Chapter 17: Quick Activities

Capturing Energy

Solar Pool Cover

Companies claim their "solar pool covers" increase the water temperature by as much as 10°C above the average outdoor temperature. What is the best material from which to make a solar pool cover?

PROCEDURE

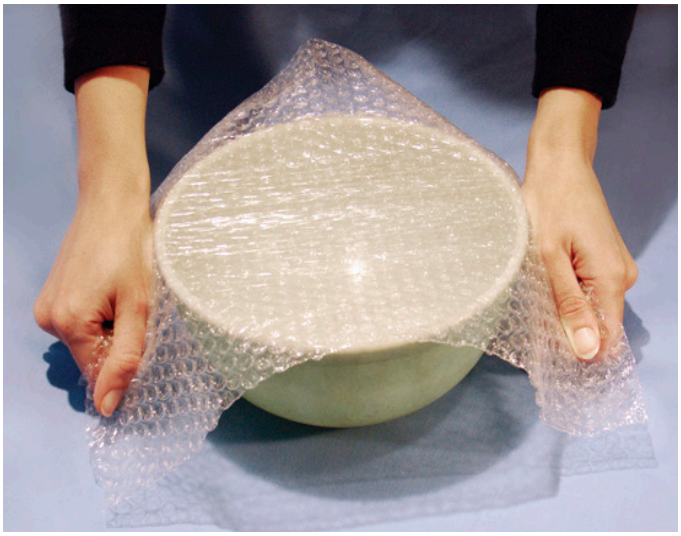
1. On a warm, sunny day, fill six identical bowls with the same volume of tap water and place them outside in direct sunlight. Cover four of the bowls with one of the following materials: aluminum foil, transparent plastic food wrap, colorless bubble wrap, and a black plastic garbage bag. Cut these materials to size and secure one to the top of each bowl with a rubber band. Poke a tiny hole through which you will be able to insert a thermometer. (If you have an infrared thermometer, you can briefly remove the tops to measure the water temperature.) Carefully add several drops of liquid detergent to the water in the fifth bowl and don't do anything to the sixth bowl, which is your control.

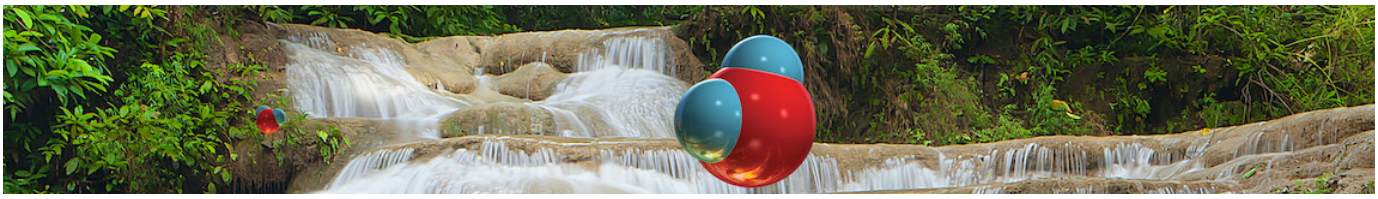
2. Allow the bowls to sit in the sunlight for at least 4 hours. (Good results can also be obtained when skies are lightly overcast.) Take temperature readings every half hour. Stir the water with the thermometer (or spoon) before taking a reading and always rinse the thermometer after dipping it into the detergent-containing water. Record your data.

3. Plot your data on a graph showing temperature on the vertical axis and time on the horizontal axis.

ANALYZE AND CONCLUDE

Is evaporation a cooling or warming process? Which cover becomes the hottest? Which covers allow most solar radiation to enter the water? Which bowl reached the highest temperature? Why?





Author Responses to Quick Activities

Evaporation accounts for a significant amount of heat loss from a swimming pool. Therefore, just about any covering that inhibits evaporation will help keep a pool warm. This explains why the water covered by aluminum foil gets warmer despite the fact that the aluminum reflects incoming solar radiation. As discussed in Chapter 8, detergents form a thin layer on the surface of water. This layer inhibits evaporation enough to allow the water in the bowl treated with detergent to become slightly warmer than the uncovered control bowl. Some commercial "liquid solar blankets" are nothing more than nonfoaming detergents that when added to the swimming pool inhibit evaporation and thus cut down on heat loss.

You know that black vinyl car seats get hotter in the sun than do white vinyl seats. Did you then assume that the black covering would result in the warmest water? You may have poked your finger into the water samples to sense the temperature differences. You may have noticed that the water under the black plastic was markedly warmer at the top of the bowl than at the bottom. (This is true of the water in the other bowls, but the effect is not as pronounced.) Although it is true that the black plastic gets the warmest of all the coverings, remember that it's the water you want to get warm, not the plastic. The temperature gradient results because only the water directly below the black plastic gets warmed—that is, it's the plastic that heats the water and not the Sun directly.

Transparent covers tend to work best because they both inhibit evaporation and allow the sunlight to heat the water directly. Thus, your highest temperatures may have been for the food wrap and the bubble wrap. The food wrap allows the most light to pass through, which explains why the water beneath it tends to reach the highest temperature. After the Sun goes down, however, the bubble wrap serves as a better insulator, maintaining a higher temperature over a longer period.