Moving Plates

Overview

In this half class-period activity, students return to the puzzles they assembled in the Plate Tectonics activity and use puzzle pieces to simulate the movements of plates. In doing this, students understand why volcanoes and earthquakes are often found near plate boundaries.

North Carolina Essential Science Standards

6.E.2.2 Explain how crustal plates and ocean basins are formed, move and interact using earthquakes, heat flow and volcanoes to reflect forces within the earth.

Brief Science Background

Earthquakes and volcanoes provide evidence that tectonic plates continually move and change. Movement of semi-liquid molten rock (magma) beneath the surface slowly shifts the tectonic plates. The molten rock rises toward the surface and falls back toward the core, producing slow currents that move the plates. As a result of this motion, some plates separate; some collide; some slide over or under one another; and some move sideways against each other. Where upwelling magma moves plates apart under the sea, we find volcanic activity and sea floor ridges. Even though plates may be separating on the sea floor, ridges can form there instead of cracks because molten rock solidifies in these places and builds up. Elsewhere around the earth, volcanoes occur anywhere magma penetrates the crust. Plate motion also lifts up mountains and even moves continents. Earthquakes occur where adjacent plates collide, slide under one another, or slip from side to side. Some earthquakes that are not directly on plate boundaries arise from cracks in the crust (faults) caused by moving plates. Plate movement builds up pressure in faults until the two sides of the fault suddenly shift to release the pressure. The result is earthquakes and tsunamis.

Materials for the whole class

- ability to project SD-1, the map of the world with tectonic plate lines

Materials for pairs of students

- puzzle from the Plate Tectonics activity
- SD-1, map of the world with tectonic plate lines
- Two raw spaghetti noodles (one per student).

Preparation

Preview the following YouTube video showing how magma moves tectonic plates. https://www.youtube.com/watch?v=ryrXAGY1dmE

Exploration

1. Ask the class to summarize what we know so far. Earth's surface is made up of plates, some geologic activity happens around the edges of these plates, and we see mountains and ocean ridges that line up with the plates. Accept any explanation as speculation.
2. Ask the class why they think some volcanoes and earthquakes are near plate boundaries.
3. Show YouTube video https://www.youtube.com/watch?v=ryrXAGY1dmE showing how magma moves tectonic plates. Explain that this video is much faster than real time. The video shows plates moving hundreds of miles in a few seconds, but they actually move only inches per year.
4. Discuss with the class what this video shows with regard to volcanoes, earthquakes, and the plate boundaries.

Procedure

1. Give out the puzzles and ask students to assemble them shiny-side-up.
2. After puzzles are assembled, project SD-1 and ask students to find the part of the Pacific Plate that runs along the west coast of the US.
3. Explain that the Pacific Plate is moving northwest and the North American plate is moving southwest. The two plates slide past each other along the west coast. Ask students to push their Pacific and North American plates together and slide one North and one South to copy this action. Ask what happens to the edges where the plates grind together. In fact, the Pacific Plate moves about 3-4 inches (7-10 cm) per year to the northwest and the North American plate moves about an inch (2.5 cm) per year to the southwest. If students rub hard, the edges fray a little. Rock at the edges of faults breaks like the fraying cardboard of the puzzle piece. In the western US, edges of rocky crust catch against each other, build up pressure, break, and suddenly slip in opposite directions to cause earthquakes. Places where this happens are called faults.
4. Give each student one stick of spaghetti and warn them to be careful not to break the stick. Ask students to hold both ends of the spaghetti in two hands, with the stick straight. Ask them to bend the stick just slightly - the smallest amount that they can see. Afterward, ask them to slowly continue bending the stick to see how far they can bend it without it breaking. As the sticks break, explain that slowly moving plates create sudden earthquakes because the movement slowly builds up pressure on both sides of the fault, until the fault breaks like the spaghetti stick. The fault holds until the pressure builds up enough to cause an earthquake.
5. Ask students to find the South American and African plates. Explain that these are moving apart in the middle of the Atlantic Ocean. Ask students to move these two plates slightly apart. Ask what is happening to the far sides of these plates? They are moving into other plates.

6. Ask students to find the Nazca Plate and the South American Plate. The Nazca Plate is sliding under the South American Plate and causing the Andes Mountains to form. Ask students to slide their Nazca Plate under the South American Plate. What happens to the South American Plate? It is lifted up by the thickness of the puzzle piece.
7. Ask students to find the Eurasian Plate and the Indo-Australian Plate. In Tibet, north of India, these two plates are colliding without one plate sliding under the other. Both plates push each other up to form the Himalaya Mountains. Ask students to push the edges of these two puzzle pieces together without one sliding under the other. What happens? The two plates buckle upwards. Students might find it difficult to press on the cardboard pieces to make this happen. You can demonstrate the effect of the two plates pressing against each other in this way by pushing on a piece of paper from both sides. It will create a mound in the center as shown in the diagram below.

Reflection/Discussion

- Describe the crust of the earth. What do we know about its structure? It is a thin layer on top of the molten part. It is not one solid piece, but broken into parts, called tectonic plates.
- How would you describe the motion of the plates? Powerful enough to lift up mountains, but very slow.
- What causes the plates to move? Moving magma below them.
- What are ways that the plates interact with each other? They separate, collide, slide under, slide over, or move sideways against each other.
- How does interaction between plates relate to locations of volcanoes and earthquakes? Interaction between plates causes volcanoes and earthquakes, so volcanoes and earthquakes tend to be near the borders of plates.

  NOTE: For students who wonder about volcanoes and earthquakes not near boundaries between plates, explain that there are fractures, thin spots, and unstable regions within plates. Earthquakes and volcanoes occur in these places, which can be anywhere on a plate.

SD - 1 TECTONIC PLATES