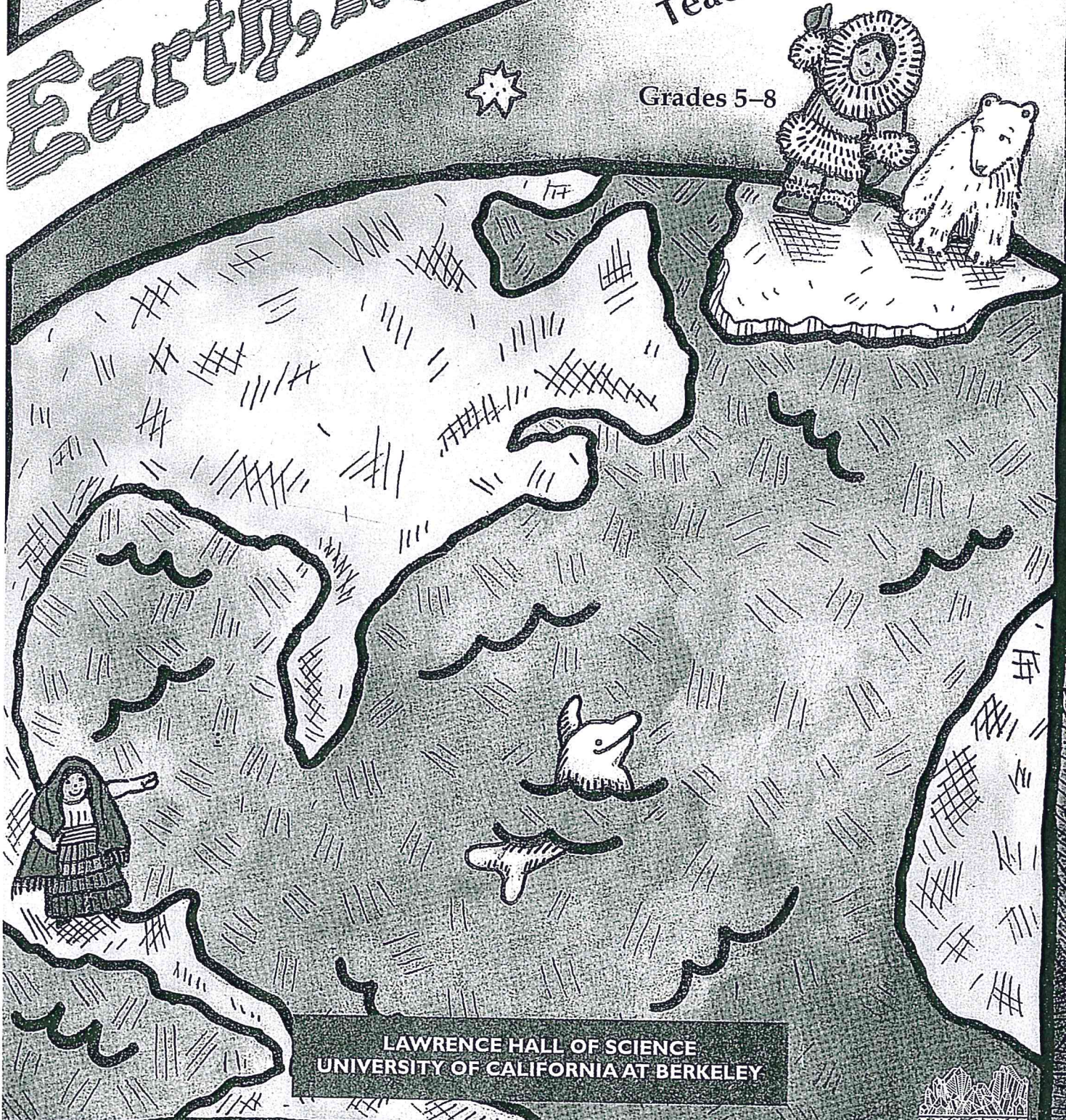


Earth, Moon, and Stars

Teacher's Guide

Grades 5-8



LAWRENCE HALL OF SCIENCE
UNIVERSITY OF CALIFORNIA AT BERKELEY



Activity 1: Ancient Models of the World

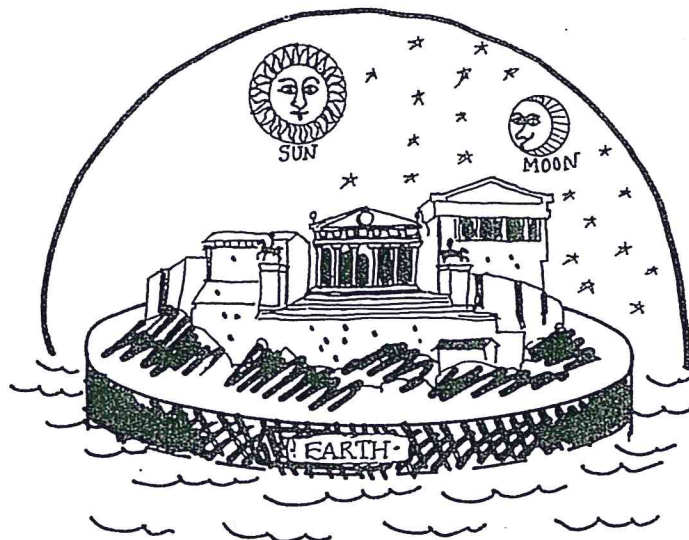
Introduction

Even from a high mountain, the Earth *looks* flat. So it is natural that most ancient models of the world did not portray the Earth as round.

In this first activity, your students compare four ancient models of the Earth. They learn how each of these models explained common events seen daily in the sky, such as the Sun rising in the east and setting in the west. Your students then invent their own "ancient models" of the world.

The process of creating models leads to a much deeper understanding of how they are used in science than does a model designed by someone else. Your students will learn that the science of astronomy began when people started comparing different models to see which ones were most helpful in explaining what they saw in the sky.

Your students will also learn that these early models of the world evolved from ancient myths, passed on to later generations in stories and art. The parts of this activity which describe and illustrate these myths address learning objectives in language and art, as well as science.



Thales' idea of the world in 500 B.C.
"The earth is like a cork bobbing
in the sea."

Time Frame

Part I: Models of the World	40-90 minutes
Part II: Presentations	40-90 minutes

