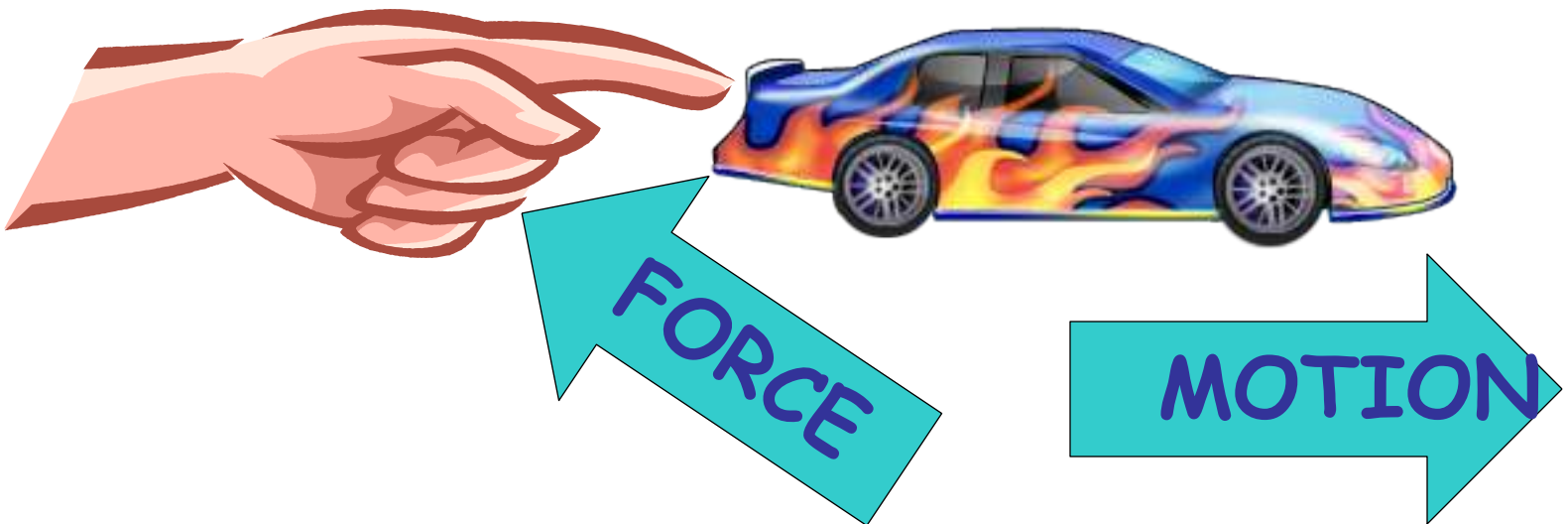
Force and Motion

Balanced and Unbalanced Forces
Velocity and Acceleration

Motion

- What is motion?
  - A change in the position of an object over time.
- How do you know something has moved?
  - You use a reference point!
    - A stationary (not moving) object such as a tree, street sign, or a line on the road.

- **What causes an object to move?**
  - A FORCE!
  - ALL motion is due to forces acting on objects!
- **What is a force?**
  - A push or a pull



The total combination of the forces acting on an object is called NET FORCE.

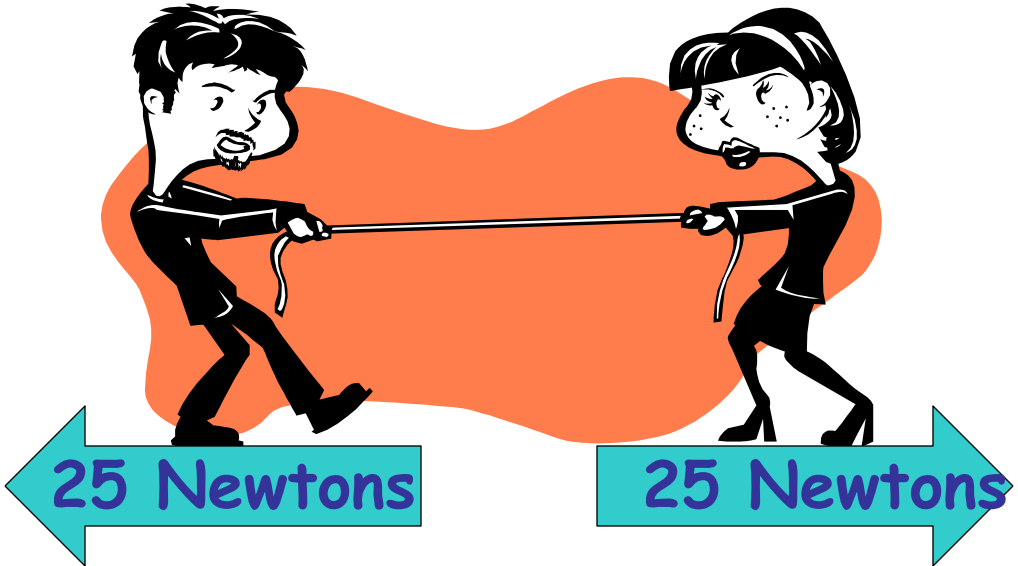
Can more than one force act on an object at the same time?

