

Shadow Play

SUNWATCHERS

Until well into the last century, one of the most important people in the pueblos of the southwest was the Sunwatcher. Each day, he watched the Sun rise, using hills or other objects to track its motion along the horizon. His observations told the tribe when to plant or harvest crops, and when to conduct important ceremonies.

The Sunwatchers may have been carrying on a tradition established by some of the ancestors of the pueblo people — the Anasazi, a Navajo name that means “the ancient ones.” They built a large, well-ordered civilization in the Four Corners region a millennium ago.

Archaeological sites at several Anasazi villages suggest that they watched the Sun carefully. One example is the Sun room in Hovenweep Castle, a ruin in southeastern Utah. Doorways and windows in the room align with the sunset on the summer and winter solstices — when the Sun appears farthest north and south in the sky — and the equinoxes, when it's half-way between.

Nearby, a pair of buildings atop Cajon Mesa apparently served as a solar calendar. Sunwatchers kept track of the Sun's motion from a series of windows. They also used the shadows of the two buildings to determine the arrival of the solstices and equinoxes.

The most famous Anasazi sunwatching sites are in Chaco Canyon, in northwestern New Mexico. In fact, quite a few people are visiting the canyon this week to watch the sunrise on the summer solstice.

This is the transcript of a StarDate radio episode that aired June 19, 2001. Script by Diamond Benningfield, ©2001.



Everyone and everything has a shadow. Shadows illustrate how three-dimensional objects can be viewed in two dimensions. Younger students can learn about the Sun's relative motion in the sky as they experiment with shadows.

MATERIALS

- Chalk
- Outdoor drawing area
- Lamp
- Globe (a large globe is preferable)
- Tape
- Action figure (3 inches or smaller)

ACTIVITY ONE

Begin by asking, “Where is the Sun at noon?” Depending on the age of the child, responses might be “straight up,” “in the sky,” “overhead,” or “in the south.” Ask, “What is a shadow?” Accept responses.



PREPARATION

Divide the class into teams of two or three before going outside.

EXPERIMENT

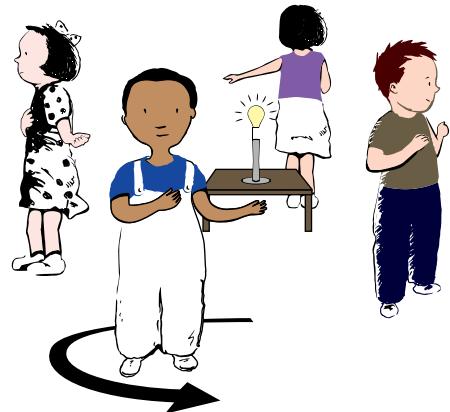
Begin in the morning. One member is to play “statue” — holding still while the other team members trace the outlines of both the statue’s feet and shadow on the pavement. When all the tracings are completed, the entire class can examine them. Wait about 30–60 minutes, then ask the “statues” to return to their places (which is why they traced their feet) and hold the same position again.

ANALYSIS

What has changed?

ANSWER

Students should notice that the length and position of the shadow have changed. Younger children may think that the “statue” changed position. Ask them to predict where the shadow will be in three hours. Repeat the tracings about once per hour until the end of the school day. The shadows will grow progressively shorter in the morning



until mid-day, after which they will grow longer. It is best to do the tracings throughout the school day. Note that the shadow never shortens enough to disappear, which means that the Sun doesn’t pass directly overhead at noon (unless you live between the tropics). Depending on the grade, students may

measure the lengths of the shadows or even graph the length versus time of day. Discuss the results.

ACTIVITY TWO

This activity demonstrates the daily motion of Earth. We perceive the Sun as rising, crossing the daytime sky, and setting. It is actually Earth that moves.

PREPARATION

Inside the classroom, arrange all the children in a circle around a lamp, which represents the Sun. The teacher should demonstrate and then ask the children to “spin.” (Young children prefer the term “spin” to “rotate” when thinking about Earth’s motion.)

DEMONSTRATION

To find the proper direction, place your right hand over your heart (the position for reciting the Pledge of Allegiance) and rotate in the direction the fingers point. (As an extension, walk around the lamp to model Earth’s annual motion around the Sun. Don’t try to spin and walk at the same time; it takes 365.25 spins to make a year!)

ANALYSIS

What has changed?

ANSWER

When children are facing the lamp, it is day. When they are facing away from the lamp, it is night.

ACTIVITY THREE

PREPARATION

Inside the classroom, demonstrate the connection between the first two activities. First, tape the action figure onto the globe at your geographic location. Still using the lamp to represent the Sun, place the globe at least 6 feet away from the lamp (ideally with the globe’s spin axis tilted relative to the lamp to represent the current season, so it will be tilted away from the lamp in the winter and toward it in the summer).

EXPERIMENT

Darken the room and spin the globe so that everyone can see a change in the length and position of the figure’s shadow.

ANALYSIS

How does the figure’s shadow compare to the childrens’ shadows outside?

ANSWER

The behavior of the shadows should be similar. Spinning the globe counter-clockwise when looking down on the north pole will show the proper movement of the shadow from west to east.

EXTENSION

Students draw pictures of why we have day and night.

Students study how ancient people created stories about what causes day and night.

NATIONAL SCIENCE EDUCATION STANDARDS

- Content Standard in K-4 Earth Science (Objects in the sky, Changes in Earth and sky)
- Content Standard in K-4 Science as Inquiry (Abilities necessary to do scientific inquiry)