Part I takes about 40-50 minutes if the final drawings are assigned as homework, and closer to 90 minutes if these drawings are completed in class. The length of Part II depends on the number of students in your class, and how much time you allow for each pair of students to present their ideas.

What You Need

For each pair of students:

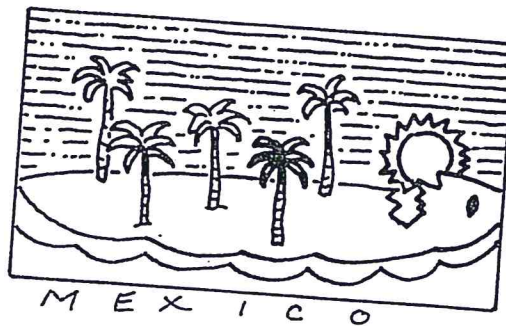
- 2 copies of the "Ancient Models of the World" activity sheet (master included, page 7)
- 1 large sheet of paper or cardboard
- crayons or magic markers

Getting Ready

Make a copy of the activity sheet for each student and yourself. Familiarize yourself with the models suggested on the activity sheet so you can facilitate the discussion.

An adaptation of this GEMS activity, "Ancient Models of the World" appeared in 1995 National Science and Technology week materials from the National Science Foundation (NSF), which added an ancient legend thought to be derived from the Aztec culture of Mexico:

The Earth and sky are two halves of a divided monster that was split in the distant past. The land is surrounded by water. The sky is held up by five trees, one in the center of the earth, and one at each corner. The sky has 13 levels and the Underworld has nine levels. The sun comes out of the Underworld as it rises in the East, travels West over the 13 levels, and is swallowed up by the monster as it sets. It travels through the Underworld, then rises again the next day.






