack. It is believed that this new material pushes against the old floor, causing it to spread. Discuss the relationship of where the old floor is located in terms of the location of the new floor. The Atlantic Ocean may be widening by about 1 in. (2.5 cm) each year. As the ocean widens, the continents of Europe and North America are moving apart as did the clay pieces (refer to the map and identify the ridge between the two continents). Use the transparencies to lead a discussion on how the ocean floor widens along the Mid-Atlantic Ridge. After the discussion have the students work together to draw a diagram of sea floor spreading.

ACTIVITY/ DAY 4 and 5: Volcanoes and Their Locations

Objectives

- To simulate a model of an erupting volcano.
- To understand that magma is under the earth's surface and when it reaches the earth's surface it is called lava.
- To identify differences and similarities between the model and an actual volcano.
- To identify places in the world where volcanoes are located by using a desk atlas.

Materials

- Paper cone (for snow cones) *
- foil*
- Brown modeling clay*
- Baking soda*
- Vinegar*
- Red food coloring*
- Cup 3 oz.*

- World atlas*
 - Video of volcanic eruptions**
 - World map centering on Pacific Ring of Fire
- * *Enough materials for each group of 5 students*

Activity A Procedures

In this hands-on activity the students will make a model of a volcano, comparing the model to a real one.

1. Cut off cone to create a crater.
2. Cover the cone with brown modeling clay to represent the earth.
3. Make a depression in the foil, representing a cup shape, and fit the foil down into the crater area. (This is most easily done by molding a small piece of foil over your thumb.)
4. Fill the foil cup with baking soda.
5. Pour a small amount of vinegar into the 3 oz. cup.
6. Add red food coloring to the vinegar to look like lava.
7. Dribble vinegar over the crater of baking soda. This will simulate an eruption.
8. **Results:** The vinegar will react with the baking soda and flow down the sides of the cone to simulate a volcanic eruption. The red food coloring will simulate the red color of lava.

** After the hands-on activity show the video on volcanoes. The video will lead into the class discussion.

Activity B Procedures

In this map activity students will improve their map skills and identify locations of notable volcanoes. Students will also recognize the pattern of volcanoes known as the Ring of Fire.

- Using a world atlas depicting major volcanoes have the students identify locations of volcanoes in the world.
- Have students mark each volcano and label them on a blank world map.

Examples of Notable Volcanic Eruptions

These are but a few examples of what the students may find:

VOLCANO	PLACE	YEAR
Kilauea	Hawaii, U.S.	1983-present
Pinatubo	Philippines	1992
Redoubt	Alaska, U.S.	1989-1990
Nevada del Ruiz	Columbia	1985
Mauna Loa	Hawaii, U.S.	1984
St. Helens	Washington, U.S.	1989
Krakatoa	Sumatra, Indonesia	1919
Vesuvius	Italy	1979

Information for Classroom Discussion for Activities A and B

WHY? Explain that a volcano is a mountain, or a hill formed around a crack in the earth's crust, through which magma and other hot materials are thrown out. Discuss how magma moves towards the earth's surface and cools and hardens as it rises. Magma becomes lava when the magma reaches the earth's surface. Lava rocks, like pumice and scoria, are very light rocks, with holes in them, formed from the lava that hardened while steam and other gases were still bubbling from it. Discuss how the simulation (volcano model) was the same as an actual volcano and how the model was different. You may want to make a Venn-diagram to illustrate these traits. Discuss the relationship of where most volcanoes are found. Discuss the Pacific Ring of Fire. Discuss the volcanoes in Iceland, the Azores, and some islands in the West Indies.

Evaluations

Each of these lessons will be evaluated according to activity objectives. Students will be assessed on their completed projects.

National Geography Standards:

1: How to use maps and other geographic representations, tools, and technologies to acquire, process, and report information from a spatial perspective.

4: The physical and human characteristics of places.

7: The physical processes that shape the patterns of the Earth's surface.

17: How to apply geography to interpret the past.

18: How to apply geography to interpret the present and plan for the future.



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