Unit 8 - Forces

RCD Physical Science

Force = Mass x Acceleration

- **Force:**
  - **– Can cause a resting object to move**

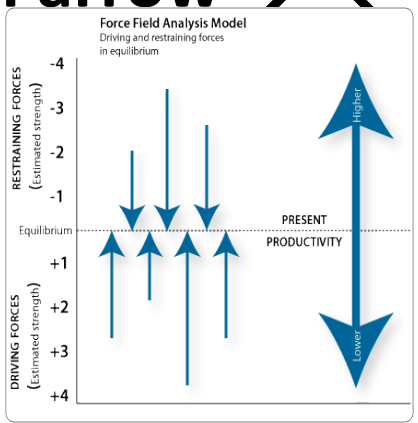
Measuring Force:

- **Spring scale (weight is a type of force)**

Units of Force:

-Newton (N) (force that causes one kg to accelerate at a rate of one meter per second)

-Force can be represented by an arrow → ←



Net Force: overall force acting on an object

- **Types of forces:**
  - **Balanced forces: forces on an object are balanced and the net force is 0 (zero)**
  - **Unbalanced forces: when an unbalanced force acts on an object, the object accelerates**

Friction

- **All objects are subject to friction!**
- **Four main types:**
  - **Static friction**
  - **Sliding friction**
  - **Rolling friction**
  - **Fluid friction**

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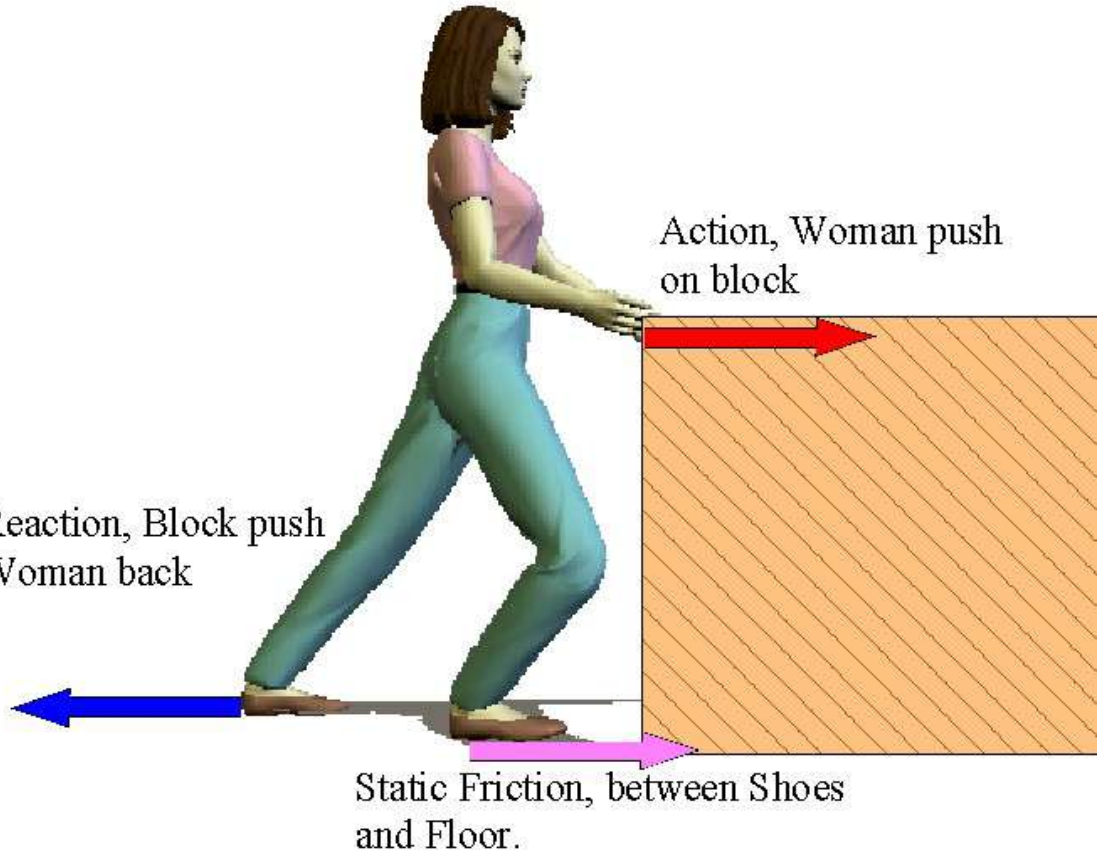
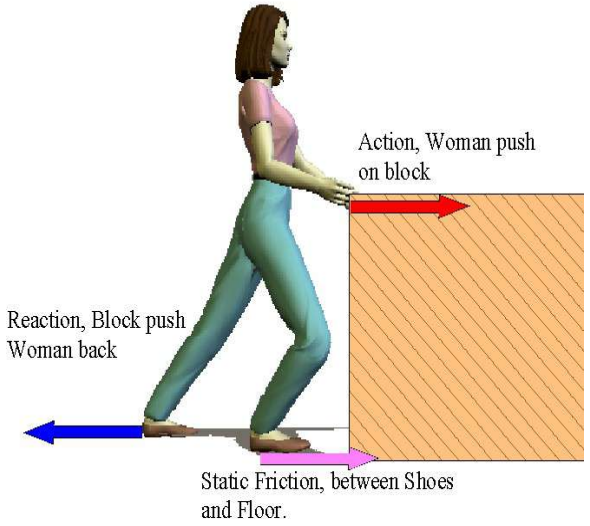


