Static and Kinetic Friction

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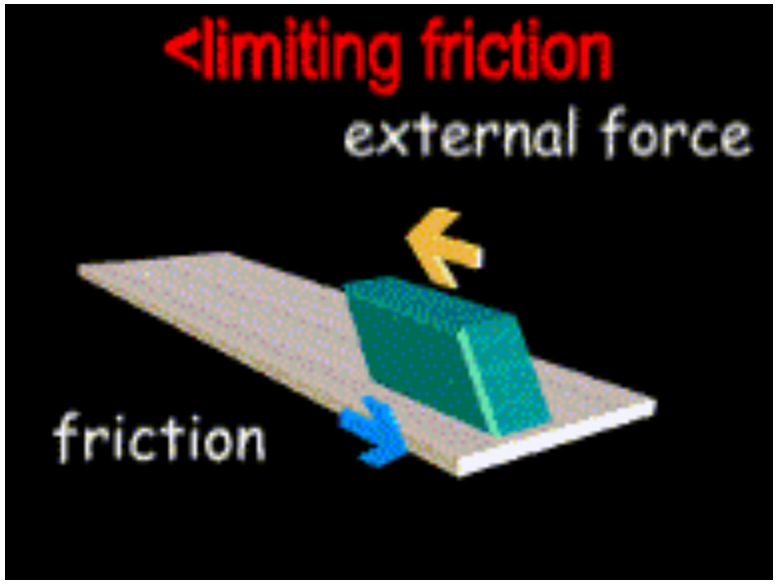
Instructional Objectives

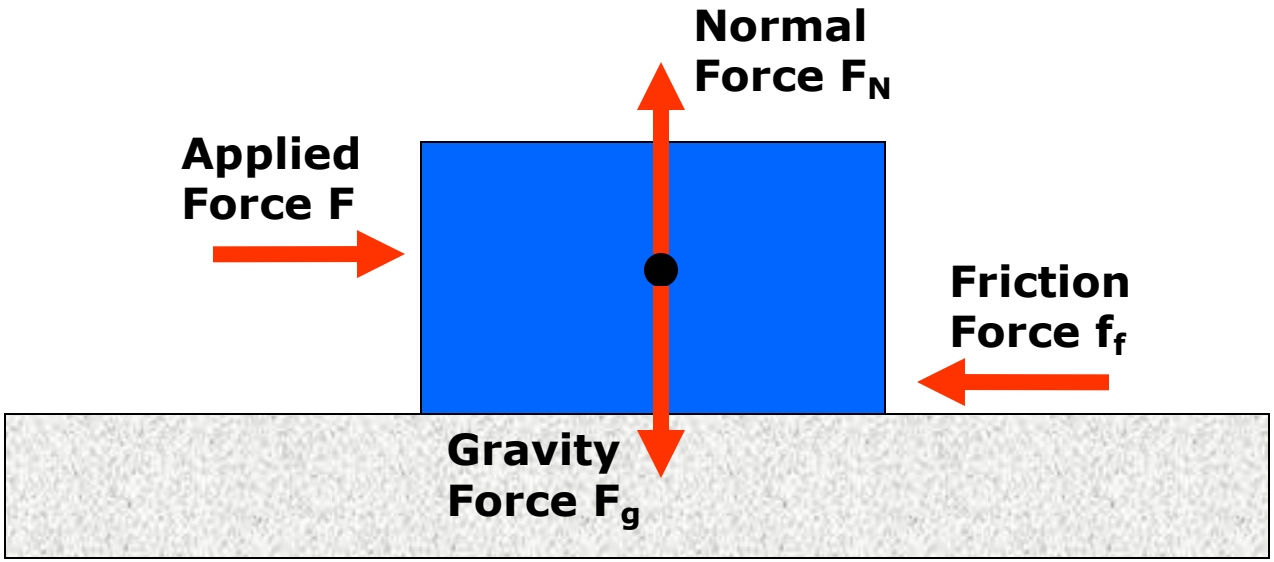
- Distinguish the Difference Between Static & Kinetic Friction
- Solve Problems Involving Friction Effects

What is Friction?

