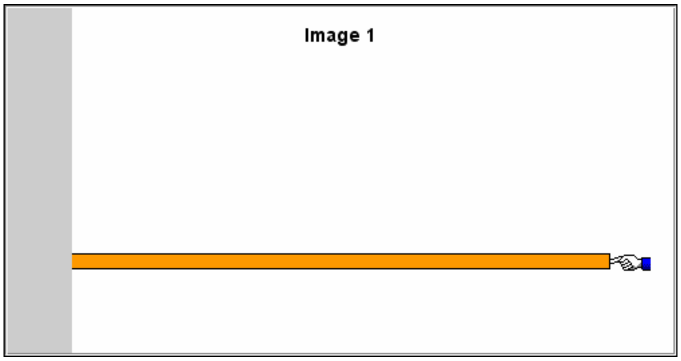
Worksheet for Exploration 13.2: Static Friction on a Horizontal Beam



You hold a piece of wood by pushing it horizontally against a wall as shown in the animation **(position is given in meters)**.

The finger/hand contributes to the frictional force in exactly the same way as the wall does.

a. What forces act on the wood? Draw a free-body diagram for the wood showing the forces at their proper locations. Compare your diagram to the one shown in Animation 2. (sketch onto the above figure).

b. What is the force(s) in the +y direction that counteracts the weight of the wood in this example? Note that this force is parallel to the surface of the wall and wood where they are in contact. (don't forget that the hand on the right does exactly what the wall on the left does).

c. What do we call the parallel component of a contact force?

In Animation 3 you can adjust the magnitude of the push by clicking and dragging on the white circle at the tip of the vector representing the force of your hand on the wood. The maximum frictional force (shown as a **red vector**) adjusts accordingly. At the instant where the actual frictional force (**black vector**) equals the maximum frictional force (**red vector**), the beam will still be in equilibrium. In this case this is the least force that you can push the wood and have it remain in equilibrium. If you push it with less force, the meter stick will fall.

In Animation 4 you can adjust the magnitude of the push so that it is less than the minimum push required for the wood to remain in equilibrium. If the maximum possible static frictional force is less than the actual frictional force needed for equilibrium, the piece of wood will fall. In the animation if you adjust $f_{s\,max} < f_s$, the resulting situation depicted in the animation is *unphysical* since the piece of wood will actually fall.