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. More on that tomorrow.

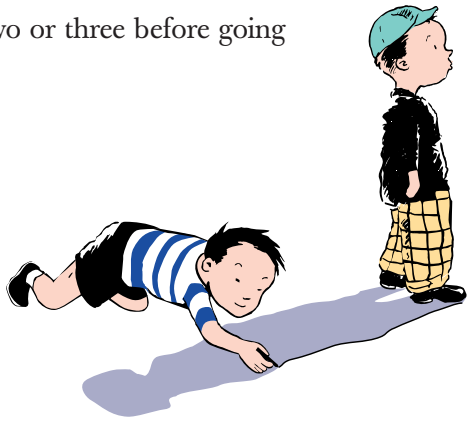
Everyone and everything has a shadow. Shadows illustrate how three-dimensional objects can be viewed in two dimensions. Younger students can learn about the Sun's relative motion in the sky as they experiment with shadows.

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.



Materials

- Chalk
- Outdoor drawing area
- Lamp
- Action figure and flashlight for each team of students

Experiment

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. 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.

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)

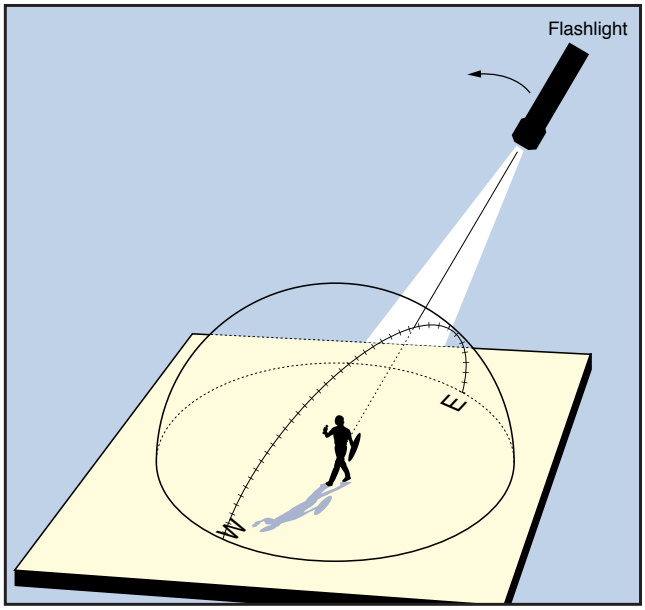
ACTIVITY THREE

Preparation
Replicate the outdoor activity in the classroom by placing an "action figure" (a 3-inch figure works well) on a piece of paper. Use a flashlight to represent the Sun in the darkened room.

Experiment
Move the "Sun" across the sky, from rising in the east to setting in the west, through a curved path over the paper.

Analysis
What changes?

Answer
The position of the flashlight mimics the daily apparent motion of the Sun as Earth rotates.



TIM JONES (3)

Extension
Students draw pictures of why we have day and night.

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

Shadow Play

Subjects: Our Solar System

Grade Levels: K-5

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Texas Essential Knowledge and Skills

Science:
§112.11 kindergarten (b)-6(A) use the five senses to explore different forms of energy such as light, heat, and sound.

§112.11. kindergarten (b)-8(B) identify events that have repeating patterns, including seasons of the year and day and night.

§112.12. grade 1(b)-2(D) record and organize data using pictures, numbers, and words.

§112.12. grade 1 (b)-2(E) communicate observations and provide reasons for explanations using student-generated data from simple descriptive investigations.

§112.12 grade 1 (b)-(8)(B) observe and record changes in the appearance of objects in the sky such as clouds, the Moon, and stars, including the Sun.

§112.12 grade 1 (b)-8(C) identify characteristics of the seasons of the year and day and night.

§112.13 grade 2 (b)-8(D) observe, describe, and record patterns of [caused by] objects in the sky, including [shadows and] the appearance of the Moon.

§112.14 grade 3 (b)-3(C) represent the natural world using models such as volcanoes or Sun, Earth, and Moon system and identify their limitations, including size, properties, and materials.

§112.14 grade 3 (b)-8(C) construct models that demonstrate the relationship of the Sun, Earth, and Moon, including orbits and positions.

§112.15 grade 4 (b)-8(C) collect and analyze data to identify sequences and predict patterns of change in shadows, tides, seasons, [in the reflection of sunlight,] and [in] the observable appearance of the Moon over time.

§112.16 grade 5 (b)-8(C) demonstrate that Earth rotates on its axis once approximately every 24 hours causing the day/night cycle and the apparent movement of the Sun across the sky.