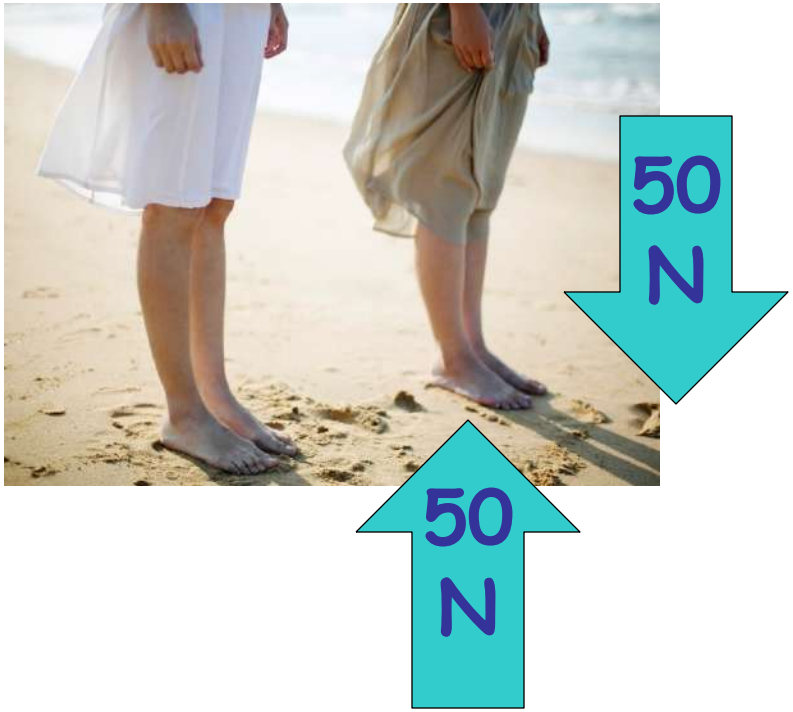
YES!

Example: Gravity is pulling you down to Earth, the ground is supporting you, and your legs moving you forward as you run during PE.

Balanced Forces

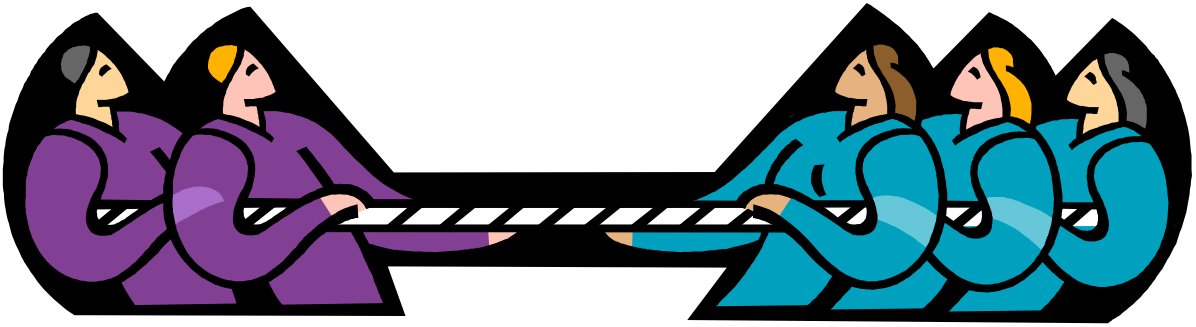
- A balanced force is one in which the net force equals ZERO.
- Do you think there will be any motion?
  - NO!
- Examples:





Unbalanced Forces

- An unbalanced force is one in which the net force is greater than zero.
- Do you think there will be any motion?
  - YES!
- Examples:



25 Newtons

40 Newtons

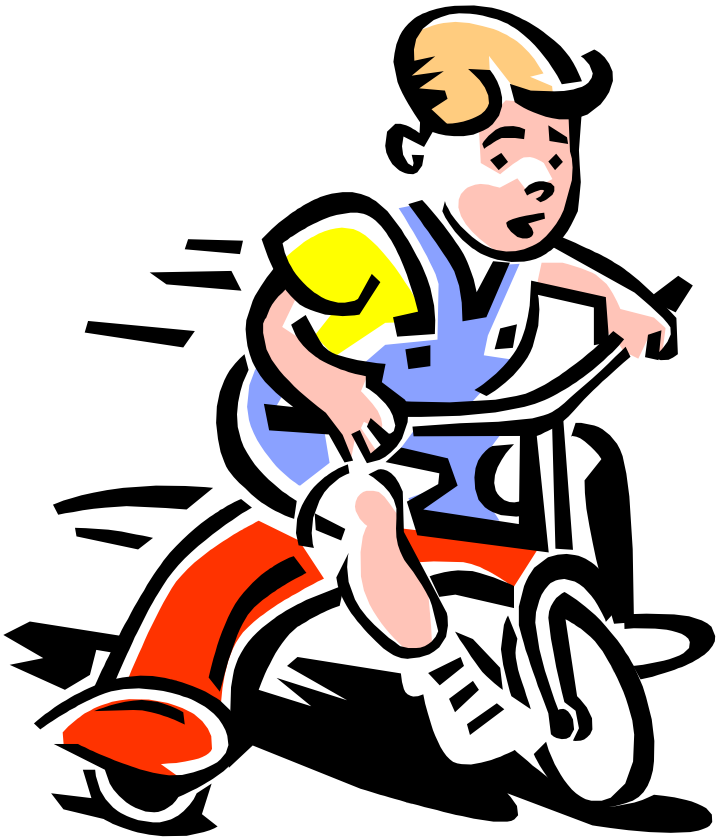
2 N

Only an unbalanced force can change the motion of an object.

- Example: Your doggy can cause you to move if he pulls with enough force.
  - His force is greater than the force you're using to stay in place

What would happen if an unbalanced force acted on an object that's already in motion?

- It will change the **speed** or **direction** of the object.
- Example: Your little brother is riding his tricycle. You run up behind him and give him a push.
  - Your force adds to the existing force causing him to speed up.



Unbalanced forces can act in the same direction.

- Example: You're pushing a cabinet across the room with a force of 15 N. You're friend is pulling with a force of 10 N.
- **What is the NET FORCE?**
- **What direction is the cabinet moving?**

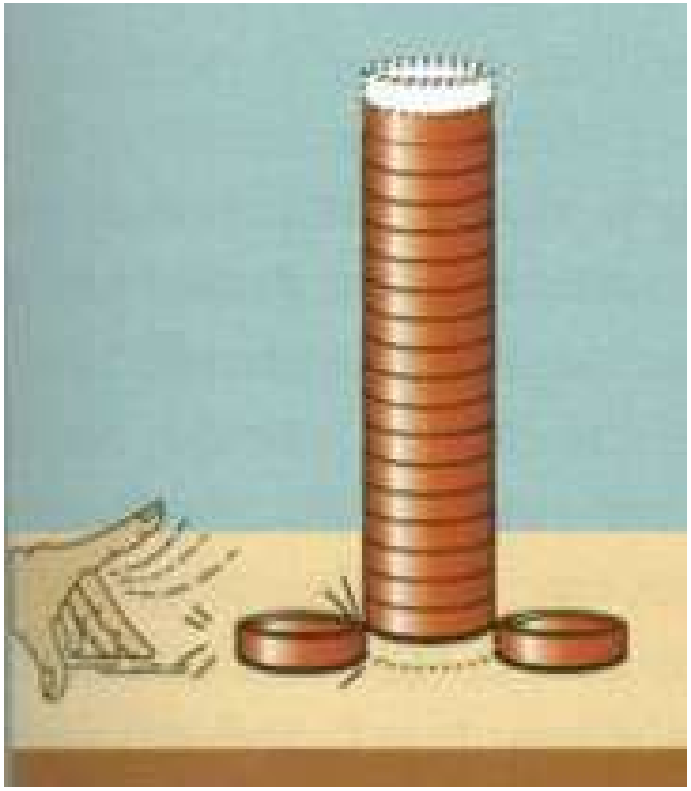
Unbalanced forces can act in <u>opposite</u> directions.

