Lesson 4: Making a Sun Clock

A major factor contributing toward our concept of time is based on the apparent motion of the Sun. In this activity, students will construct Pocket Sun Clocks. They are challenged to determine the correct orientation needed for the Sun Clock to function. Keeping track of the Sun's shadow with the Sun Clock will help reinforce for students the relationship between the Sun's motion and our concept of time.

Concepts

Our notion of time is based in large part upon the apparent motion of the Sun.

Objectives

Students will:

- construct Pocket Sun Clocks;
- make observations about the passing of time using their Sun Clocks; and,
- explain the relationship between the motion of the Sun and our concept of time.

Materials

One per student:

- Pocket Sun Clock pattern (for your location)
- Cardboard slightly larger than the Sun Clock (file folders, index cards, etc.)
- String, 7 inches (20 centimeters) long
- Astronomy Notebook

One or two per group:

- Glue
- Chalk or pencil
- Scissors
- Tape

Procedure

Advanced Preparation

Make a copy of the Pocket Sun Clock pattern for each student. Use the appropriate clock pattern for your specific location. If possible copy the pattern on heavy paper, tagboard or cardstock. If this is not available, duplicate the pattern on regular paper and have the students glue their patterns onto heavier weight paper. Old file folders or large index cards are good materials.

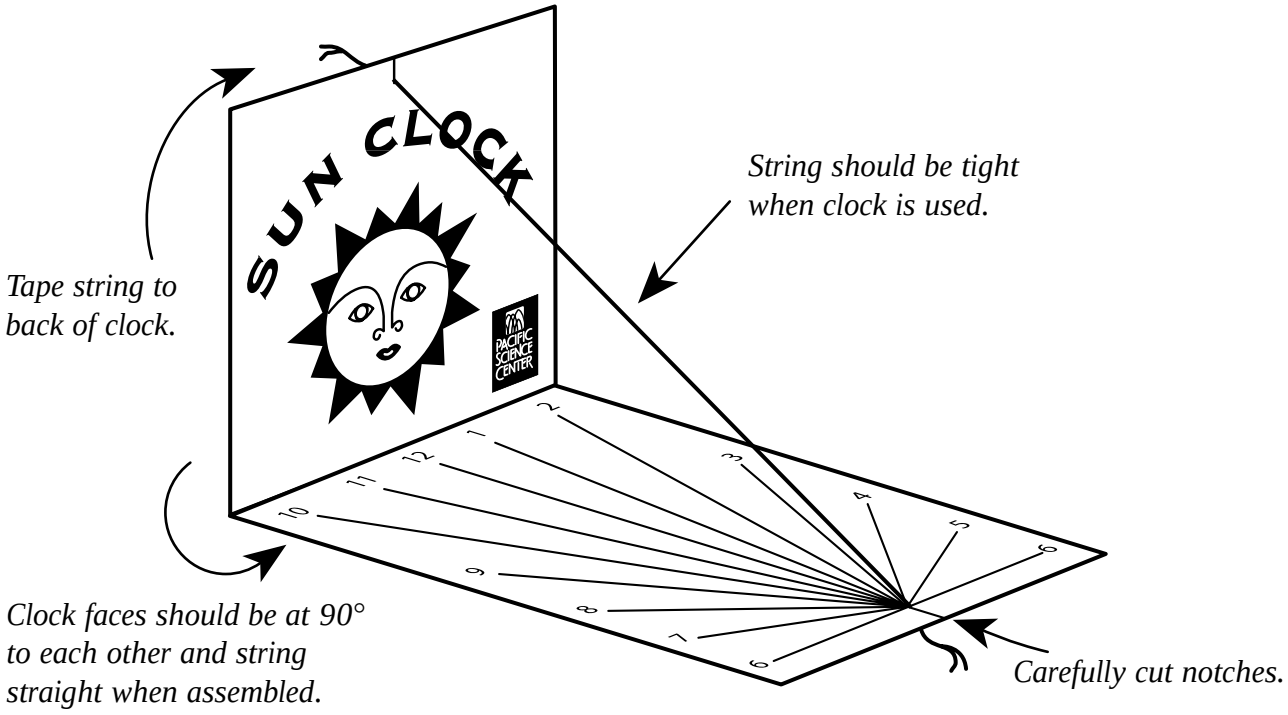
1. Distribute copies of the Sun Clock pattern. Have students cut out the rectangular pattern.

