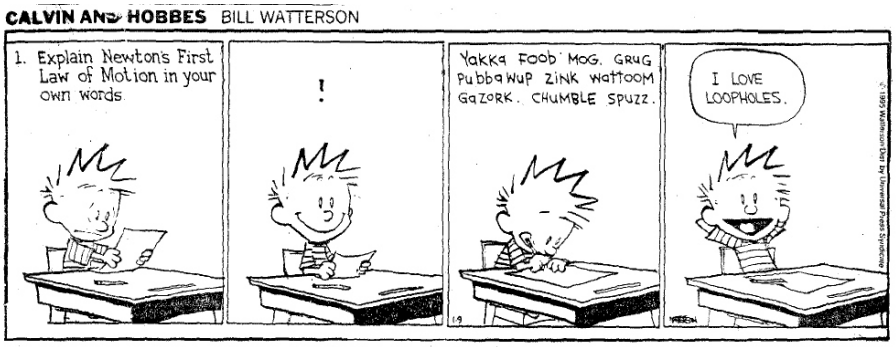
September 26, 2016 Physics 131 Prof. E. F. Redish

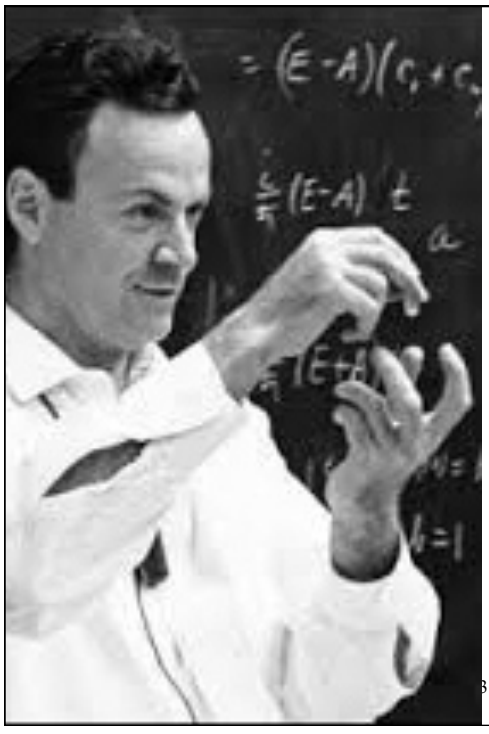
- **Theme Music: Fleetwood Mac**

  Silver Springs

- **Cartoon: Bill Watterson**

  Calvin & Hobbes





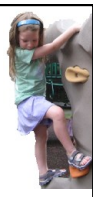
The Equation of the Day

Hooke's law

$$T = k\Delta L$$

Physics 131

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 $\vec{a}_A = \vec{F}_A^{net} / m_A$
- 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
  - Resistive: f, F^D, F^V
  - Weight: W
  - Electric: F^E
  - Magnetic: F^M
- Notation convention.

$\vec{F}$ type of force
(object causing force)→(object feeling force)

Reading questions (N3/N0)

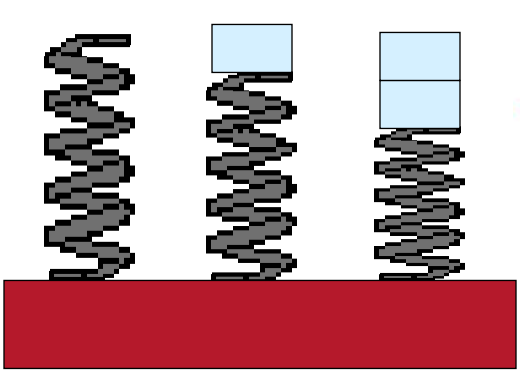
- If Newton's 3rd law does not apply unless the same type of force is under consideration, this means the force normal to the object and the force of gravity are not an example of this law, even if their values are equal but opposite. Why has the 3rd law not been revised in a more broad sense to exclude the "same type of force" portion, if the required calculations are the same?
- If the law states that when one object exerts a force on another object, that other object will exert a force that is equal but opposite, then how is it that often, one force from one object will cause the other to move? If the forces are equal, shouldn't the objects stay still?
- Why isn't the resistive force of B->A considered in the diagram pertaining to object B?

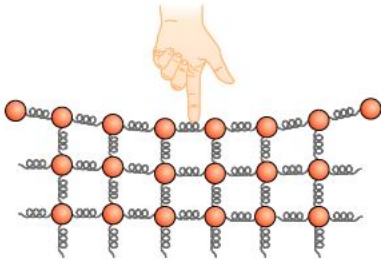
Tension: The Spring

- A spring changes its length in response to pulls (or pushes) from opposite directions.

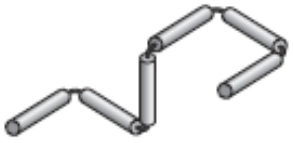
$$T = k\,\Delta L$$

Normal Force: works like a very stiff spring

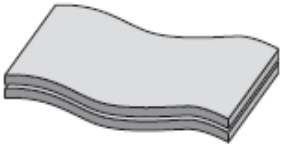




Springs in biology

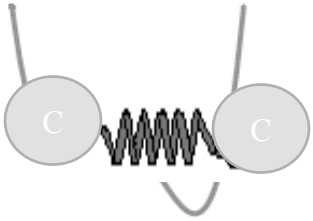


DNA polymer wriggling in solution



cell membrane fluctuating

flagellum beating on a swimming sperm



- Connected Atoms in molecules