Friction Objectives

- Understand friction force and the factors that contribute to friction force.
  - Coefficient of friction
  - Normal reaction force
  - Surface area (?)
- Know how to calculate friction forces and coefficients of static and dynamic friction.

FRICTION

- Applied Force
- Friction
- W
- $R_N$
Friction

- The friction force acts in a direction parallel to the area of contact, and opposes the motion or the tendency to move. The friction force depends on two things:
  - The normal force \( R_N \)
  - The nature of the surfaces involved \( \mu \)

\[
F_f = \mu \cdot R_N
\]

- The friction force does not depend on the surface area (contact area).

\[
\begin{align*}
F_a &= \text{Applied Force} \\
R_N &= \text{Normal Reaction Force} \\
F_S &= \text{Static Friction Force} \\
F_{\text{MAX}} &= \text{Maximum Static Friction Force} \\
F_D &= \text{Dynamic Friction Force}
\end{align*}
\]
As more force is applied, the friction force **increase**. The friction force will continue to **increase** until the instant immediately prior to the initiation of movement. At this moment:
- **Motion** ≠ 0
- $F_{\text{friction}} = F_{\text{max}}$
- $\mu = \mu_s$
- Therefore, at this moment, $\mu_s = \frac{F_{\text{max}}}{R_n}$
Normal Force = force *perpendicular* to surface
A different way to find $\mu$

\[ \theta \hspace{2cm} R_t \hspace{2cm} R \hspace{2cm} R_n \]

Pushing a desk:
- $P$
- $P_h$
- $P_v$
- $R = wt + P_v$

Pulling a desk:
- $P$
- $P_h$
- $P_v$
- $R = wt - P_v$
Is it easier to pull a desk than push it?

- When you pull you usually have an **upward** component of force -- so...
  - the **normal force** is **decreased** and therefore the **friction** force is **decreased**.
- When you push you usually have a **downward** component of force -- so...
  - the **normal force** is **increased** and therefore the **friction** force is **increased**.

Things to consider

- What are some examples of manipulating the coefficient of friction and/or the force of friction in athletics? Everyday life?
  - How does surface area affect coefficient of static friction?
  - How does the normal force affect coefficient of static friction?
  - Once an object has been set in motion (i.e., $F_s$ has been overcome), what is the friction force? What would the net force look like? How would you describe the resulting acceleration?