- Example: Two dogs [illegible] on a rope. One dog pulls with a [illegible] and the other pulls with a [illegible]
- What is the NET FORCE?
- What direction is the rope m[illegible]

When you have opposing forces, the direction the object moves is in the same direction as the larger force.

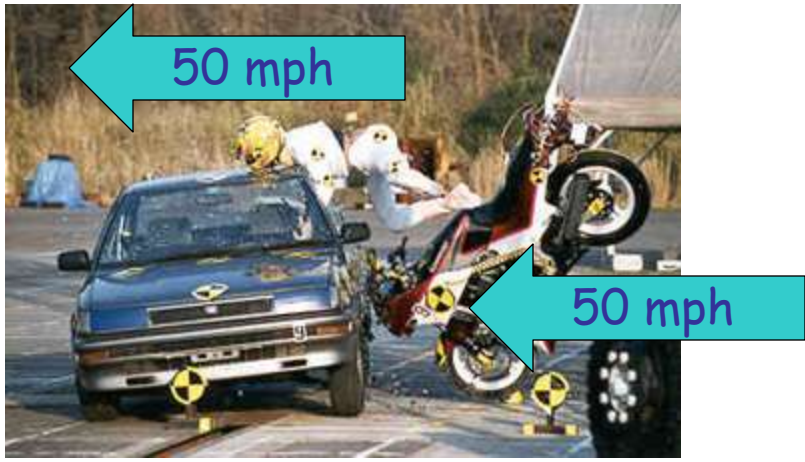
Mass and Inertia

- **Newton's 1st Law: The Law of Inertia**
  - An object at rest will remain at rest, unless acted upon by an unbalanced force
  - An object in motion will continue moving, in the same direction, at the same speed, unless an unbalanced force acts upon it.



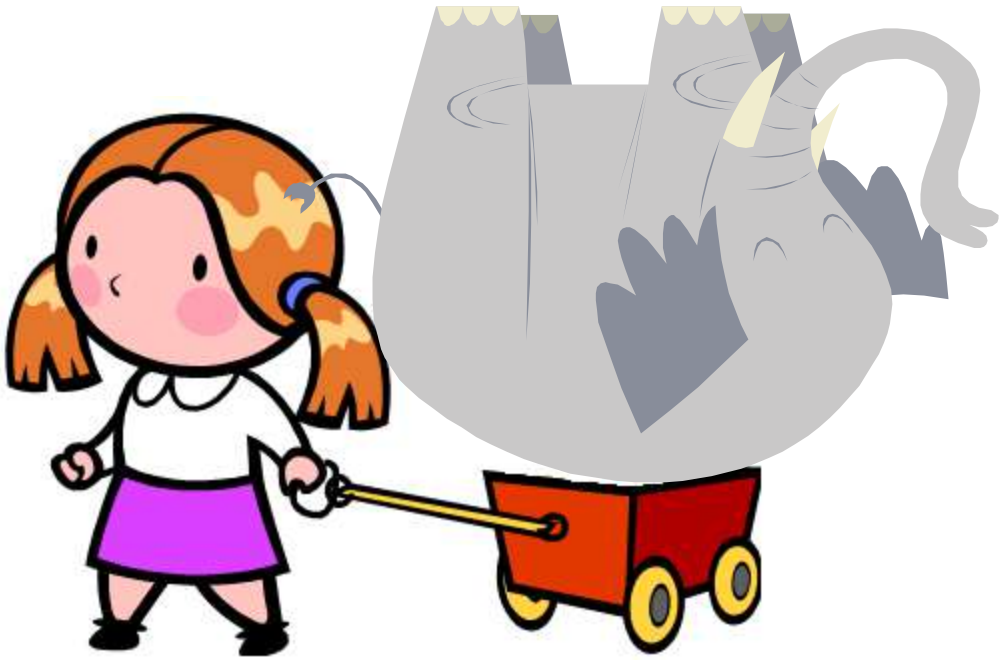
Inertia

- Inertia is the tendency of objects to resist a change in motion.
- Example: seatbelts!
  - http://www.youtube.com/watch?v=2DWFQ73cevU



