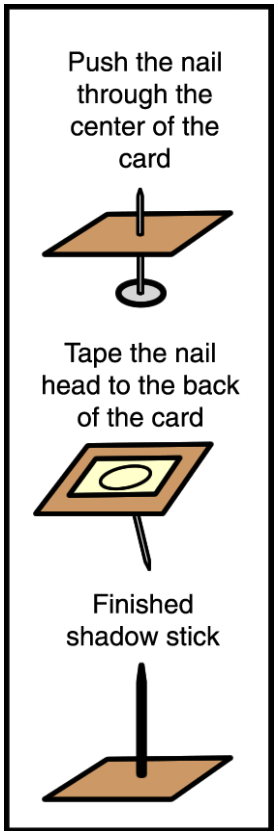
What Shape Is Earth?

For nearly 2000 years before Columbus, people knew that the Earth was shaped like a ball. No one knows who first proposed this idea, but Pythagoras of Samos may have suggested it about 500 B.C. The idea was strongly supported by Aristotle. In about 350 B.C. Aristotle mentioned the disappearance of ships over the horizon, the Earth's round shadow on the moon during an eclipse, and the changing positions of stars as a person travels southward. Unlike modern scientists, however, Aristotle believed that the Earth must be a sphere, because a sphere is a perfect shape!

In this activity, your students will explore one very important line of evidence, known in Ancient Greece, that supported the idea that the Earth is shaped like a ball. They will see that shadows of vertical sticks, placed at different locations around the Earth, have different lengths at the same time. This particular argument for the ball-shaped Earth premise lays the foundation for the next activity in which the students measure the Earth's circumference.

Materials

- 1 large globe of the Earth without the cradle (at least 12" in diameter)
- 1 large flat map of the world
- 12 nails with large, flat heads about 1–2" long
- 12 pieces of stiff stiff paper, 1" x 1" cut from index cards
- 1 pair of scissors
- 1 roll of masking tape
- 1 ruler
- A sunny day

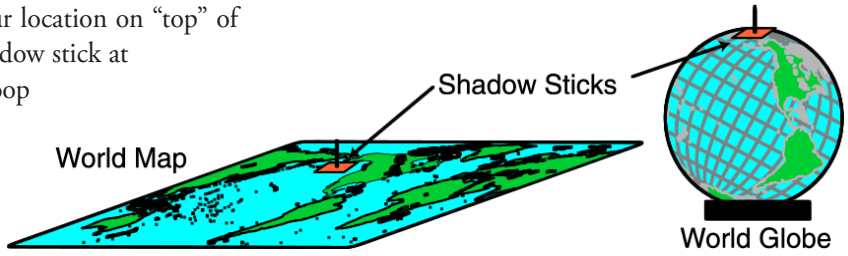


Preparation

1. Make 12 shadow sticks by pushing the nails through the centers of the 1" x 1" pieces of stiff paper and taping the nail heads to the backs of the cards. For extra safety, blunt the ends of the nails with a file.
2. Make a few masking tape loops, with the sticky side out, so that the shadow sticks can be attached to the globe and flat map.

Part A. Shadows Around the Earth

1. Take your class outside on a sunny day.
2. Set up the globe on a support with your location on "top" of the globe. Have a student place one shadow stick at your location, taping it in place with a loop of masking tape.
3. Place the flat map of the world on the ground nearby. Have another student place a shadow stick at your location on the flat map and hold it in place with tape.



4. Ask a third student to use the ruler to measure and compare the lengths of the two shadows.
5. Form a team of students to place five or six shadow sticks on the globe with tape in various sunny locations all over the world. Ask them to measure and compare the shadows.

Are they the same, or different, and why? [The shadows are different lengths because the globe is round.]

6. Form another team of students to place five to six shadow sticks on the flat map of the Earth at the same locations as on the globe. Ask them to measure and compare the shadows.

   Are they the same, or different, and why? [Approximately the same because this map of the world is flat.]

7. Ask the students if their observations of shadows on the globe and flat map suggest a way to determine if the Earth is really flat, or round like a ball. (We could have people in cities all around the world measure the lengths of shadows from vertical sticks of the same size. Then they call each other on the telephone. If the shadows are the same, the Earth is flat. If the shadows are different, the Earth is round!)

Part B — Finding the "No Shadow" Place

1. Have students experiment with the shadow sticks to find a place on the sunny side of the globe where there is no shadow cast by the nail. When the place is located, tape the shadow stick to the globe. It marks the place where the Sun is directly overhead at that moment in time.
2. Find the same place on the flat map, and compare the shadow on the flat map with the lack of shadow on the globe.
3. Try to find the "no shadow" place on the flat map of the Earth. The shadows on the flat map of the Earth will all be the same. The students will not be able to find a "no shadow" place on the flat map of the Earth.
4. Explain to your students that the varying lengths of shadows on the globe demonstrate what is observed on the real Earth. It is evidence that the Earth is round. Today we define the tropics as the portion of the world where there is at least one "no shadow" day each year when the Sun passes directly overhead at local noon. The next activity, How Big Is the Earth?, allows students to apply these concepts to measure the size of the Earth.