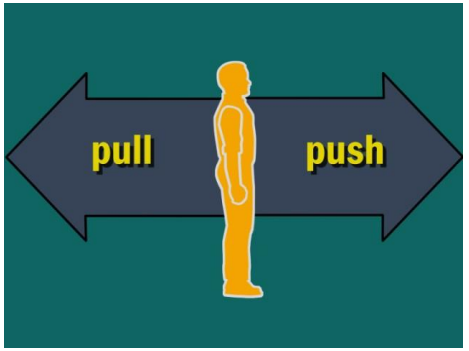
# FORCES

## How We Get Matter to Move

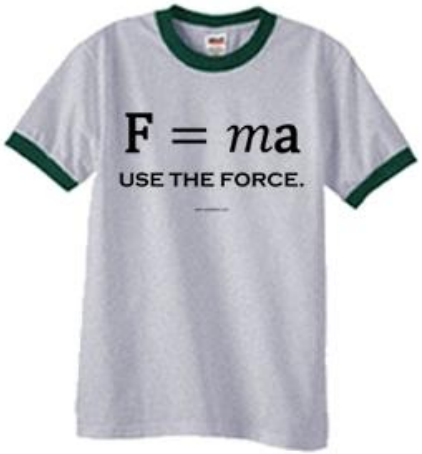
# What is a Force?




- Force = a push or pull
- Has size (magnitude) and direction
- Can change acceleration of an object (speed and/or direction)
- Measured in newtons (n) with a spring scale
- Calculated by this equation:

Force = mass x acceleration

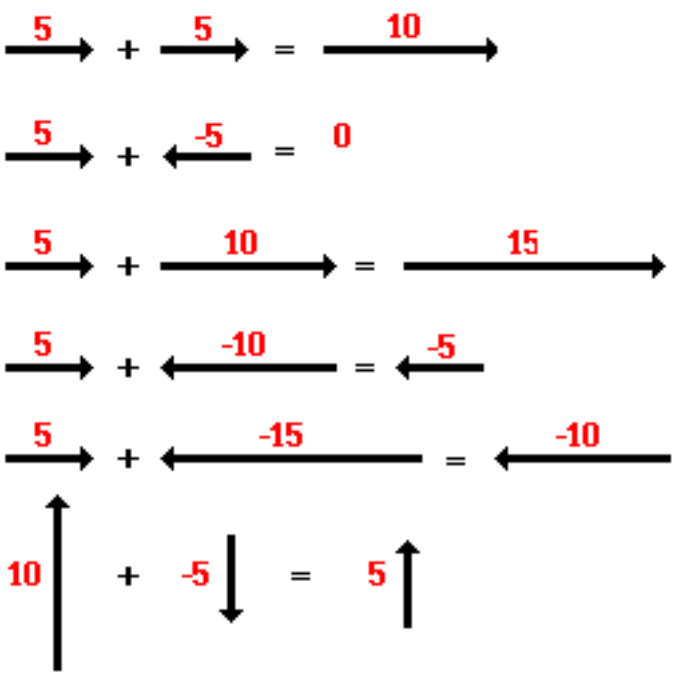
$$F = ma$$




* Some forces are unseen (magnetic force, gravity, etc.) *

# Net Force

- Combination of all the forces acting on an object
  - Add forces that act in the same direction
  - Subtract forces that act in opposite directions



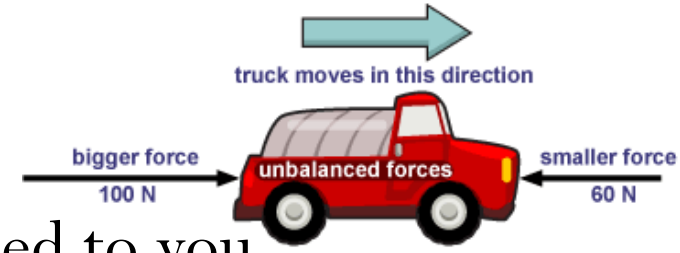

What do you notice about the SIZE of the arrows?

- Knowing the Net Force tells us about the object's motion

# Balanced vs. Unbalanced Forces

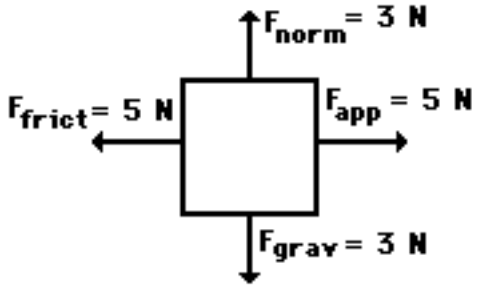
- Balanced Forces – Net Force on object = 0 newtons
  - Cause no change in motion to a moving object
  - Will not move a still object
  - Ex: hat sitting on your head


- Unbalanced Forces – Net Force is *NOT* 0 newtons
  - Produce a change in motion (speed or direction)
  - Cause a still object to move
  - Change motion of moving objects
  - Ex: kicking a soccer ball that is passed to you