Mass

- The mass of an object affects its' inertia.
- Objects with more mass have more inertia than an object with a smaller mass.
  - It's harder to make a large object move or change the speed and direction of it when it's moving.

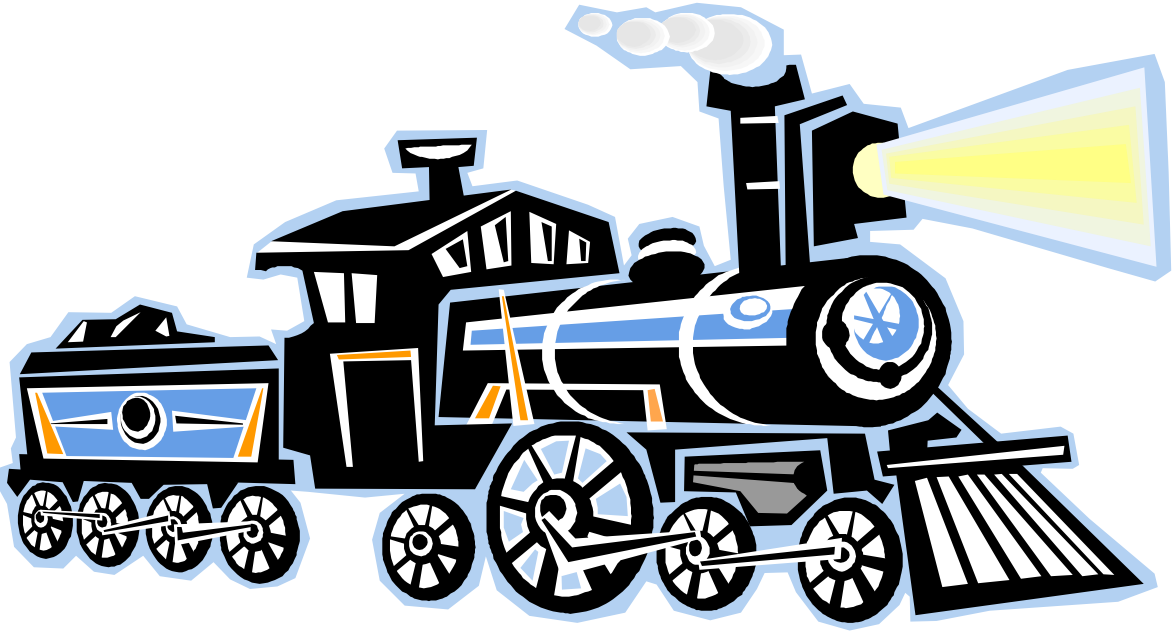


Closing: Pair share

- Give Examples of balanced and unbalanced forces not given so far.
- Explain relationships with net force with both balanced and unbalanced forces.
- Can be written or drawn.

