■ Theme Music: Morcheeba
Friction

■ Cartoon: Bob Thaves
Frank & Ernest

Foothold Principles
Newton's Laws

- **Newton 0:**
  - An object responds to the forces it feels when it feels them.

- **Newton 1:**
  - An object that feels a net force of 0 keeps moving with the same velocity (which may = 0).

- **Newton 2:**
  - An object that is acted upon by other objects changes its velocity according to the rule
  $$\vec{a}_A = \vec{F}_A^{net} \big/ m_A$$

- **Newton 3:**
  - When two objects interact the forces they exert on each other are equal and opposite.
  $$\vec{F}_{A \to B}^{type} = -\vec{F}_{B \to A}^{type}$$

Kinds of Forces

- Forces are what objects do to each other when they interact.
- Types of Force
  - Normal: N
  - Tension: T
  - Friction: f
  - Weight: W
  - Electric: F^E

$$T = k\Delta L$$

$$f \leq \mu N$$

Foothold ideas:
Resistive forces

■ Resistive forces are contact forces acting between two touching surfaces that are parallel to the surface and tend to oppose the surfaces from sliding over each other.

■ There are three types:

- Friction (independent of velocity)
- Viscosity (proportion to velocity)
- Drag (proportional to the square of velocity)

Foothold Ideas:
Friction

- Friction is our name for the interaction between two touching surfaces that is parallel to the surface.
- It acts to oppose the <u>relative motion</u> of the surfaces. It acts as if the two surfaces stick together a bit.
- Normal forces adjust themselves in response to external forces. So does friction – up to a point.

<div align="center">

Static   *Sliding*

</div>

$$f_{A \to B} \leq f_{A \to B}^{\max} = \mu_{AB}^{static} N_{A \to B} \qquad f_{A \to B} = \mu_{AB}^{kinetic} N_{A \to B} \qquad \mu_{AB}^{kinetic} \leq \mu_{AB}^{static}$$

- Friction is independent of velocity and only depends on how hard the two surfaces are being squeezed together.
- Friction can oppose motion or cause it.