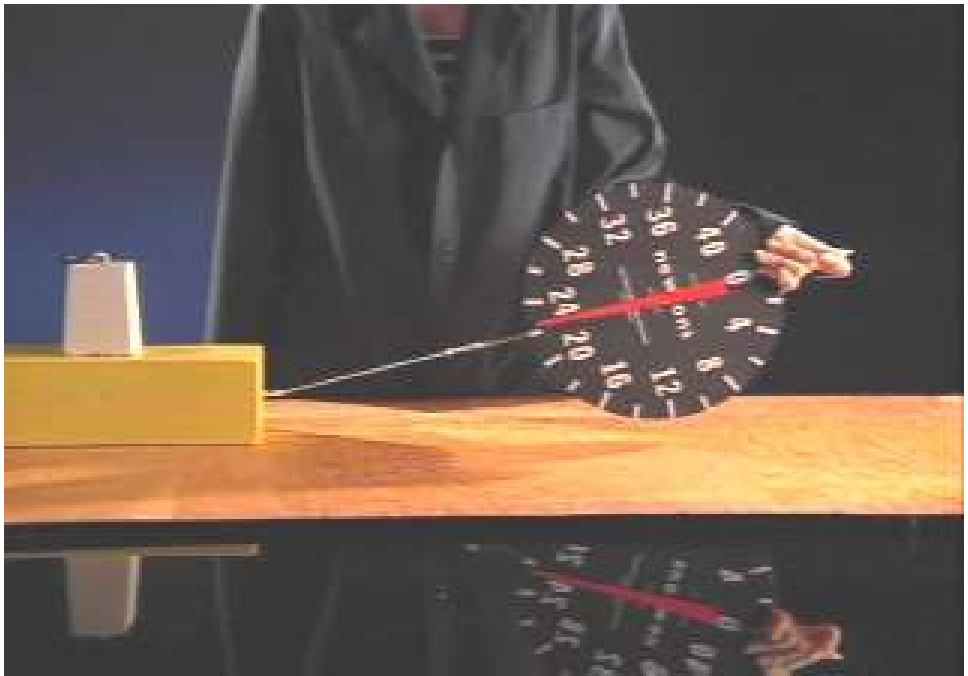
Static Friction

- **Friction that acts on objects that are not moving.**
- **Ex. Pushing a refrigerator, static friction must be overcome before it will move.**