Part I: Models of the World


1. Ask your students to describe the motion of the Sun in the sky. Most students are aware that the Sun rises in the east, goes overhead, then sets in the west. A few students may be aware that the Sun rises and sets farther to the south in the months October through February, and farther to the north in the months April through August.
2. Ask your students, "After the Sun sets in the west, how does it get all the way over to the east before it rises the next morning?" Encourage several answers.
3. Introduce the term *model*, defined as a person's explanation for something that has been observed. Your students' explanations for the motion of the Sun are "models" in this sense of the term.
4. Hand out copies of the "Ancient Models of the World" activity sheet. Tell the students that if they had gone to school 3,000 years ago, they might have been taught that *one* of these models was the *only* way to explain observations of the Sun, Moon, and stars.
5. Ask for student volunteers to read aloud the explanations given for each illustration on the activity sheet. Discuss the different explanations and approaches to the same phenomenon—the daily movement of the Sun from east to west. How might these explanations have evolved? How do the explanations reflect the surroundings of the people who created them? [The Egyptians made flat metal plates, and they lived in a river valley. People from India could not get beyond the steep Himalaya Mountains. The Chinese made beautiful rounded and square bowls from ceramic and metal. The ancient Greeks lived on islands, surrounded by the sea.]

Ancient Models of the World
In each of the countries listed on this page, there were many different stories about the world. Here are just a few of these stories.

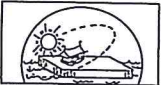
EGYPT
The Earth is flat. The sky is like a flat plate, supported at four points by mountains. The sun is carried across the sky in a boat, from east to west. At night, the sun is carried back to the east through the Underworld.




INDIA
The Earth is a circular disk, surrounded by the ocean. In the center of the world is a great mountain. The sun goes around the mountain once a day. In the evening, the sun goes behind the mountain on the western side of the mountain. It travels behind the mountain at night, and comes out on the eastern side in the morning.



CHINA
The sky is a round dome, surrounding a flat square-shaped Earth. The ocean goes all around the Earth. The sun travels in a big, tilted circle. At night the sun is not under the Earth, but rather on the side of the Earth.



GREECE
Most ancient Greeks believed that the Earth floated in the ocean like a cork in water. One person, named Anaximander, thought that the Earth was a cylinder with a rounded top, floating in the air. The sky surrounded the Earth, and beyond the sky was a region of fire. The sun, moon, and stars were holes in the sky, through which the fire could be seen.



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There are many other possible models that could be adapted for this lesson, including stories from Native American and world cultures. Any story that explains or provides a metaphor for the rising and setting of the Sun could be used. The "Literature Connections" section at the end of this guide includes several collections that feature such stories. The GEMS guide Investigating Artifacts has a more extensive list of stories that "explain" natural phenomena, including the movements of the Sun and Moon.

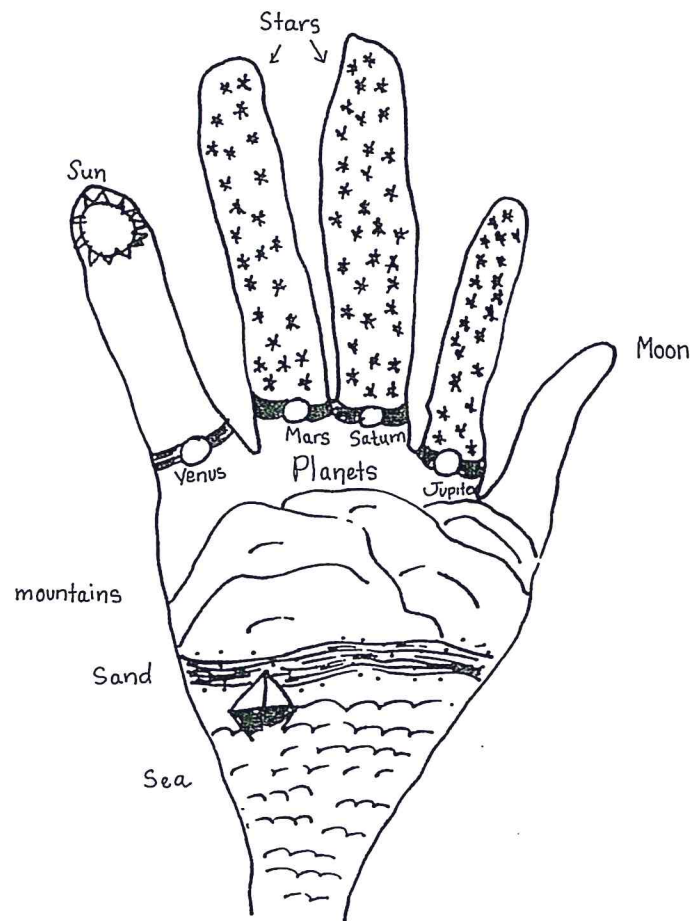
6. Ask the students to imagine that they are living several thousand years ago, on the site where they live now. Challenge them to invent a model of the world to explain how the Sun gets from the western part of the sky back to the east during the night. The model can be a flat Earth or any other shape that might explain the observations. The model can also be designed to explain observations of the Moon and stars.

