Lesson Plans: Effects of Solar Radiation on Land and Sea

Educational resources that have been selected by the Climate Literacy and Energy Awareness Network (CLEAN) have passed an extensive peer-review process to verify the accuracy and currency of the science.

Objective

The objective is to find out about the different heating properties of soil and water, and to understand why places near the sea have a more moderate climate than those inland.

Materials

Each student or group of students will need the following:

- Bucket of soil and a bucket of water
- 2 ordinary thermometers
- Recording sheet
- Normal graph paper
- Ruler and pencil

Important Points to Understand

When solar radiation reaches the earth, land surfaces absorb the energy in a different way to water surfaces. They heat and cool at different rates. Water takes longer to heat up than land, but once heated up, it retains its heat for longer than the land does. This is why, during the day-time, the sand on a beach gets much hotter than the water does particularly if the sand is black. At night time, the sea water-is warmer than the land! Therefore, places that are close to the sea, or near a large lake, have their temperatures moderated by the water, they will not be as hot as places inland during the day (or during the hot season), and they will not be as cool as places inland during the night (or during the cool season).

Most Pacific islands are so small that the temperature in most places is influenced by the sea, and the climate is known as *marine*. There is also very little variation between the temperature inland and the temperature on the coast. However, on some of the larger islands of Melanesia (Fiji, Vanuatu, Solomons, and Papua New Guinea), the effect of land and sea on temperature is noticeable, particularly on fine days and clear nights. We must remember that the height of the islands is also important because there will always be lower temperatures where the land is mountainous.

Procedure

This lesson can only proceed if it is a fine, sunny day!

1. The group takes its buckets of soil and water outside the classroom and sets them up in direct sunlight.
2. After allowing 15 minutes for the sun to heat the soil and water, the group takes 2 temperature readings in the soil bucket, 0.5 centimeters below the surface, and the other about 7 centimeters below the surface. While this is being done, and using the other thermometer, 2 temperature readings are taken at the same depths in the water. Temperatures are recorded. It is important that the water is not stirred or disturbed during this experiment.
3. **Soil (15 min)** **Soil**(3 h, 15 min) **Water (15 min)** **Water**(3 h, 15 min)

Temperature (0.5 cm)
Temperature (7 cm)

4. Both buckets are then left in the sun for a further 3 hours. The students will have to return to the buckets outside class time, and take further readings, 2 in each, at exactly the same depth as before. Temperatures are again recorded.

Questions

1. Each student draws a graph to show his/her group's findings, and produces a short report on how soil and water behave when heated. Students should find that the soil temperature was much higher at half a centimeter below the surface than was that of the water. However, at a depth of 7 centimeters, the water should have been warmer than the soil. Reasons for this can be discussed with the class.
2. Each student to write written answers to these questions:

- Why, after three hours in the sun, was the water temperature at a depth of 7 centimeters higher than that of the soil at a similar depth.
- Show, with a simple diagram, how the interior of a large flat island will be warmer during the day time than the coasts, and colder during the night.
- Explain what is meant by a *Marine Climate*. Why do most Pacific islands have what is called a *Tropical Marine climate*?