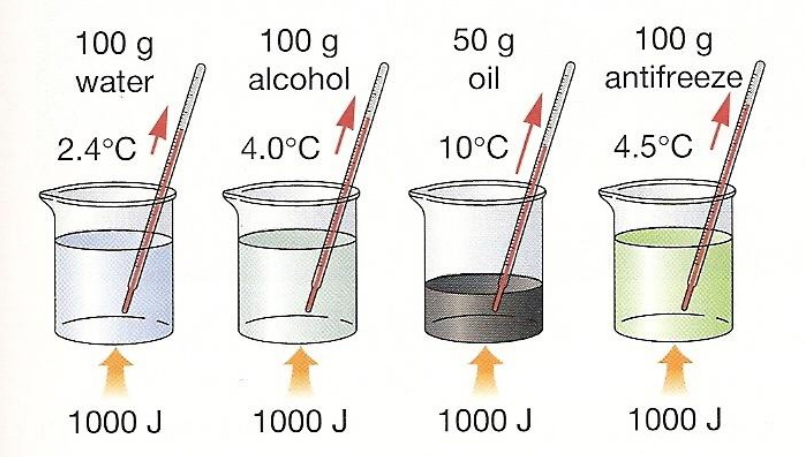
HEAT CAPACITY

You have seen that different materials expand by different amounts as they warm up. Another difference in the way that materials respond when they are heated, is the amount that their temperature rises when a certain amount of thermal energy is added. Some materials, such as sand, warm and cool quickly, under identical conditions, other materials, such as water, warm and cool slowly.

The **heat capacity** of an object is a number that tells you how much thermal energy must be added to the object to make its temperature increase by one degree Celsius. If you remove the same amount of thermal energy from the object, its temperature will decrease by one degree Celsius. If an object has a large heat capacity, that means that you must add a large amount of heat to make its temperature increase just a little. For example, it takes more than four times as much added thermal energy to raise the temperature of water one degree Celsius than it takes to raise the temperature of the same amount of copper by one degree Celsius. The heat capacity of water is more than four times as large as the heat capacity of copper.

Of course, temperature changes also depend on the amount of material in an object. A small glass of water warms up much more easily than a large saucepan or a whole lake. To make fair comparisons between different materials, you must warm or cool samples that have the same mass. The **specific heat capacity** of a material is the amount of energy you must add to a standard amount of the material (one gram or one kilogram) to increase its temperature by one degree Celsius. For example, the specific heat capacity of copper is 0.39 J/g °C. This means that to warm up one gram of copper by one degree Celsius, you must add 0.39 J of thermal energy. To warm it by two degrees, you would need to add 2 x 0.39 J or 0.78 J of energy.



1. This experiment is not a fair test of all four materials. Which sample cannot be compared with the others? Explain why. Do not use this sample to answer the rest of the questions.
2. Why can the temperature changes in the remaining three materials be compared fairly?
3. Rank the three materials according to temperature change. List the material with the greatest temperature change first.
4. Which material has the largest specific heat capacity?
5. Which material has the smallest specific heat capacity?