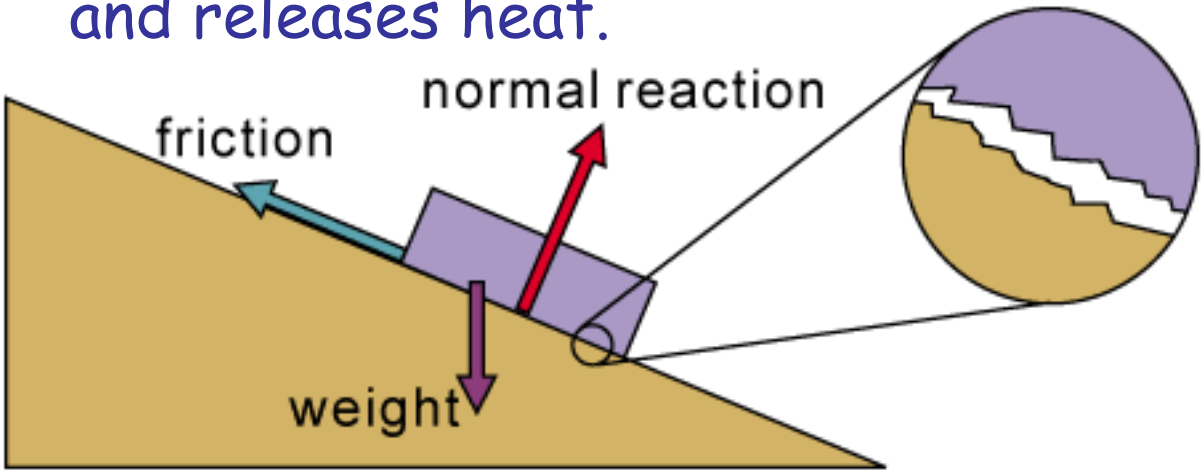
Another Example

- Train v. Car: Which will take longer to accelerate to 60 mph? Why?



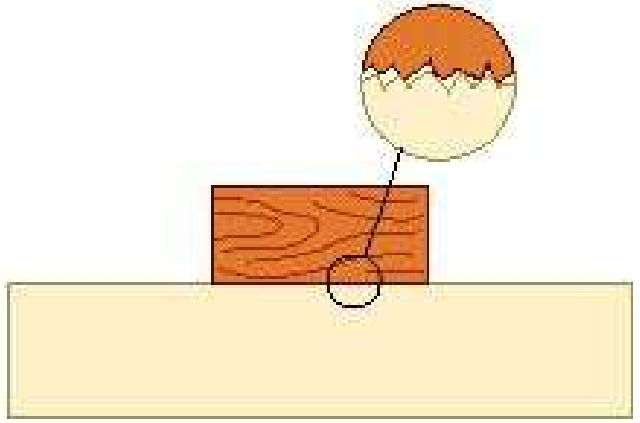
Friction and Gravity

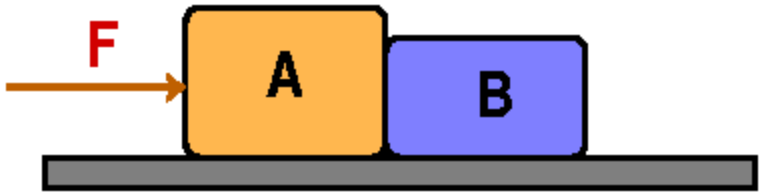
- What is friction?
  - A force that opposes the motion of an object
  - It's a "contact" force!
    - Occurs when an object in motion rubs against a surface.
    - The contact reduces the speed of the object and releases heat.



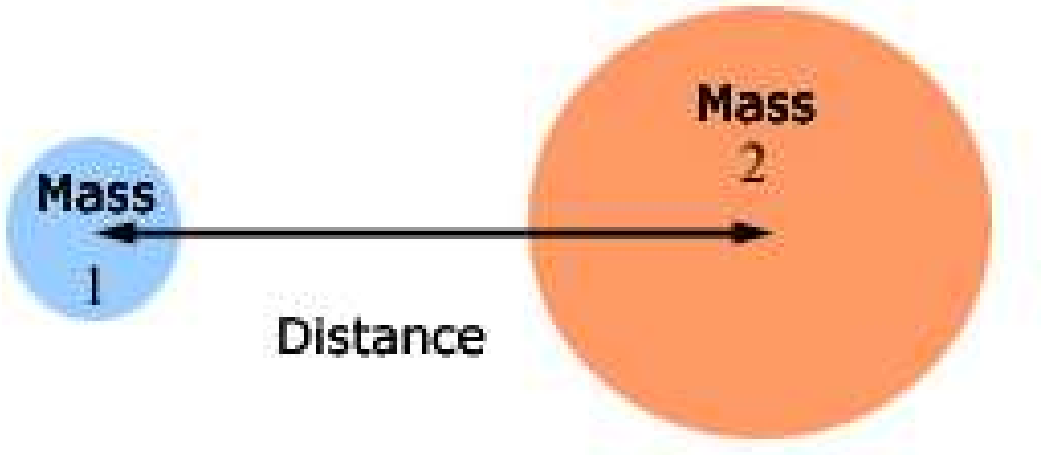
What affects the amount of friction?

