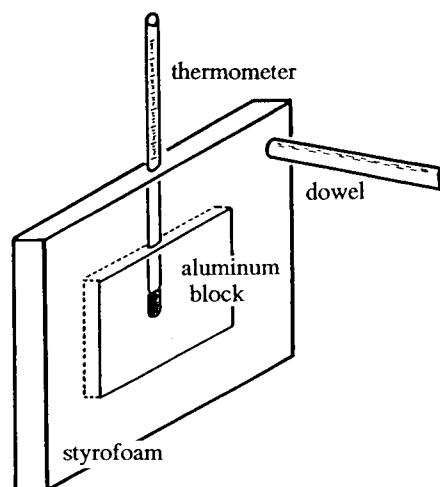


11. A photodetector can be placed on a flat board that is then oriented perpendicularly to light rays coming from a source placed further away. As the detector is tilted with respect to the light source, the signal will decrease. If the tilt angle is measured, the photodetector signal will be seen to obey a cosine law.

Student Projects

1. Items #2, #3, 10 and #11 above could form the basis of a student project or experiment.
2. There are several interesting experiments in Chapter 4 (Heat) in Hands-On Meteorology (see reference on p. 2 of this manual).

3. The solar irradiance (calories/cm² min) at the ground can be measured relatively easily using a rectangular piece of aluminum. One side of the block should be painted black to make it a good absorber of sunlight. Drill a hole in the side of the block so that a thermometer can be inserted. The block is positioned in a piece of styrofoam so that only the blackened surface is exposed. Position the block in full sunlight and orient it so that a dowel stuck into the styrofoam does not cast a shadow; this will insure that the block is pointing directly at the sun. Record the temperature of the block at 30 to 60 second intervals for 15 to 20 minutes.



The solar irradiance, S , can be determined using the following formula:

$$S = (\text{mass} \times \text{specific heat} \times \Delta T / \Delta t) / \text{area}$$

The area is the cross sectional area of the surface exposed to the sun. The time rate of change of temperature, $\Delta T / \Delta t$, can be determined from a graph of temperature and time. The block's temperature should increase fairly linearly early in the experiment before the block becomes too hot and begins to lose significant amounts of heat to the surroundings (the plot of temperature versus time should show this).

4. A rough estimate of the latent heat of vaporization of liquid nitrogen (or alternatively the latent heat of fusion of ice or latent heat of sublimation of dry ice) can be determined relatively easily. Pour 100 to 200 grams of warm tap water into a 16 oz styrofoam cup. Measure the exact mass and temperature of the water. Measure about 30 grams of liquid nitrogen into a smaller cup. Pour the liquid nitrogen into the warm water (carefully to avoid splashing). Once the nitrogen has evaporated remeasure the temperature of the water. If we assume that all of the heat removed from the warm water is used to evaporate the liquid nitrogen we can use the measured drop in water temperature, ΔT , to determine the latent heat of vaporization:

$$\begin{aligned} \text{Heat lost by warm water} &= \text{Heat used to evaporate nitrogen} \\ (\text{mass water}) \times \text{specific heat} \times \Delta T &= \text{latent heat} \times (\text{mass } N_2 \text{ evaporated}) \end{aligned}$$

By varying the initial temperature of the warm water, students can investigate an important source of error in this experiment. Students could also perform the experiment with a cover on the cup or in a dewar flask to try to reduce heat loss to the surroundings.