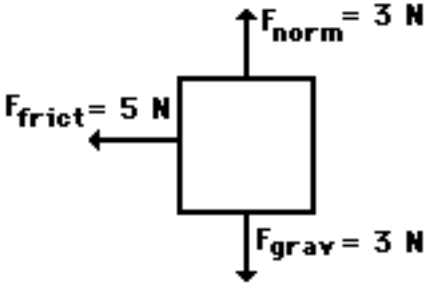


# Practice Finding Net Force

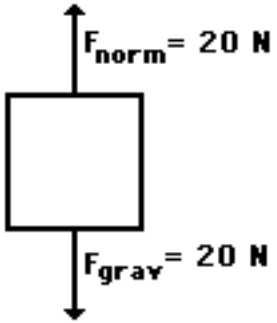
Situation A



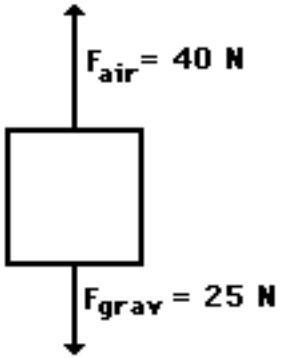

Situation B




Situation C



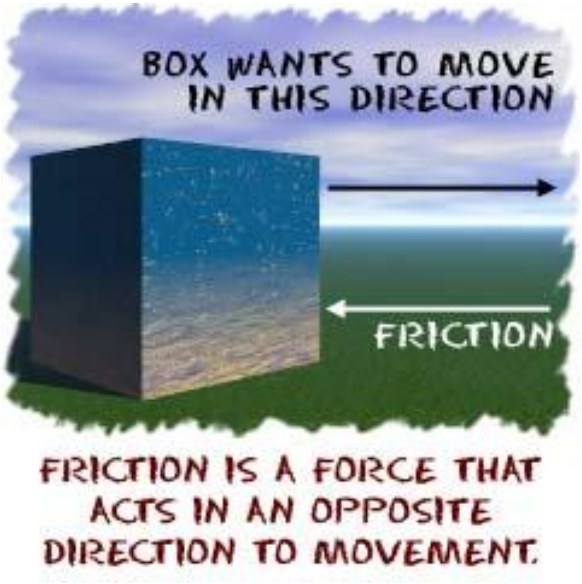

Situation D




Are these balanced or unbalanced forces?

# Special Forces: Friction & Gravity

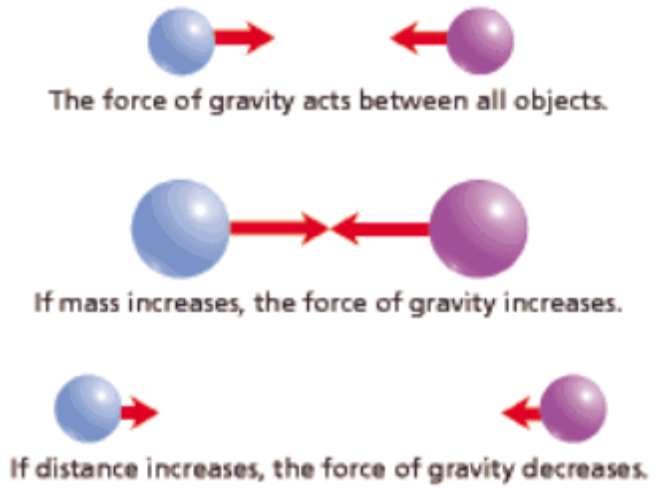
- **Friction**: force that opposes motion between two surfaces that are touching
  - Can cause a moving object to slow down/stop
  - Effect of friction depends on the force pushing the surfaces together and the surface roughness

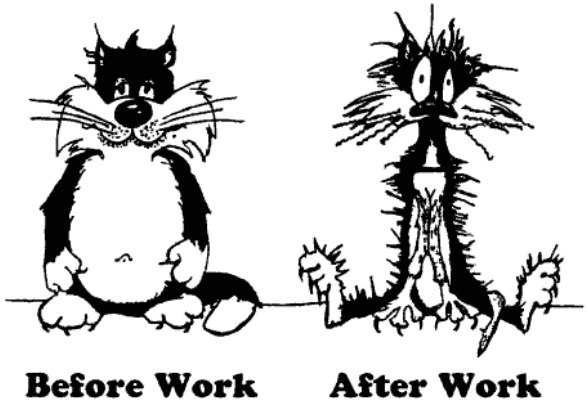


# Special Forces: Friction & Gravity

- **Gravity:** force of attraction between objects due to their masses
  - Can change the motion (speed or direction) of an object
  - All matter experiences gravitational force (attraction to other matter)
  - Larger mass = larger gravitational force

**Things with a large mass feel heavy because Earth is pulling on them with a larger force! **






# Work, Work, Work!

- Work is done when a force applied to an object moves that object
- Calculated using this equation:

  Work = Force x distance  ($W = F \cdot d$)
- Metric unit is newton-meters (n-m) or Joules

** Sitting still in your chair is not work! You have to cause an object to move (Like your pencil!) to actually do work. ** ☺