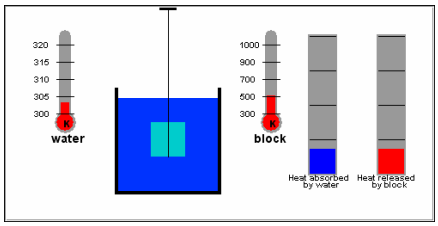
Worksheet for Exploration 19.3: Calorimetry



When two objects at different temperatures are in thermal contact with each other, they will eventually reach the same temperature. Heat will flow from the warmer object to the cooler one until they are at the same temperature **(temperature is given in kelvin and heat is given in joules)**. Using the equation for heat absorbed or released with a temperature change, $Q = mc\,(T_f - T_i)$, where Q is the heat, m is the mass, c is the specific heat, and T is the temperature (with subscripts indicating final and initial temperatures), we can determine the specific heat of an object. Restart.

In the animation a piece of metal at a high temperature is placed in water at a lower temperature and, if the water is well insulated so we can assume essentially no heat loss to the environment, the final temperature of the water/metal combination depends on the mass of the water, the mass of the metal, and the specific heat of each. Try changing the initial temperature of the metal and the mass of the metal. By equating the heat lost by the object to the heat gained by the water, we can calculate the specific heat of an unknown object or the final temperature of the system. There are 10 kg of water, and the specific heat of water is 4.186 kJ/kg*K. The specific heat of the block is 0.39 kJ/kg*K.

Note that when discussing heat absorbed Q is positive. When discussing heat released, energy is lost, Q is strictly negative, although the sign often gets ignored.

a. For a 1-kg block and an initial block temperature of 800 K, use the equation above to calculate the heat absorbed by the water and the heat released by the block when they reach the final temperature.

$T_{i\ water}$=_____ $T_{i\ block}$=_____ T_f=_____

Q_{water}=_____ Q_{block}=_____ $|Q_{block}|$=_____

i. Why are there initial temperatures for both the water and block, but only one final temperature?

b. What is the scale for the heat on the bar graphs? In other words, what unit of heat does each mark correspond to (10 kJ, 100 kJ, 200 kJ, etc.)?

c. If m = 3 kg and the initial temperature of the block is 1000 K, equate the heat released to the heat absorbed to predict the final temperature. Run the animation to check your prediction of both the final temperature and the heat released and absorbed.

$T_{f\ predicted}$=_____

$T_{f\ measured}$=_____