- **The force of the push/pull**
  - The harder you push, the longer it's going to take friction to stop the object.
- **The bumpiness of the surface**
  - The rougher the surface, the more friction.
- **The weight of the object**
  - The heavier the object, the more friction.

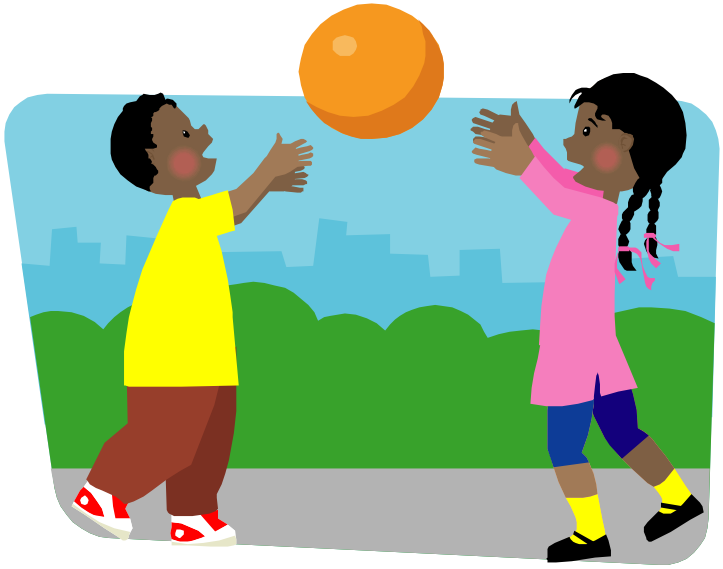




- **What is gravity?**
  - The force of attraction between <u>all</u> objects.
- **The amount of gravity depends on two things:**
  - The objects' masses
  - The distance between the two objects



- Since the earth is so large, everything on it is attracted to it even if they're not touching!
- Example: Throwing a ball.
  - You throw a ball up, but gravity pulls it back down to earth.
  - You can counteract gravity by catching the ball before it hits the ground (you provide the outside force!)



- http://www.youtube.com/watch?v=4NQbeZ0EXZQ
- http://www.youtube.com/watch?v=iH48Lc7wq0U&feature=related

Penny Lab

Students will investigate relationship between force, mass, and the motion of objects.

- Purpose: Demonstrate the effect of balanced and unbalanced forces on an object in terms of gravity, inertia, and friction.
- Material: Beaker, index card, penny.
- Hypothesis: What will happen if you flick an index card out with a penny on top?
- Procedures:Place index card over beaker, then penny on top over the hole.
- Flick card out. (10 minutes).
- Create 3 trials with data chart.
- Write a conclusion using balanced, unbalanced force, mass, inertia, gravity, reference point, motion, force, distance, friction, and Law of inertia .
- Include reference to data and hypothesis.
- Include how this applies to daily living.

Discover Activity

Which Lands First? Materials
4 quarters, ruler, tape

Procedure

Stack three quarters. Place tape between the quarters to hold them tightly together. Place the stack of quarters next to a single quarter near the edge of a desk.
Put a ruler flat on the desk behind the coins. Line it up parallel to the edge of the desk and just touching the coins.
Keeping the ruler parallel to the edge of the desk, push the coins over the edge at the same time. Observe how long the coins take to land.

Think It Over

Predicting Did you see a difference in the time the coins took to fall? Use what you observed to predict whether a soccer ball will fall more quickly than a marble. Will a pencil fall more quickly than a book? How can you test your predictions?

Tips
Remind students to keep the ruler parallel to the edge of the desk.

Think It Over

Students should observe that the single coin and the three-coin set took the same time to fall. They should predict that the soccer ball and the marble and the book and the pencil will all take the same time to fall. They can test their prediction by holding two of the objects at the same height, releasing them at the same time, and observing whether or not they land at the same time.

Closing: Report out

- 1. How does mass and distance affect the gravitational attraction between two objects?
- 2. How is mass related to inertia?