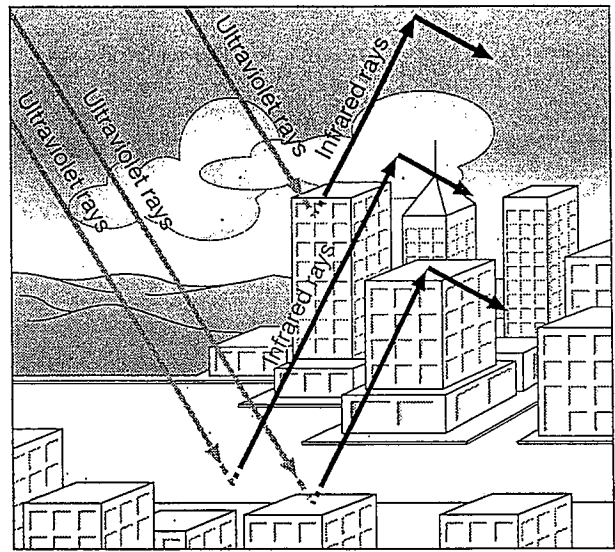
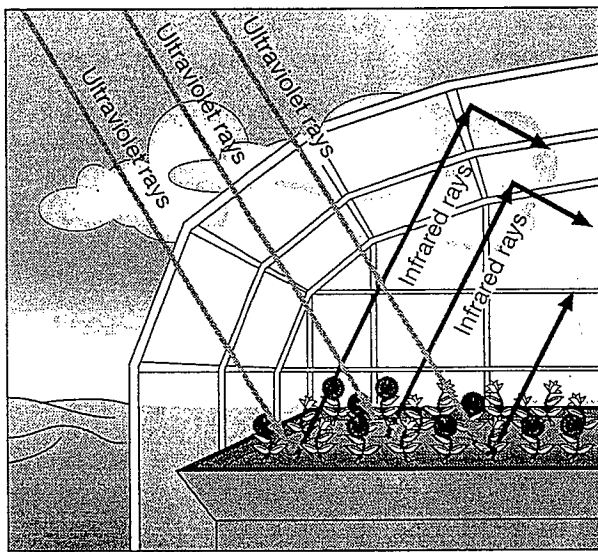


Teaching Activity: Insolation and the Earth's Surface

Introduction: Large amounts of heat energy received from the Sun are reradiated and reflected back into the atmosphere. The amount of reradiation and reflection varies depending upon the material that has been heated. The amount of heat absorbed by Earth materials in a given time depends largely on the *specific heat*, or *heat capacity*, and the surface characteristics of the material exposed to the incoming radiation. Once heat has been emitted by the Earth, it is circulated by atmospheric and oceanic transport systems, ((wind and ocean currents). In addition, varying amounts of the reradiated heat return to space, providing a necessary output to maintain the Earth's energy budget. Water vapor and carbon dioxide present in the atmosphere absorb or trap some of the *terrestrial infrared radiation*, increasing temperature levels in the atmosphere. This lower-energy-level radiation cannot penetrate the atmosphere as well as the shorter wavelength, higher energy radiation, and is held at lower levels of the atmosphere. A similar situation exists in a greenhouse, giving rise to the term "greenhouse effect" when referring to the Earth-atmosphere heat transfer system.



Some of the trapped heat energy evaporate surface water. The moist air then rises to higher altitudes, where condensation takes place. *Latent heat* gained at lower levels is released by condensation and escapes to space, making the Earth a somewhat imperfect greenhouse.

Pollution and changes in land use have modified the mixture of gases in the atmosphere, as well as their protective and regulatory role. Ozone depletion and increased levels of carbon dioxide and methane are examples of harmful trends that are interacting against a background of possible climate change.

Important Terms: Specific heat, latent heat, atmospheric transport system, infrared radiation, evaporation, condensation, ozone, methane, carbon dioxide, climate change;