- Force that acts oppose the relative motion of two surfaces
- High for dry and rough surfaces
- Low for smooth and wet surfaces



Free Body Diagram



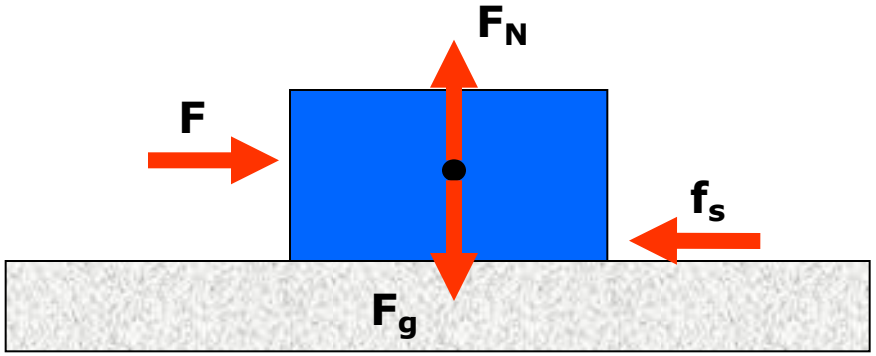
$F_g = mg$

$F_N = F_g$

$f_f = F$

Static Friction

The Force of Static Friction keeps a stationary object at rest!

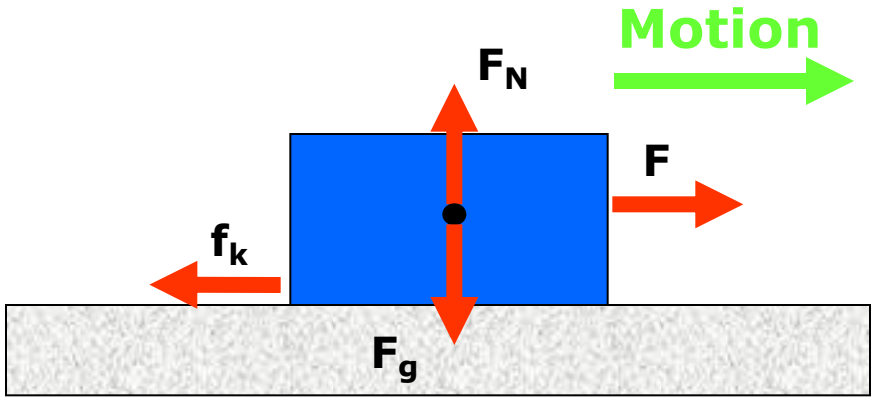


$$f_s = F_N \times \mu_s$$

$$\mu_s = coefficient\ of\ static\ friction$$

Kinetic Friction

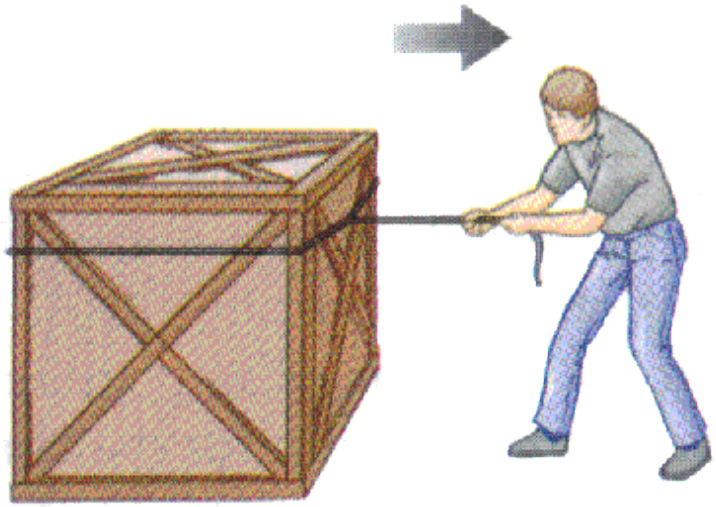
Once the Force of Static Friction is overcome, the Force of Kinetic Friction is what slows down a moving object!



$$f_k = F_N \times \mu_k$$

$$\mu_k = coefficient\ of\ kinetic\ friction$$

Types of Friction



To initiate motion of the box the man must overcome the Force of *Static Friction*

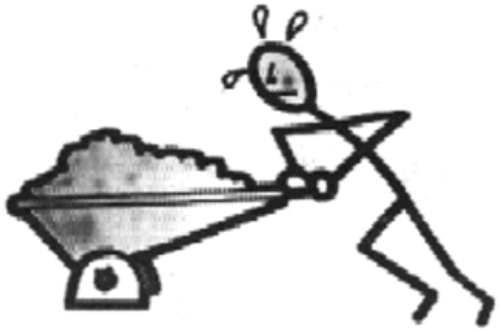
I better be safe Ump!!