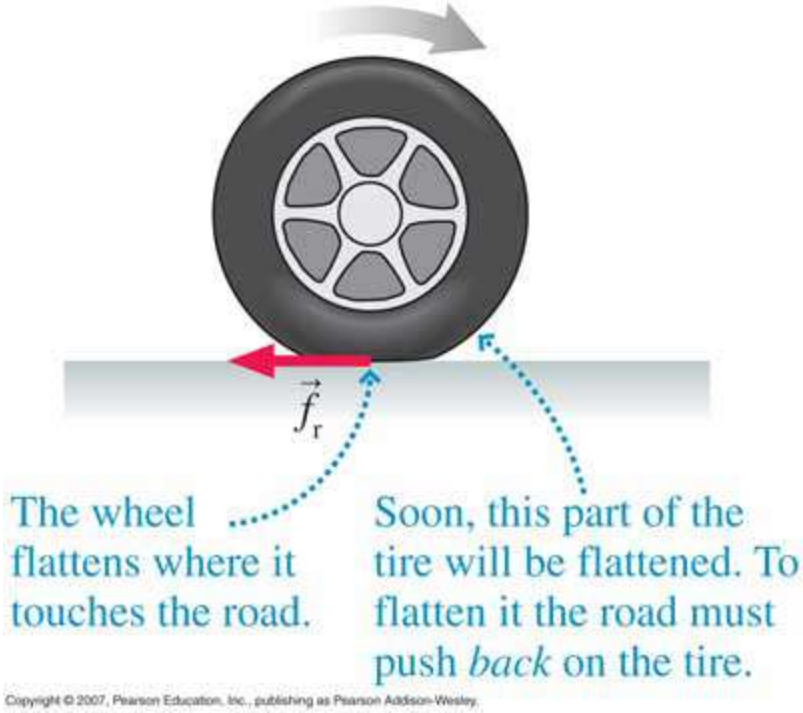
Sliding Friction

- **Friction that opposes the direction of motion of an object**
- **Ex. One the refrigerator is moving, the friction between the floor and fridge is sliding friction**



Rolling Friction

- Friction that acts on rolling objects
- Rolling friction is less than sliding friction
- Ex. Anything with ball bearings- cars, inline skates, skateboards



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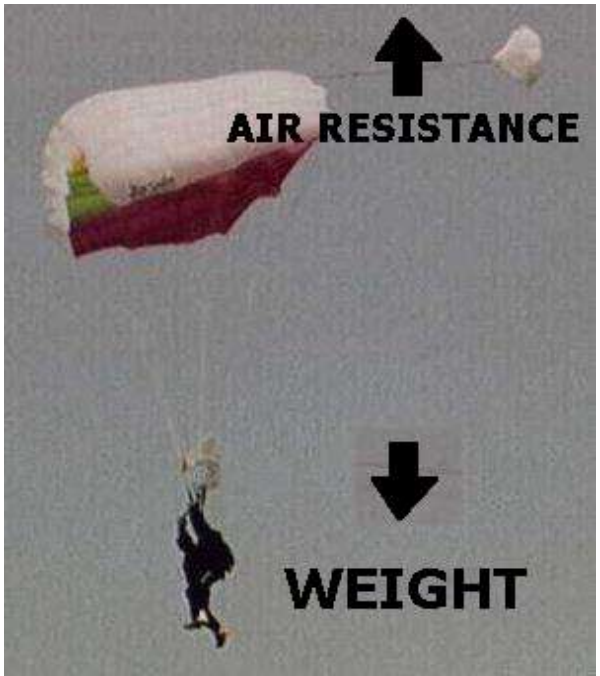
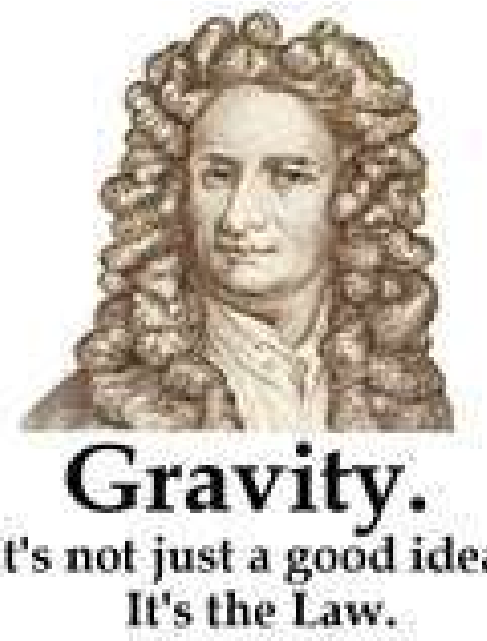
Fluid Friction