2. Students then cut, as accurately as possible, the short notches at each end, as indicated on the Sun Clock pattern. They should fold the clock along the dotted line on the pattern, making sure the print is on the inside.

3. Have students take approximately 7 inches (20 centimeters) of string, place one end through one of the notches on the Sun Clock, and tape it to the back of the clock.

4. Have them stretch the other end of the string through the notch at the other end of the Sun Clock. The string should be adjusted so it is tight when the two panels of the clock are at a 90-degree angle. Have students tape the string's end to the back of the Sun Clock.

Properly Assembled Sun Clock



5. Ask the students to decide what they would need to make their clocks work. (A sunny day!) Have them predict what position(s) the Sun Clock can be placed in to register the correct time. Have them record their predictions in their Astronomy Notebooks.

   Teacher's Note: Students will discover that the clocks must always face the same way—south. This is a good problem-solving activity; so give them plenty of time to discover the required positioning of the clocks. They need not conclude that the direction the clock must face is south (this will be explored in more depth in the next activity), but they will discover that it must always face in only one direction.

6. Before going outside to use the Sun Clocks, check the time on a clock or watch. If it is daylight saving time (depending on your locale, between the first Sunday in April and the last Sunday in October), subtract one hour to give standard time.

7. Once students have the correct standard time, take them outside to a sunny location where there is a flat surface. Be sure the location will be in the Sun for at least the next half-hour. Have them place the Sun Clocks on a flat surface, with the string of the Sun Clock taut. Have students rotate the clocks until the shadow of the string reads the correct time. Ask them to find as many orientations as possible to get the Sun Clocks to read the correct time. (They can usually find at least two.)

8. Have students use a pencil or piece of chalk to draw a box around the base of the clocks so they can tell exactly how the Sun Clocks are oriented. They should put their initials inside the boxes so they can find their clock's location when they make the next observations. Students should do this for each orientation that results in the correct time. Chalk works best on concrete or asphalt.

9. Return to the classroom and ask students how they think they will need to move their Sun Clocks so they read correctly when they check the time in 15 to 45 minutes. Will they need to change the clocks' orientation? How much, if any, will they need to move them?

10. After 15 to 45 minutes, have students place their Sun Clocks back in the spots marked earlier and determine what must be done to read the correct time. (Only one orientation will work and the clock needs to be placed in the exact same position.)

11. Have students get into small groups to discuss how to correctly orient the clocks. Did all orientations work? Is there anything special about the direction the string faces on the Sun Clocks? Have them develop a set of instructions that someone could read to understand how to use the Sun Clock. These should be recorded in their Astronomy Notebooks.

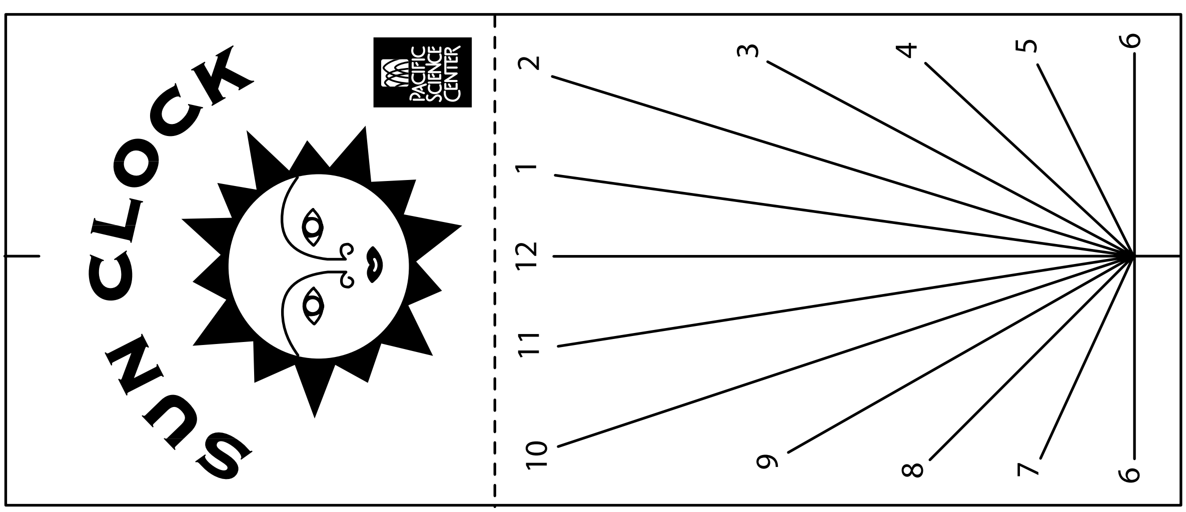
12. Have groups share their instructions for using the Sun Clocks. The directions could be written on the board and modified as different groups add or alter various instructions. Make sure the following details are included:
    a. Use the clock on a sunny day on a level spot away from buildings and trees that create shadows.