Upon sliding, the baseball player will come to a complete stop due to the Force of *Kinetic Friction*

Static & Kinetic Friction Coefficients

Material	Coefficient of Static Friction μ_S	Coefficient of Kinetic Friction μ_S
Rubber on Glass	2.0+	2.0
Rubber on Concrete	1.0	0.8
Steel on Steel	0.74	0.57
Wood on Wood	0.25 – 0.5	0.2
Metal on Metal	0.15	0.06
Ice on Ice	0.1	0.03
Synovial Joints in Humans	0.01	0.003

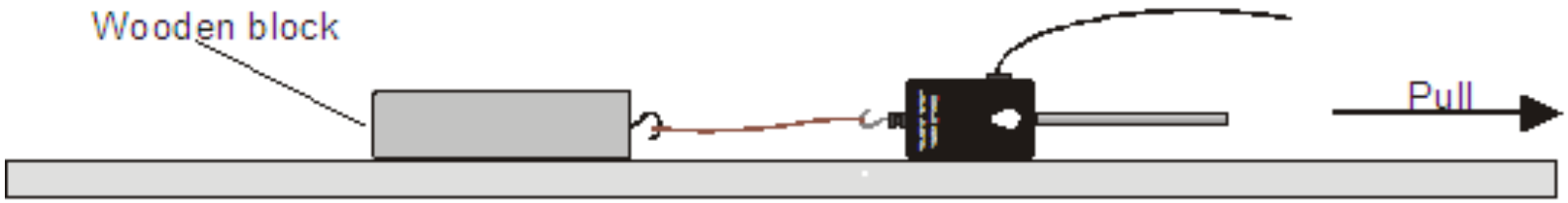
Static VS. Kinetic Friction



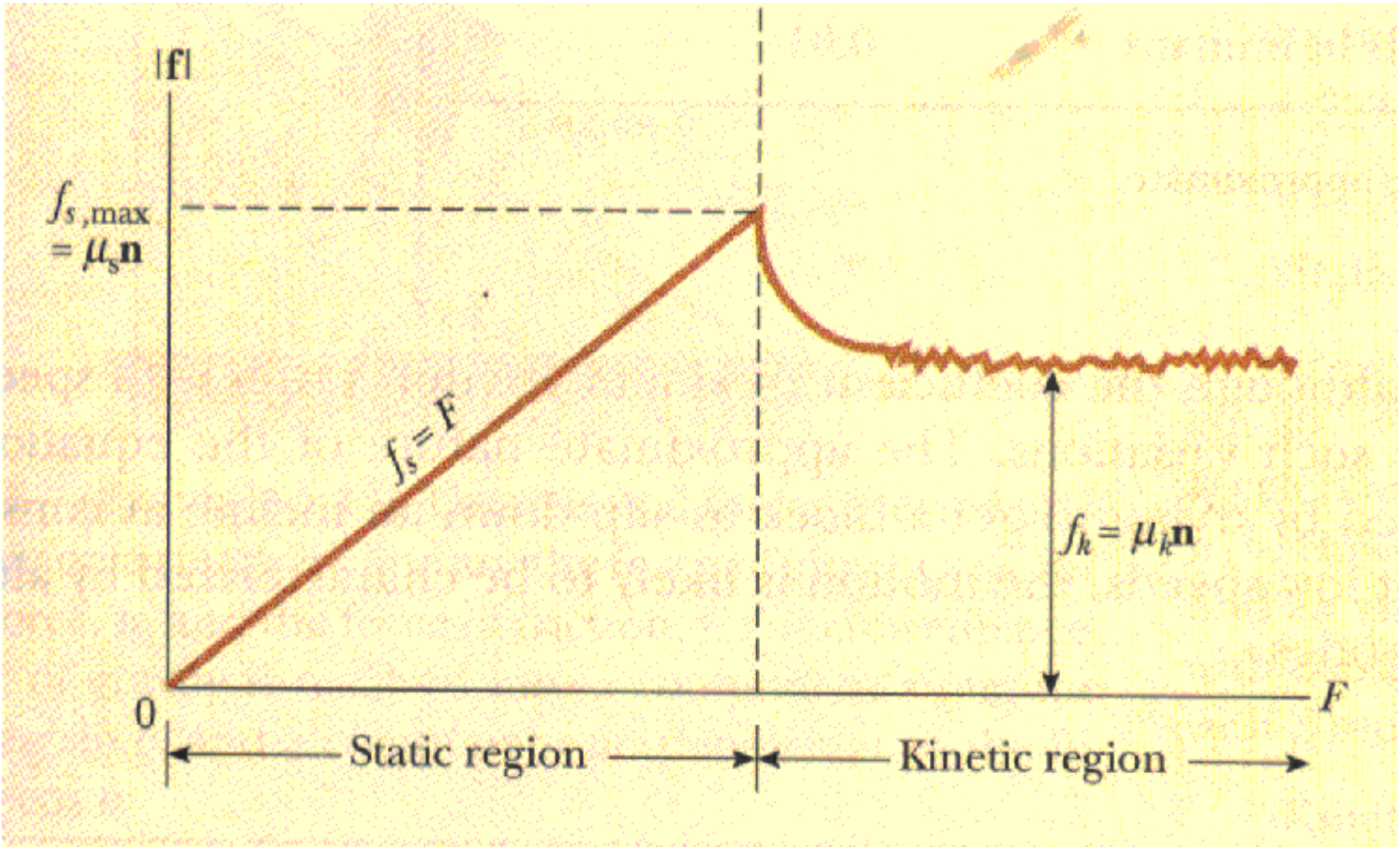
Only flat on the bottom! Ha Ha!

