ANATOMY AND PHYSIOLOGY

14. **Keeping the Heat In**

Objective: Students will compare heat loss in objects with different surface area to volume ratios, and relate the physical characteristics of whales to the environment in which they live.

Level: K-3, 4-7

Background: Whales have a very small body surface compared to their massive volume. That's why they look the way they do - a torpedo-shaped body with small limbs. Evolution has decreased the amount of surface area exposed to the external environment while increasing volume. Although they spend a lot of time in cold water, whales' bodies are well adapted to the cold and for preventing heat loss. Whale adaptations include heavy, round bodies, short, stubby limbs, and a thick layer of blubber.

Materials: hot and cold water, two plastic sandwich bags, a disposable plastic glove, a Styrofoam cup, three thermometers (optional), a dishpan, bucket or similar container.

Procedure:

1) Fill the container half full with cold water. This represents the cold ocean.
2) Put equal amounts of hot water into the glove and each sandwich bag (use enough water so the fingers of the glove are filled out). Tie or tape the bags and glove shut.
3) Feel each bag and the glove and remember how hot each felt. They should all feel the same.
4) Put one of the bags of hot water in the Styrofoam cup. Bend the tops of the cup in like a lid to seal the bag tightly inside.
5) Place the glove, hot bag, and closed cup into a bucket of cold water. Leave them in for about five minutes.
6) Remove the glove, bag and Styrofoam cup from the water. Remove the bag from the cup. Feel each again. They will now feel quite different. The glove will feel the coolest and the bag from the cup will be the warmest.
7) Optional: Do the experiment again but use a thermometer to record the actual before and after temperatures of the bucket, bags and glove, or monitor the temperature of each example throughout the experiment.
8) Discuss the results. The glove is like an animal with long legs. It has a lot of surface area and very little volume. If a whale had long legs, its body would cool quickly in the cold ocean. The plain sandwich bag shows how having no legs helps a sea animal. It remains warmer than the glove. But by far the warmest bag is the one from within the cup, showing the advantage of insulation, much like the blubber in a real whale.