- **Fluid friction is the force that opposes the motion of an object in a fluid (mixing cake batter)**
- **Air resistance is a type of fluid friction (faster the speed- greater the resistance, think about jets and airplane design)**



Gravity

- **A force that acts between two masses**
- **Earth's gravity acts downward toward the center of the Earth**
- **Acceleration due to gravity is 9.8m/s^2**



Falling Objects

- **Gravity causes objects to accelerate downward, whereas air resistance acts in the direction opposite to the motion and reduces acceleration**

$9.8 m/s^2$

Terminal Velocity

- **Constant velocity of a falling object when the force of air resistance equals the force of gravity.**

Projectile Motion

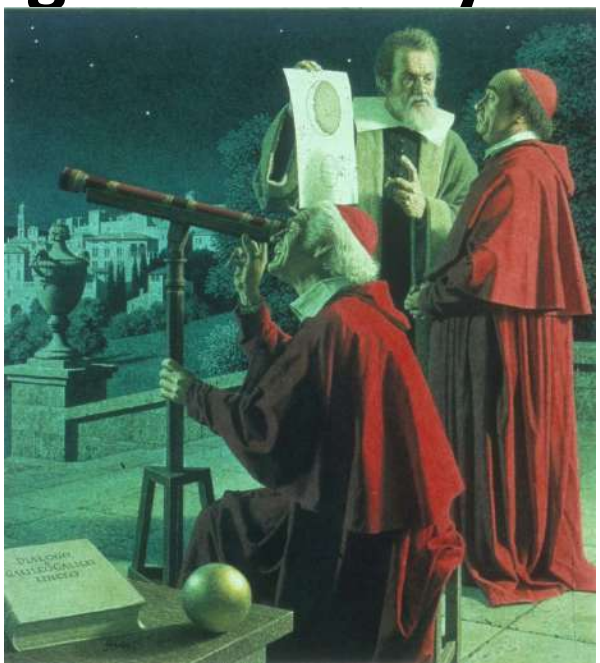
- http://galileoandeinstein.physics.virginia.edu/more_stuff/Applets/ProjectileMotion/jarapplet.html

Where does our understanding of force and motion come from?

- **Aristotle (384 BC– 322BC):**
  - **Made many scientific discoveries**
  - **INCORRECTLY proposed that force was required to keep an object moving**
  - **This proposal held back progress in the study of motion for almost 2000 YEARS!**

Galileo (1564-1642)

- **Studied how gravity produces constant acceleration**
- **Moving objects not subjected to friction will keep moving indefinitely**



Newton

- **Built on the work of other scientists**
- **Printed *Principia* - this book <u>introduced his 3 laws of motion</u>**

Newton

- **First Law of Motion: The state of motion of an object does not change as long as the net force action on the object is zero**
- **Also known as the law of INERTIA**
- **INERTIA the tendency of an object to resist a change in its motion**

INERTIA

Your truck has brakes...the massive hunk of stone doesn't.

fakeposters.com

Newton

- **First Law continued…**
- **“ An object at rest tends to remain at rest and an object in motion tends to remain in motion with the same direction and speed until acted on by outside forces”**

First Law

- **What my demonstration with the penny and cup.**
- **What happens when I pull away the cardboard?**
- **Why?**
- ***ANSWER:***
- ***The force was applied on the cardboard and the coin got left behind because of its inertia of rest***.