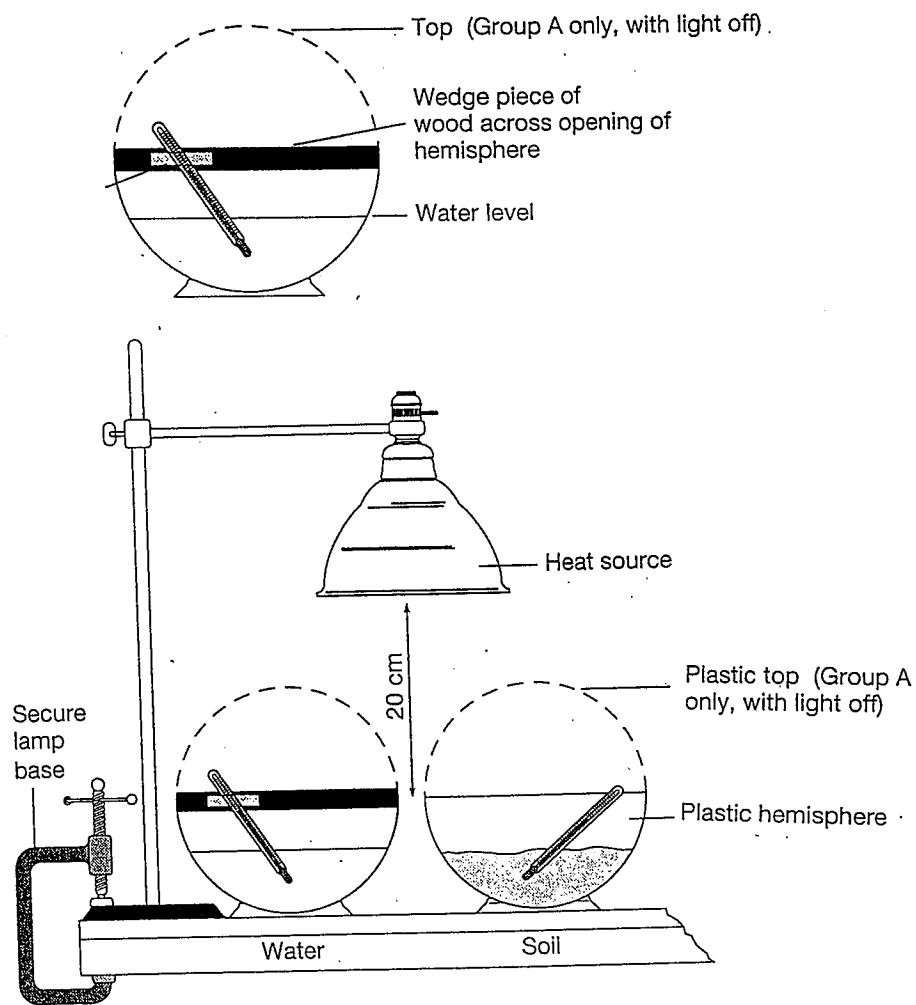
Objective:

- To create and use a small scale model to observe the factors affecting both energy absorption and emission in Earth materials;

Materials: 2 plastic hemispheres with covers, dark, dry soil, C-clamp, 2 Celsius thermometers, heat lamp, clock or timer, colored pencils, tape, grid paper, pencil;

Procedure:

1. Set up the plastic hemispheres with soil and water, thermometers and a heat lamp as shown in the figure below.

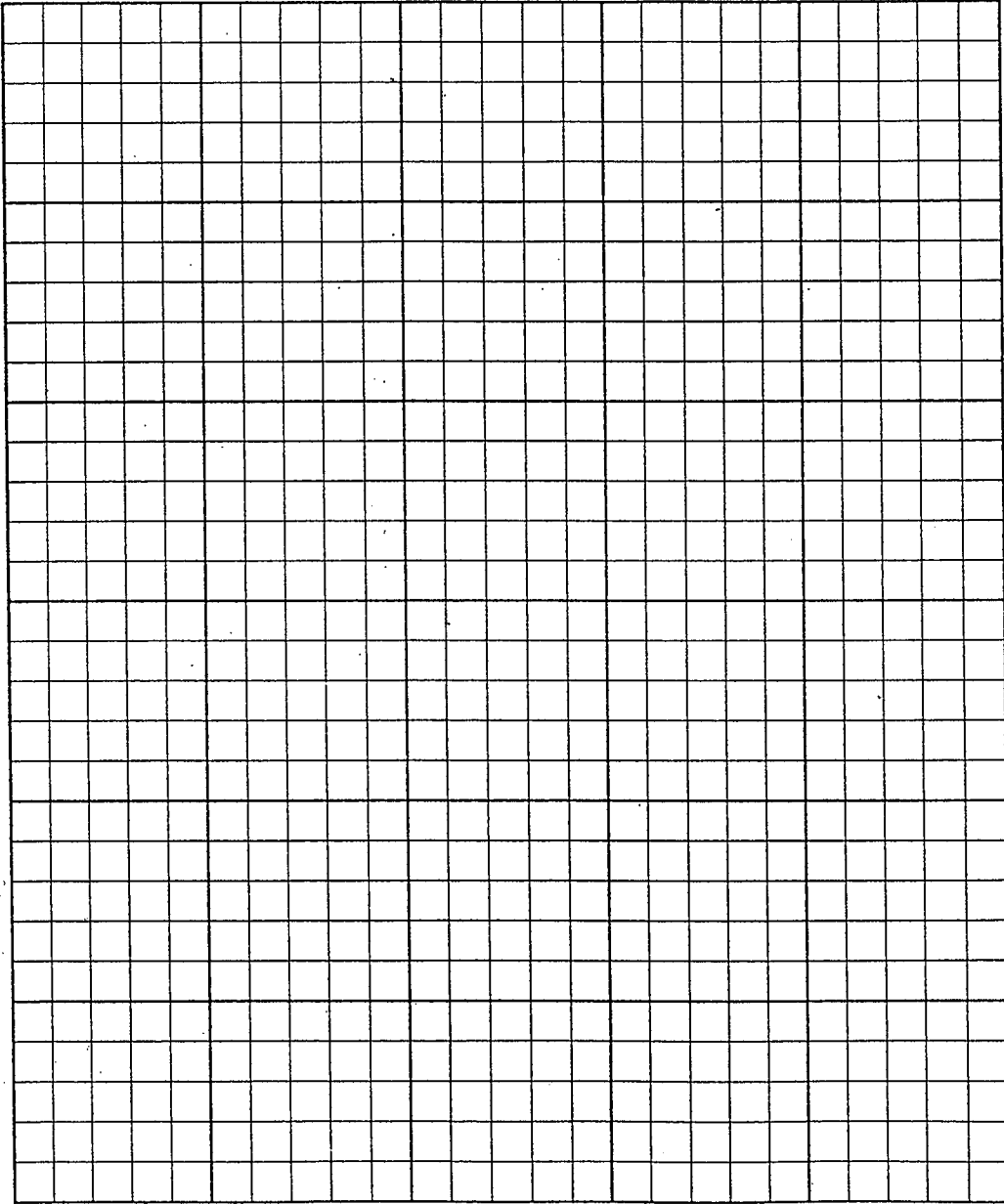


2. Position the bulb of the heat lamp about 20 cm above the hemispheres as shown, being sure that the energy from the lamp is divided evenly between the two hemispheres.

CAUTION: Be sure to keep water away from any part of the lamp assembly.

3. When doing this activity, students will work in two different groups, group A and group B.
 - Give instructions for forming groups (A or B) before handing out materials.
 - Both groups A and B will follow the same procedure for this step.
 - When temperature equilibrium has been reached, students should begin recording the temperatures of the water and soil under time) in the **Data Table**.
 - Students should use the table designed for their group, A or B.
4. Turn on the heat lamp and have students begin recording the temperatures of the water and soil every minute for 10 minutes.
 - Be sure the hemispheres are not covered.
5. Both groups A and B: After 10 minutes, turn off the heat lamp.
 - **Group A:** Quickly fasten the tops over the soil and water hemispheres. Continue to take temperature readings every minute for the next 10 minutes. Record the data on the **Data Table**.
 - **Group B:** Continue to take temperature readings every minute for the next 10 minutes. Record the readings in the Data Table. **Do not place covers on the soil and water hemispheres.**
6. Both group A and B: Draw a graph of your data on the grid paper provided.
 - Graph Time on the horizontal (X) axis.
 - Graph Temperature on the vertical (Y) axis.
7. When the first graph for this investigation has been completed, groups A and B will exchange graphs so that all students will be able to complete a second graph.
 - Give instructions for exchanging data.
 - Have students record the data for the second graph.
 - Be sure students use the Data Table for the correct group, A or B.
8. Have students complete their second graph on the same set of axes.
 - Students should use a different colored pencil to connect the second set of plots.
9. Students should complete the activities in the **Analysis and Conclusions** section.

GRAPH OF DATA TABLES A AND B



ANALYSIS AND COMPREHENSION SECTION:

1. Which material heated more rapidly? Why?

2. Which material cooled more rapidly? Why?

3. Which material in the group A (covered) model cooled more rapidly?

4. In which model, group A (covered) or group B (uncovered), did cooling occur faster? Why? _____

5. Which material has the higher specific heat, soil or water? How do temperature readings indicate this?

6. What does the plastic cover in the group A model represent when compared to the Earth's surface? How good a representation is it?