7. Organize the students into pairs, and hand out scratch paper so they can sketch their ideas. (Note: This project can also be done by individuals or small groups.)

8. Give each pair of students a large sheet of white paper or cardboard. Explain that they should draw their ideas of the world so the drawing can be seen by the entire class. Suggest that they label parts of their drawings. If this takes too much time, have the students finish their drawings as homework.

9. When the students finish their drawings, ask them to decide what they will tell their classmates about how their ideas explain the movements of the Sun, Moon, and stars.

Maria and Gina (fifth graders) invented this model and explained, "The people from long ago may have thought that the world was a god's hand. The pointer, middle, and ring fingers were full of stars, and the sun was on the little finger's nail. The moon was on the thumb's nail. The moon would turn back and forth. Sometimes they saw the whole moon or half moon. The planets Venus, Mars, Saturn, and Jupiter were stones on rings. In the morning when the sun came up the three middle fingers would come down and cover the rings."

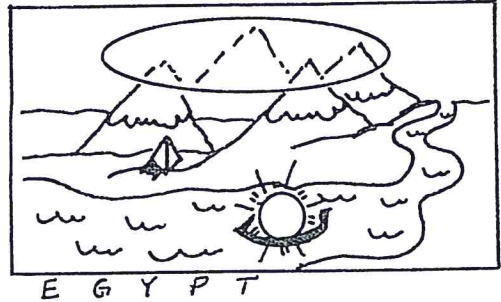


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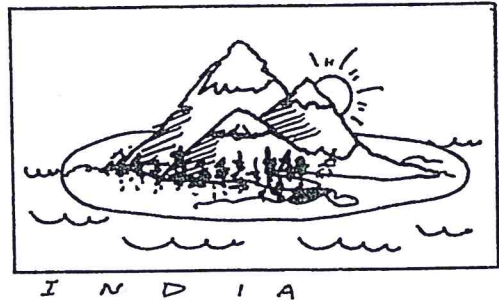
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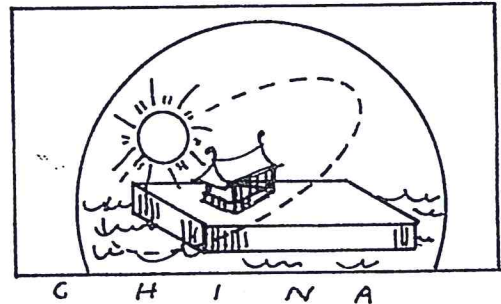
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Part II: Presentations

1. Ask each pair of students to present their ideas. After each presentation, encourage the other students to ask questions. Discuss how well each model explains what we see in the sky.
2. After the student presentations, summarize the lesson by referring to specific examples which show that many different models can be used to explain the same set of observations.
3. You may wish to end the lesson with some additional information about the history of astronomy:
 - a. Greece was a center of trade routes, where people from different countries met and exchanged stories about the Earth and sky. Some ancient Greeks listened to these stories and wondered how they could all be true. These people tried to invent models that provided the best explanations for what they saw in the sky. The ball-shaped Earth was one of these ideas, probably suggested by Pythagoras or one of his followers, over 2,500 years ago!
 - b. By the time Columbus set sail in 1492, many educated people believed in a ball-shaped Earth. Their biggest disagreement was about its size. Most people thought the Earth was so big that Columbus and his crew would run out of food before they reached land again. In fact, were it not for their unexpected encounter with the Americas, they would have!

The "Mount Nose" activity, described in more detail on page 24, can be done at the beginning of Activity 4, and helps extend and deepen what students have learned in Activity 1 about the rising and setting of the Sun and the ball-shaped Earth.