Weather Begins with the Sun

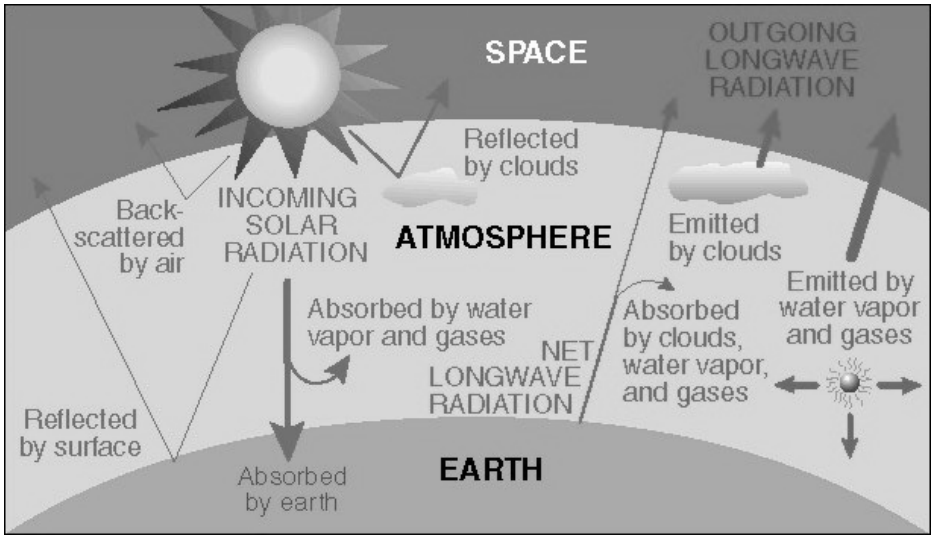
Summary
Students will investigate the effects of the sun on weather by conducting two experiments. Experiment #1 looks at the difference between a jar of water in the sun versus in the shade. Experiment #2 looks at how different surfaces reflect the sun in different ways consequently affecting the temperatures.

Objectives: Students will:
- Gain an understanding of the effects the sun has on the weather;
- Make a connection between the sun's energy and the weather and the water cycle.

Vocabulary: solar energy, radiant energy, albedo

Materials: Each of the following items are needed for each group of 2-4 students:
- 2 jars (or if doing both Experiment #1 and #2 at the same time, then each group will need 4 jars)
- Thermometers
- Aluminum foil
- Black construction paper
- Graph paper
- Copies of the data recording sheets – one for Experiment #1 and one for Experiment #2

Background
All weather begins with the energy from the sun. This energy come to the surface of the earth in the form of short-wave radiation. Many things can happen to this short-wave radiation before it gets to the earth's surface – it can be reflected back into space by earth's atmosphere, it can be reflected by clouds, or it can be absorbed by clouds, air, and water vapor.



If the short-wave radiation does make it to the earth's surface several things can happen – it can be reflected by the earth's surface or, it can be absorbed into the earth.

A portion of the incoming solar radiation is absorbed by the surface and a portion is also reflected away. The proportion of light reflected from a surface is the **albedo**. Albedo values range from 0 for no reflection to 1 for complete reflection of light striking the surface. Albedo can be expressed as a percentage (albedo multiplied by 100) that for some is easier to understand. For instance, grass has an albedo of about .23. This means that of the incoming solar radiation that strikes the grass, 23% of it is reflected away. On the other hand, highly reflective surfaces like snow have an albedo upwards of .87, or 87% of sunlight is reflected away.

When energy from the sun is not reflected by the atmosphere, clouds, or earth's surface, it is absorbed into the earth. This is what makes soil warm on summer days, or what water in lakes to be warmer in the summer.

Procedure

Warm Up

On a sunny day, take students outside. Ask the students if they can feel the sun. If it has been an especially warm day, have the students feel the blacktop or cement. Ask students why the ground feels warm? What happens if you spend the entire day in the sun without sunscreen? You get sunburned! What is it that is causing all this heat?... the SUN!

Tell students that they are about to discover the effects the sun has on the earth's weather. Instruct students to get into groups of 2-4.

NOTE: In an effort to save time, you can do Experiments #1 and #2 at the same time.

Experiment #1

1. Give each group 2 jars, 2 thermometers, and a Data Recording Sheet for Experiment #1.
2. Have students full both jars about ½ full of water. Place a thermometer in each jar, then put the lid on the jar (if the jars actual lids are not available, the lid can simply be some wax paper with a rubber band around the jar or a piece of plastic wrap).
3. Immediately after placing the lid over the jar, have students record the temperature of the water. This will be the "Starting Temperature."
4. Next, tell students they will be placing one jar in the sun and the other in the shade. Have students create a hypothesis for what will happen to the temperature of the water in each jar.
5. With their hypothesis created, have students make predictions about what the temperature of the water will be in each jar after 2 hours. These will the "Prediction of Temperature Change."
6. Next, have students place one jar in a sunny location and the other jar in a shady location.
7. Every 30 minutes, have students record the temperature of each jar on their Data Recording Sheet.

Experiment #2:

1. Give each group 2 jars, 2 thermometers, and a Data Recording Sheet for Experiment #2.
2. Have students fill both jars about ½ full of water. Place a thermometer in both jars. Put black construction paper over the top of one jar, and aluminum foil (shinny side up) over the other jar.
3. Immediately after placing the "lids" over the jars, have students record the temperature of the water. This will be the "Starting Temperature."
4. Next, tell students they will be placing both jars in the sun. Have students create a hypothesis for what will happen to the temperature of the water over two hours.
5. With their hypothesis created, have students make predictions about what the water temperature will be in each jar after 2 hours. This will be the "Prediction of Temperature Change."
6. Next have students place both jars in a sunny location.
7. Every 30 minutes, have students record the water temperature for each jar on their Data Recording Sheet.

DISCUSSION

1. Why was water in the sun a different temperature that the water in the shade?
2. Why were the covered jars (black construction paper and aluminum foil) different temperatures?
3. How is the black construction paper like soil and the aluminum foil like water?
4. Does the sun heat all areas of the earth evenly? What proof do we have that there are different temperatures around the world? (Answer: there are different plants and animals around the world that require different temperatures; different temperatures are what causes there to be wind and weather patterns).
5. How might forests and lakes affect the sun's heating of the earth?
6. What does uneven heating of the earth have to do with weather?

EXTENSION

- Have students create graphs for each experiment. For example, a graph of temperature v. time for both the sun and shade jars in Experiment #1.
- Discuss the day-to-day applications of what they have learned
- Why humans get sunburned and how we can prevent sunburns – sunscreen, proper clothing, hats….
- Have students create a travel guide for a different location. Have students tell about the climate of the area – average temperature, rainfall…