b. Choose a spot that is easy to get to when the Sun Clock is used.
c. The first time the Sun Clock is used, line up the string's shadow to give the same time as a clock or watch. (Don't forget to adjust for daylight saving time, if it is in effect, by subtracting one hour from the time on the clock or watch.)
d. Draw an outline of the Sun Clock on the surface on which it will sit each time in order to get an accurate reading.
e. Be sure to place the clock in the same orientation each time when taking a reading. The clock face (with numbers) should be on the ground and the Sun Clock face with the picture should be perpendicular to the ground.

Remember that the Sun Clock reads standard time, so an hour needs to be added to the reading when daylight saving time is in effect.

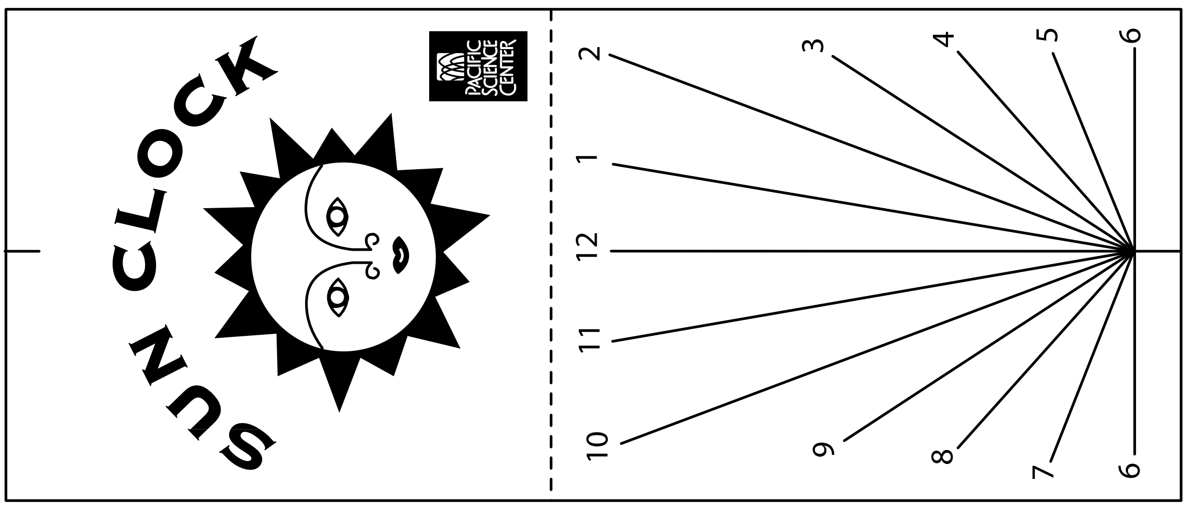
Pocket Sun Clock

CLOCK 1



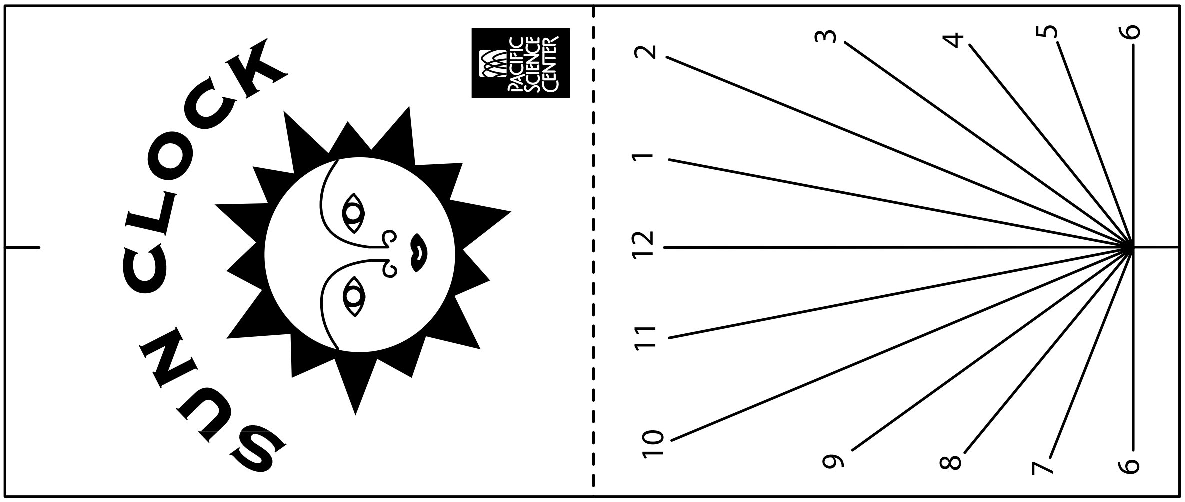
Use this Sun Clock if you live in: Southern California, Southern Nevada, Arizona, New Mexico, Oklahoma, Texas, Arkansas, Louisiana, Tennessee, Mississippi, Alabama, Georgia, Florida, North Carolina, South Carolina

CLOCK 2



Use this Sun Clock if you live in: Northern California, Northern Nevada, Utah, Colorado, Southern Wyoming, Nebraska, Kansas, Iowa, Missouri, Illinois, Indiana, Ohio, Kentucky, Virginia, West Virginia, Maryland, Delaware, New Jersey, Pennsylvania, Lower New York, Massachusetts, Connecticut, Rhode Island

CLOCK 3



Use this Sun Clock if you live in: Washington, Oregon, Idaho, Montana, North Dakota, South Dakota, Northern Wyoming, Minnesota, Wisconsin, Michigan, Upper New York, Vermont, New Hampshire, Maine, Southern Canada

Lesson 5: Using a Sun Compass

Being able to correctly orient the Sun Clock in Lesson 4 is important in using it to tell the time. A correctly aligned Sun Clock also can be used to tell cardinal directions (north, south, east and west). After students become comfortable reading time, this activity may be introduced. It will let them explore how to use the Sun Clock as a compass. All of the directions for this activity assume the participants are in the Northern Hemisphere.

Concepts

The Sun's position can be used to determine cardinal directions.

Objectives

Students will:

- relate how to tell time using a Sun Clock;
- determine cardinal directions using a Sun Clock;
- follow a set of directions using the Sun Clock as a compass; and,
- create a map based upon a set of directions.

Materials

- Pocket Sun Clock (created in Lesson 4)
- Watch
- Pencil or chalk
- Drawing paper
- Cardboard X's or other markers (one for every two to three students)
- A copy of the compass riddle
- Astronomy Notebook

