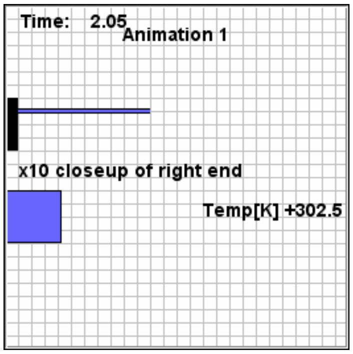
Worksheet for Exploration 19.2: Expansion of Materials



A rod is fixed at one end. In the animation you see both the rod and a magnified view of the right end **(position is given in meters, time is given in minutes, and temperature is given in kelvin)**. As you increase the temperature, notice that the rod increases in length. This Exploration will help you develop a quantitative relationship for the increase in the length of the rod, as a function of the initial length and the temperature change, that holds for all materials. Restart..

Note that the x10 closeup means that a reading (in meters) really is in tenths of meters.

a. For animation 1, if you double the length, what happens to the change in length?
   i. For example, try 10 m and 20 m.

ΔL_{10}=________

ΔL_{20}=________

b. Repeat (a) for the material in Animation 2. How do the two results compare?

ΔL_{10}=________

ΔL_{20}=________

c. How does changing the final temperature change the expansion? (if you double the *change in temperature*, what happens to the change in length?)
   i. Do this for both materials for several final temperatures. Keep the initial length constant.

$T_{f\ material\ 1}$	ΔT_1	ΔL_1

$T_{f\ material\ 2}$	ΔT_2	ΔL_2

d. What general expression can you now write for the change in length as a function of the temperature change and initial length?

The difference between the two materials is described by a different coefficient of linear expansion, α. For the material in Animation 1 α is 30 x 10^{-6}/K, while for the material in Animation 2 α is 20 x 10^{-6}/K.

When heated, a solid (even a thin rod as above), expands in all three dimensions. The equation for the volume expansion is similar to the linear expansion case with the coefficient of expansion approximately equal to 3α.

e. Why didn't you see the expansion of the rod in the other dimensions?