



# SUN SHADOW TRACERS

## **BENCHMARK and TASKS**

**SC.E.1.2.1** The student knows that the tilt of the Earth on its own axis as it rotates and revolves around the Sun causes changes in season, length of day, and energy available.

- The student locates and describes the position of an object relative to another object or the background (e.g., the earth changes its position in relation to the sun).
- The student describes an object's motion by tracing and measuring its position over time (e.g., the relationship of the sun's position to the earth as the earth rotates during the course of a day).

## **KEY QUESTION**

How can the changing of shadows demonstrate the earth's movement on its axis?

## **BACKGROUND INFORMATION**

Shadows are created from indirect light from the **sun** and the earth's movement. When an object blocks light, a shadow is created based on the shape of the object. Indirect light occurs best in the morning and afternoon. The shadow cast by an object changes over time. Over the period of several months, the shadow changes in length. A short shadow indicates that the sun is high in the sky. A longer shadow indicates that the sun is lower in the sky. During the day, the shadow changes in length and position, allowing the sun to be used as a clock, which demonstrates the movement of the earth on its **axis**.

## **MATERIALS**

### **Teacher**

overhead projector

### **Per group**

1 small lump of clay  
1 large sheet of white poster board  
1 sharpened pencil or a craft stick  
clock or watch  
1 compass  
1 colored pencil or crayon  
1 metric ruler  
1 small lump of clay

## **TEACHING TIPS**

1. Select an appropriate outdoor area prior to the activity.
2. Begin this activity as early in the morning as possible. Students will need to observe shadows every hour throughout the day.
3. **Caution students never to look directly at the sun!**

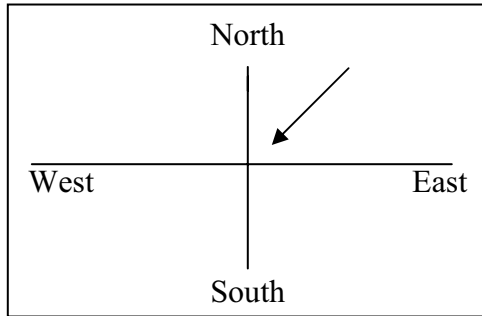
## **ENGAGE**

1. Using the overhead projector as a light source, trace a child's profile on the board.
2. Ask:  
*What do you see?* (a silhouette)  
*What is another name for a silhouette?*

*What caused the shadow to appear?  
Where do we find shadows?*

**EXPLORE**

1. Tell students to draw a horizontal line and a vertical line across the middle of a white poster board. Write the directions *North*, *South*, *East*, and *West* as shown in the illustration.



2. Next, students should place a lump of clay in the center where the two lines intersect (see the arrow) and stand the sharpened pencil straight up in the center of the clay.
3. Take the students outside and direct them to place their sun shadow tracers out in the open on a flat surface. They should use a compass to help them position the poster boards, according to the directions that are marked.
4. Students will use a ruler and a crayon to draw a line, tracing the shadow made by the pencil (from pencil to shadow's end). Tell students to measure the length of the shadow line in centimeters and record it on the Sun Shadow Tracer chart under the correct hour.

**Sun Shadow Tracer Chart**

<b>Hour</b>	<b>10 a.m.</b>				
<b>Estimated length of Shadow</b>	<b>9 cm</b>				
<b>Actual Length of Shadow</b>	<b>12 cm</b>				

5. Have students predict how the line will have changed before each tracing and measurement is made.
6. Repeat these steps every hour on the hour throughout the school day, if possible.

**EXPLAIN**

*In what direction did the sun rise? (east)*

*In what direction will the sun set? (west)*

*Why does the sun appear to rise in one direction and set in another? (Have students stand up and slowly turn around from west to east while noticing in what direction the surroundings appear to be moving. The same idea applies to the earth's rotation; the earth spins from west to east, making the sun appear to move from east to west.)*

*When was the shadow line the shortest? (when the sun was highest in the sky – around noon)*

*When was the shadow line the longest? (when the sun was lowest in the sky)*

*What caused the shadow line to change? (the rotation of the earth on its axis)*

*Is the sun traveling around the earth or is the earth traveling around the sun? (Contrary to what it looks like, the sun doesn't really move across the sky; the earth travels around the sun.)*

### **EXTEND/APPLY**

1. Make a line graph showing the length of the hourly shadow line over time.
2. Have students take their Sun Shadow Tracers back outdoors and place them in the same position as before. Instead of checking the shadows hourly, watch the shadow pattern over several weeks to see how it changes.

3. Discuss:

*Can you detect a change in the shadow's length from one week to the next?*

*How long did it take before you could see a change in the length of a shadow line?*

*What caused the shadow line to change?*

### **EXTENSIONS**

1. Discuss the characteristics of an efficient Sun Shadow Tracer.
2. Ask students if they can think of any other objects outside that would make accurate sundials. Try this activity using those objects.
3. Have your students track the path of the sun for a short while or over a long period of time. Tape a small mirror flat on a classroom windowsill. As the sun reflects off the mirror, it will make a spot on the ceiling. At a certain time during the day (same time each day, week, or month), have a student mark the date on a paper circle and use it to mark the sun spot on the ceiling. As the path of the sun changes throughout the year, going higher and lower, both the angle and the position of the spot will change. As the year progresses, a figure eight pattern will develop, with the point furthest in representing the winter solstice, when the sun is lowest in the sky. Daily changes can be marked with smaller circles and noted every fifteen minutes.

### **ASSESSMENT**

Have students respond to this question:

*Have does the length of shadows change throughout the course of a day?*