Lesson Plan: Activity 1: Shadows

In this activity, students will explore making and tracking shadows of different objects over the course of the day to discover patterns in the behavior of sunlight, temperature and shadows.

Teaching Tip

Do this activity when the sun is relatively high in the sky, either near the beginning or the end of the school year. You'll also want to measure sun shadows at least twice and perhaps three or four times during the day to see how they vary.

It is best to conduct this shadow activity a day or two before reading the book, Bear Shadow, (Activity 2 of the Cooler in the Shadows lesson) and making the map of Bear's neighborhood (Activity 3).

Materials

Per class:

- Two large classroom thermometers or temperature strips
- yardstick
- large coffee can of soil or stones holding a 12-14" stick

Per group:

- large pieces of paper
- chalk
- an umbrella
- pencils
- markers
- paints
- various objects such as hoops, lace, balls, etc.
- large, flat sheet of cardboard, poster board, or other heavy paper (at least 2' x 3')
- compass

Preparation

Assemble the needed materials [e.g. in the center of each table, on each student's desk, etc.]. If the students are working in groups it is useful to provide the materials for each group in a bucket, tub or plastic bag so that the materials are easily carried outdoors..

Warm-up & Pre-assessment

Find out from the children what they think or know about the nature and origin of shadows. Use some of the following questions to spark the conversation:

- What are shadows?
- Can you pick up a shadow?
- Can your shadow become detached from you? If so, how?
- If your shadow is detached from you, could it be sewn back on, like Wendy did with Peter Pan's shadow?
- When do you have a shadow? What needs to be true before you have a shadow?
- Why does there have to be a bright light? What does the light do?
- Where does your shadow appear? Is there any connection to where the light is coming from?
- Can you ever have more than one shadow? How?
- If a shadow forms because you block the light, how is it that you can still see something that is in the shadow?

Teaching Tip

This exercise (or something similar) can be used when children disagree about the properties of shadows, such as their size and shape. It is best if such an exercise (or small scale experiment) arises from the children's discussion and/or specific predictions, statements or disagreements. The children might well devise similar experiments involving, say, themselves and the sun or a flashlight and toy figure. It is equally important to follow the experiments with a discussion of what was discovered. The basic pattern here is the well-known POE - Predict, Observe, Explain. This method is most likely to be effective, however, when the children co-construct both the prediction and explanation through discussion, rather than by mandate from the teacher.

Procedures

1. Divide the class into 2 teams: The Shadow-Makers and the Shadow-Trackers. (You may want to have 2 trackers per maker, so that they can compare observations.)

2. Explain the roles to be played, and how important it is that everyone participate.

3. Set up a system so you can record the temperatures on a summary chart on the board to show all the students at the end of the activity.

4. Have the Shadow-Makers lay down a piece of poster board, on which they place some objects in the sun, either outside or on a window sill.

5. Have some Shadow-Trackers trace the objects' patterns on the poster board every hour.

6. Have other Shadow-Trackers measure the temperature of the stationary objects and the shadow they create every hour, and record it, with the time of day, next to the tracing on the poster board.

7. Have the Shadow-Trackers try to draw what the objects and their shadows would look like if they could take a "snapshot" that would freeze the moment in time, like a photograph does.

8. Outside in the sunlight, mark a place in chalk for a Shadow-Maker to stand and hold at arm's length one of the objects that was placed on the ground in the first part of the investigation. Have a Shadow-Tracker trace the shadow below. (Later you will compare the traced images of the objects.

Teaching Tip

When actual temperatures are not possible to measure, have the students place their hand on the object and see if they can compare how it feels in or out of the sunlight, or compared to another object in or out of the sunlight. Use "hotter" or "cooler" to describe the different surfaces of the objects, in or out of direct sunlight.

You may also want to have the students place a small object in the shade, keeping it there by moving it with the moving shadows through the day, measuring its temperature (which should remain steadily cooler than the surface of the larger object in direct sun).

Discussion & Reflection

Summarize the students' observations on a chart set up for the whole class to see. Ask what kinds of conclusions they can make about the nature and behavior of shadows, and of objects found within those shadows.

Using the traced shadows of the objects you used both on the ground and suspended in the air, ask if there are any differences. Then have the students imagine sitting in a basket under a big tree. Would there be shade? In the tree's shadow, would it be hot or cool? Now have them imagine sitting in that basket suspended high in the air. Is there any shade? Would it be hotter or cooler there than under the tree?

Point out that when objects (such as airplanes and space rockets) move up very high into the sky, they don't have shade anymore from the Sun, so we have to keep them – and any people inside -– from getting too hot from being in the sunlight all the time.

Tell the students that we are sending up a rocket into space with a little spacecraft called MESSENGER, and that since it won't have any shadows to rest in when it gets too hot, we had to build something to give it a shadow all the time.

Ask the students if they can show you one of the objects they used in the activity that would be a good shade for a small spacecraft. If necessary, stand under the umbrella and ask them if you are in the light or in the shade. If using a lamp, let a student move the lamp. Move the umbrella to keep your faced shaded. If outside, show how you can easily keep up with the movement of the sun to keep your face out of the light. Tell them that this is exactly how they're going to keep MESSENGER from getting too hot while it's up in space.

Lesson Adaptations

- For students with hand-eye coordination problems, have them work as a team to trace shadows on for the Shadow Trackers, or give them Shadow-Making roles.

- For non-readers of letters or numbers, have them mark the thermometer's mercury level with a post-it or a crayon, so that the teacher can then read it and record it for them. See also Teaching Tip about using the hand to compare warmer or cooler temperatures.

Curriculum Connections

- *Math / Measurement:* Reading thermometers

- *English:* New vocabulary words to introduce into daily usage : shadow, shaded, sunshade, attached / detached, light intensity, temperature, exposure, illumination etc

- *Art:* Tracing images, drawing in details or color after outlining, drawing an object with its shadow when illuminated from different directions

Assessment

Have students describe (orally or in writing as appropriate) the experiment, report data, and come to a conclusion about how shadows form and how the temperature varies in sunny or shaded areas.