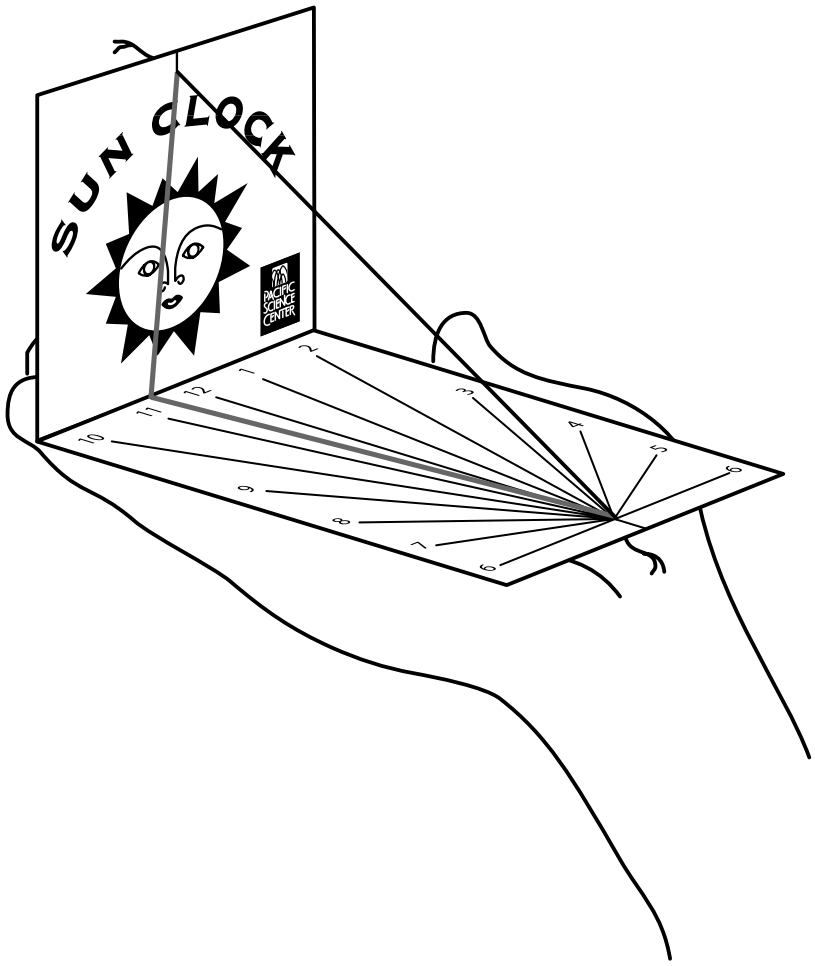
Procedure

Advanced Preparation

This activity uses the Sun Clock built in Lesson 4 of this unit. Determine an appropriate playing area for the outdoor portion of this activity. Make several large X's on construction paper or cardboard for the riddle described in the middle of this activity. Determine some reward (homework pass, small edible treat back in the classroom, computer time, etc.) that you can write on the back of the X's as a "treasure." Make copies of the riddle for students to use. Students should be reminded that it is not safe to look directly at the Sun.

1. While in the classroom, break students into small groups. Ask them to think about how the Sun Clock could be used to find direction. Allow time for them to explore this possibility with their Sun Clocks. Have them write their speculations in their Astronomy Notebooks. This extends nicely from the discussion in the last section about the need for proper orientation of the Sun Clock in order for it to work correctly. Some students already may have determined that the proper orientation for the Sun Clock is to have it face south. Make sure they can describe this to other students in their group.

2. Write the student speculations about how to use the Sun Clock to find direction on the board, directing the discussion toward the following conclusions:
   a. You need to know the time from a watch or clock to know that the Sun Clock is properly aligned. Don't forget that you need to subtract an hour from your watch's time if it is daylight saving time.
   b. If the Sun Clock is correctly aligned to read the time, it must be facing south and the rest of the directions can then be determined.



3. On a sunny day, go outside with the Sun Clocks. Ask students to hold their Sun Clocks level in their hands and rotate their clocks until they show the correct time. The Sun Clocks are now facing south, with the strings running in a north-south direction. Have students point in the direction you call out to them. If they are facing south, north will be behind them, east to the left, and west to the right. Try several different directions until you are confident that students know them.

4. Place construction paper X's about 20 feet apart in an open area with little shade. A rock may need to be placed on top of the X's so they do not blow away. Divide students into small work groups of two or three. Have the groups stand beside an X.

5. Give each group a copy of the riddle found on the following page. In order to solve it, they will have to use their Sun Clock as a compass.

   Teacher's Note: If students successfully follow the directions, they will end at the spot from which they started. If they pick up the cardboard X and turn it over, they will find their treasure. More advanced students can devise their own directions for other teams to follow. Some may want to experiment with intermediate directions, such as northeast or southwest.

6. After students have worked outdoors and followed the directions to the treasure, have them draw a map in their Astronomy Notebooks that accurately portrays the cardinal directions and is correctly aligned with them. The map should contain a dotted line of the path they just followed. The grade level of the students can determine the accuracy of the scale of the drawing. What playground features might be added to their maps to provide additional interest and references on the maps?

7. Students may wish to create their own treasure map directions. If some groups do this, they can challenge other groups to follow the directions and see where they end up going.

Sun Compass Riddle

Riddle: A treasure is to be found where these directions lead you. Use your Sun Clock to follow the instructions below to tell you where you should look:

a. Take 5 steps north

b. Take 5 steps east

c. Take 5 steps north

d. Take 10 steps west

e. Take 5 steps south

f. Take 10 steps east

g. Take 5 steps south

h. Take 5 steps west