First Law (DON'T WRITE!)

- **Reason out what happens to passengers standing in a bus when it moves suddenly.**
-

Imagine that the bus, in the above example comes to a sudden halt. The passengers are thrown forward, unless they hang onto something. This is *inertia of motion*. The same bus gets moving again and goes around a corner at a fast speed. The passengers are thrown outwards. This is *inertia of direction*

Newton’s First Law of Inertia

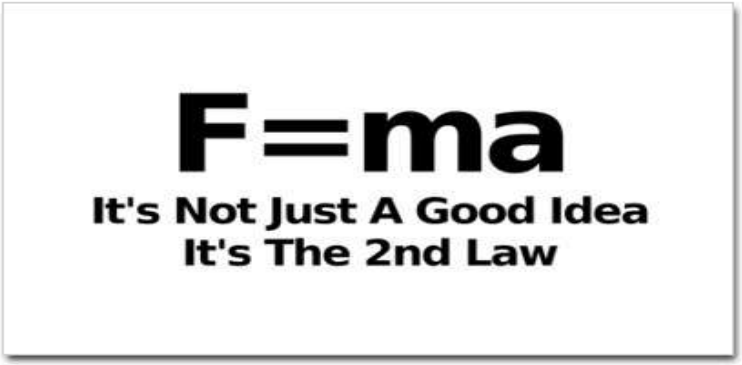
- http://videos.howstuffworks.com/discovery/29382-assignment-discovery-newtons-first-law-video.htm

Newton Second Law

- **How do unbalanced forces affect the motion of an object?**
- **Answer- an unbalanced force causes an object's velocity to change.**
- **Mass- the measure of inertia of an object, depends on the amount of matter the object contains.**

Second Law

- **The acceleration of an object is equal to the new force acting on it divided by the object's mass**
- **Acceleration = Net Force / Mass**



Or F = MA

http://teacher[illegible]ts/louviere/Newton/law2.html

Practice !!!

- **An automobile with a mass of 1000 kg accelerates when the traffic light turns green. If the net force on the car is 4000 newtons, what is the car's acceleration?**
- **The info. you are given is Force and Mass.**
- **F = 4000 N and M = 1000 kg**
- **What do you want to solve for?**
- **Acceleration! A = F/M**
- **Acceleration = 4000/1000 = 4 m/s^2**
- *** In your book page 367- complete 1-4 and turn it in to the basket. Put your name on it!**

