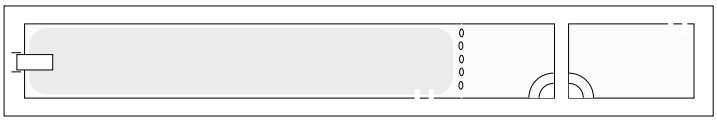
PhyzSpringboard: Understanding Temperature



1. What happens when an ordinary mercury thermometer at room temperature (20°C) is placed in a beaker of hot (80°C) water...
a. on the observable, visible level?

b. on the molecular level? Describe, step-by-step, what caused the event(s) listed above.

c. It is commonly observed that the mercury **falls** and then rises in the tube when the thermometer is placed in hot water. Explain.

2. What—if anything—would have been if
a. the water molecules in the beaker had been moving faster?

b. the molecules in the beaker had been more massive (but moving at the same speed as in the original situation)?

c. the water molecules in the beaker had been rotating as well as translating?

d. the water molecules in the beaker had been vibrating (expanding and compressing the interatomic distances) as well as translating.

3. What happens to the temperature of a body when it is thrown (given kinetic energy)? (For example, baseball pitchers are often valued for their ability to "put heat" on the ball.)

a. Consider a passenger train at rest in a station. Suppose all the passengers are at rest in their seats. What is the kinetic energy of

i. the train as a whole?

ii. the passengers (relative to the train)?

b. While the train remains at rest, the passengers get up and move about the train. What is the kinetic energy of

i. the train as a whole?

ii. the passengers (relative to the train)?

c. The train accelerates and then maintains a constant speed, the passengers continue to move about the train. What is the kinetic energy of

i. the train as a whole?

ii. the passengers (relative to the train)?

d. While the train maintains its speed, the passengers settle into their seats and remain at rest. What is the kinetic energy of

i. the train as a whole?

ii. the passengers (relative to the train)?

e. In the examples above, which quantity is more analogous to temperature:
___the kinetic energy of the train as a whole or
___the kinetic energy of the passengers relative to the train?

f. What relationship—if any—is there between the kinetic energy of the train as a whole and the kinetic energy of the passengers?

g. What relationship—if any—is there between the kinetic energy of a body and the temperature of that body?

h. If the beaker of hot water were dropped off a cliff, what would happen to the temperature indicated by the thermometer as the beaker fell (and gained speed)?

4. Which—if either—will drive a nail farther into a wall: a cold brick or a hot brick with the same mass thrown at the nail with the same speed? Explain.