Static Friction Lab Procedure

- Connect the force detector to a block of wood
- Pull gently on the force sensor unit the block begins to move
- Move the block slowly with constant force

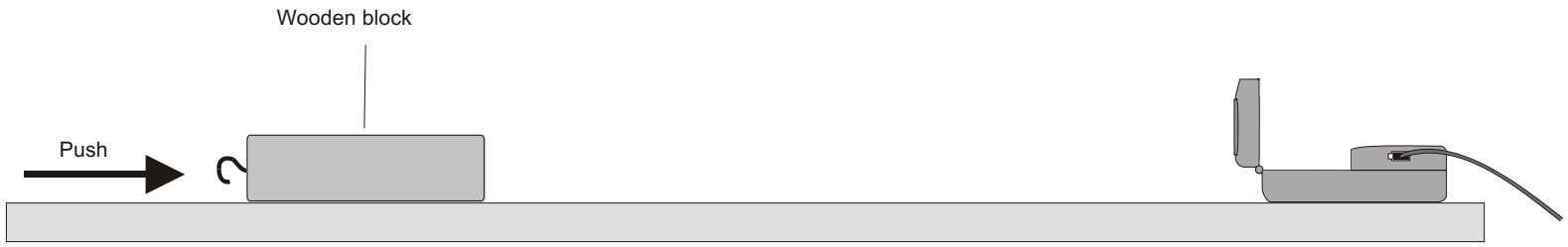


Ideal Result



Kinetic Friction Lab Procedure

- Line up the block with the motion detector
- Push the block gently toward the motion detector so that it comes to a stop approximately 1 foot away from it
- From the velocity curve determine the deceleration of the block
- Calculate the Force of Kinetic Friction
- Determine the coefficient of Kinetic Friction



Application Analysis

- An empty cart is being rolled across a warehouse floor. If the cart was filled, the force of kinetic friction between the cart and the floor would
  1. Decrease ✗
  2. Increase ✗
  3. Remain the same ✓

Application Analysis

- Sand is often placed on an icy road because the sand:
  1. Decreases the coefficient of friction between the tires of a car and the road
  2. Increases the coefficient of friction between the tires of a car and the road
  3. Decrease the gravitational force on a car
  4. Increases the normal force of a car on the road

Questions?