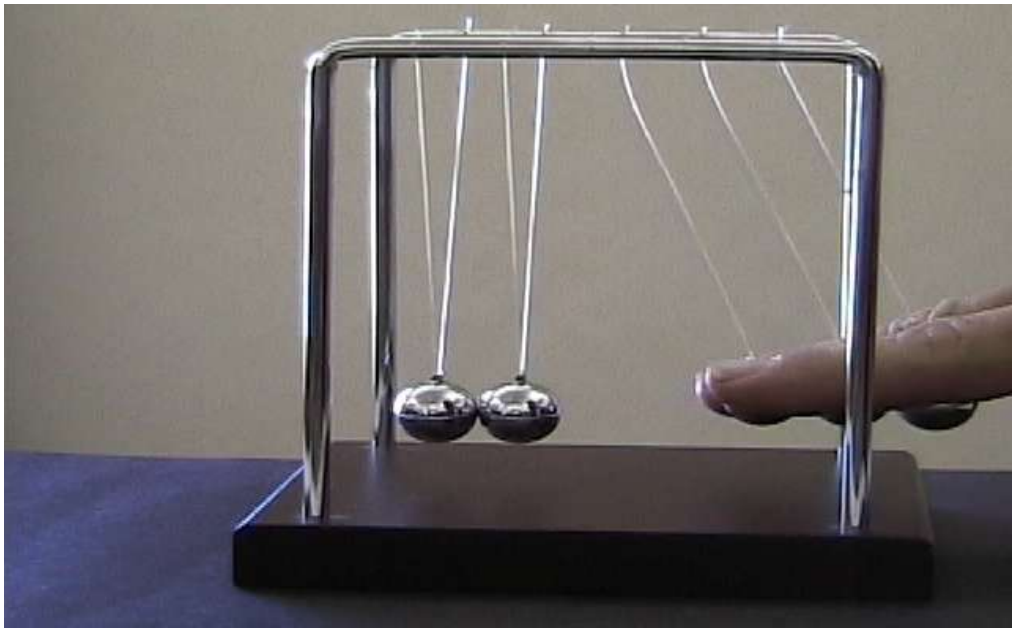
Warm-Up

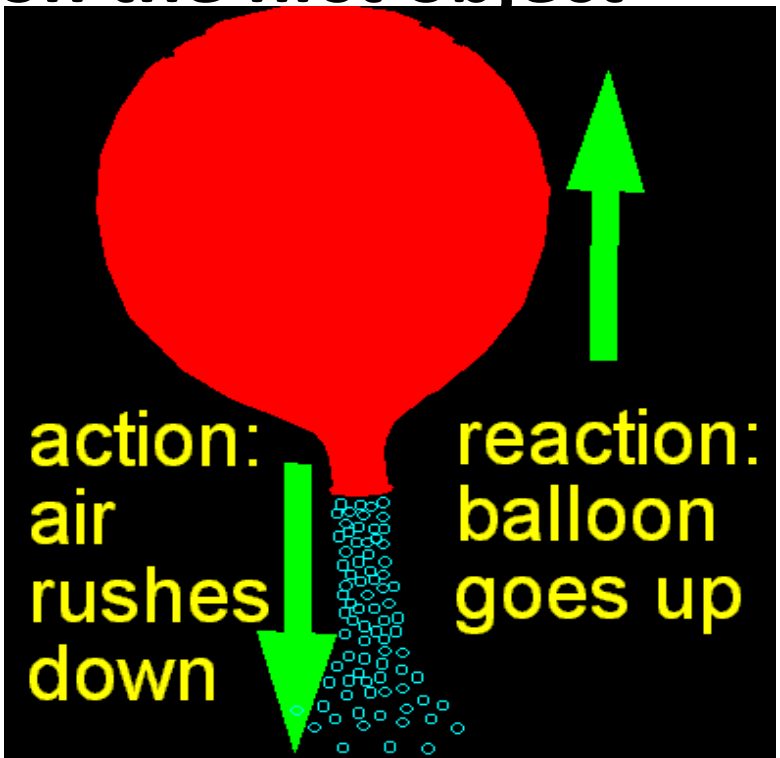
- **1) What is Newton's first law known as?**
- **2) What is INERTIA?**
- **3) What is the formula for Newton's second law? (What do the letters represent?)**
- **4) If the force of impact of a bean bag on a person is 100 N and the mass of the bean bag is 2 kg- what was the acceleration of the bean bag prior to it hitting the person?**
- **50 m/s^2**

Newton's Third Law

- **"For every action, there is an equal and opposite reaction"**

Correctly stated- " whenever one object exerts a force on a second object, the second object exerts an equal and opposite force on the first object"





Action and Reaction Forces:

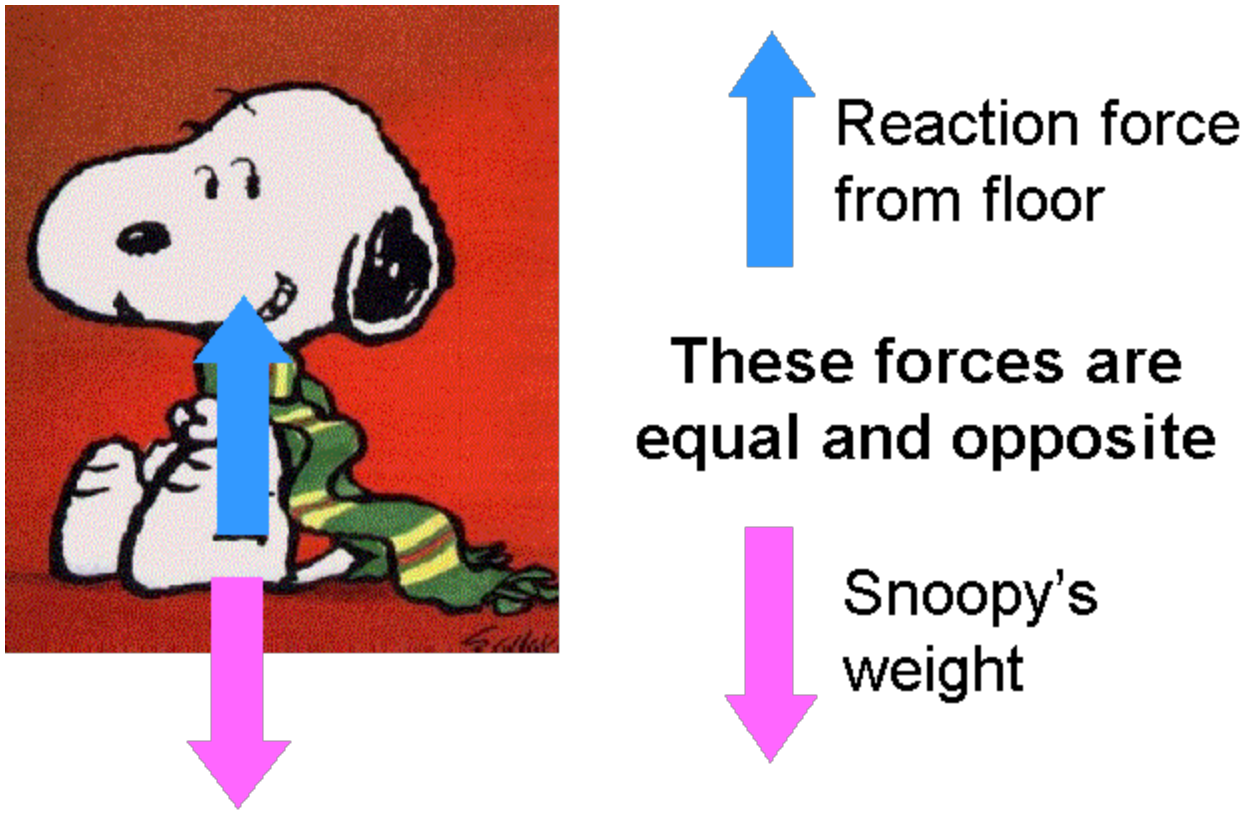
- **Bumper Cars!**

Action-Reaction Forces

- **Swimming!**
- **Action-Reaction forces propel the swimmer through the water.**
- **The swimmer pushes against the water and the water pushes the swimmer ahead!**
- **Remember- action-reaction forces don't cancel!**

Action-Reaction Forces

- **Not all action-reaction forces create movement.**
- **Ex. Pushing against the wall (the wall pushes back ☺)**



If both objects were rolling toward you at the same slow speed, which would be easier to stop?

Now- what if the marble was moving 100 times faster? Which is easier to stop? Which has the greatest momentum?

Momentum

- **Momentum- the product of an objects mass and velocity**
- **An object has a large momentum if the product of its mass and velocity is large.**

Momentum = Mass x Velocity

Balanced and Unbalance Forces

- **Balanced Forces = No movement**
- **Unbalanced Forces = Movement**

Calculate NET FORCE:

Ex. A 150 kg box experiences a 13N force to the right and a 10 N force to the left.

Draw and label the forces:

NET FORCE is ……

3 N to the right!

What happens to Momentum when objects collide?

- **Law of conservation of momentum**
- **If no net force acts on a system, then the total momentum of the system does not change**
- **Ex. Railroad cars, Newton's Cradle**
- **http://www.lhup.edu/%7Edsimanek/scenario/newton.htm**