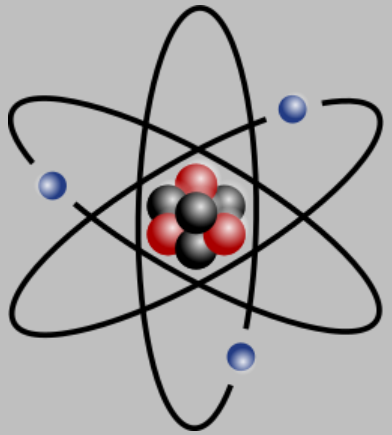
International House Tashkent
Subject: Physics
Department: ES, Course 1
Lesson 5. Newton's laws of motion



Background

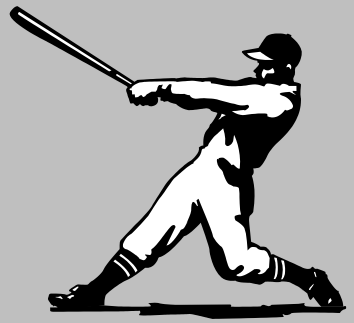
Sir Isaac Newton (1643-1727) an English scientist and mathematician famous for his discovery of the law of gravity also discovered the three *laws of motion*. He published them in his book Philosophiae Naturalis Principia Mathematica (mathematic principles of natural philosophy) in 1687. Today these laws are known as *Newton's Laws of Motion* and describe the motion of all objects on the scale we experience in our everyday lives.

Newton's Laws of Motion

- 1st Law – An object at rest will stay at rest, and an object in motion will stay in motion at constant velocity, unless acted upon by an unbalanced force.
- 2nd Law – Force equals mass times acceleration.
- 3rd Law – For every action there is an equal and opposite reaction.

Newton's First Law

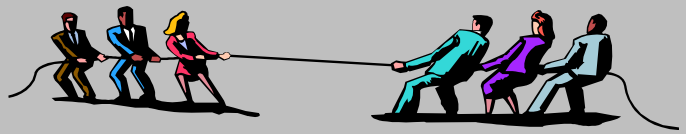
- **Newton's First Law of Motion**
  - "Law of Inertia"



- **Inertia**
  - tendency of an object to resist any change in its motion
  - increases as mass increases

Some Examples from Real Life

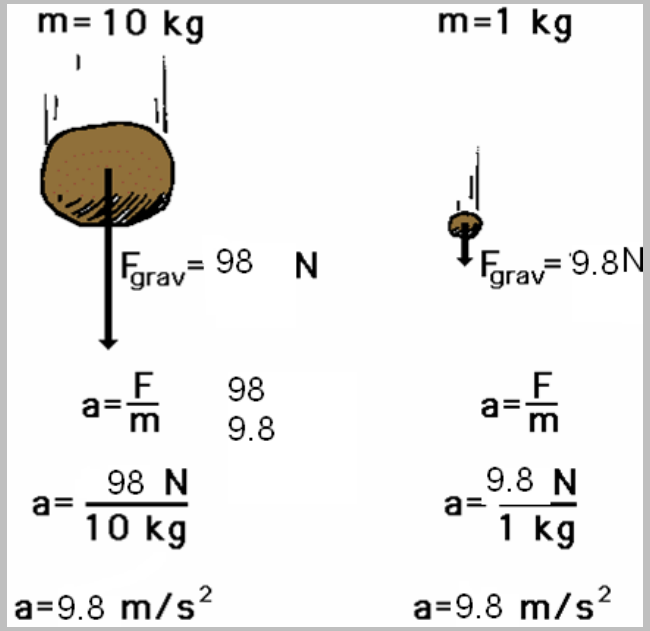
A soccer ball is sitting at rest. It takes an unbalanced force of a kick to change its motion.



Two teams are playing tug of war. They are both exerting equal force on the rope in opposite directions. This balanced force results in no change of motion.

Newton's 2nd Law proves that different masses accelerate to the earth at the same rate, but with different forces.

- We know that objects with different masses accelerate to the ground at the same rate.
- However, because of the 2nd Law we know that they don't hit the ground with the same force.



F = ma

98 N = 10 kg x 9.8 m/s/s

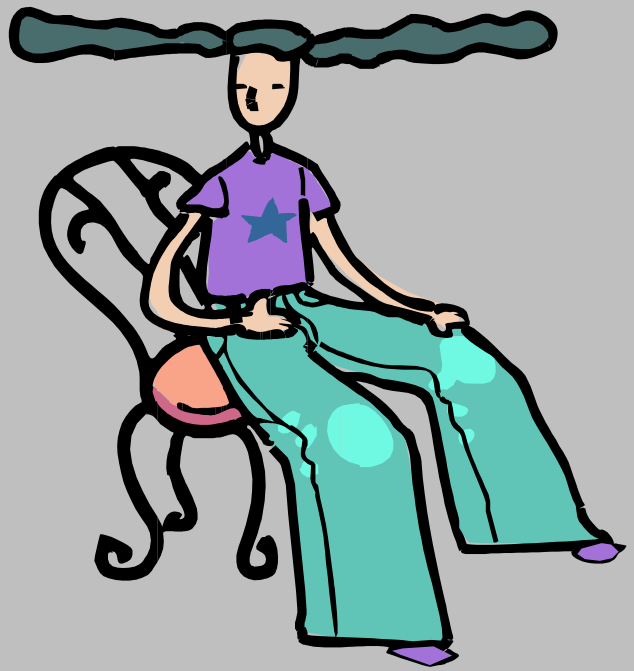
F = ma

9.8 N = 1 kg x 9.8 m/s/s

Check Your Understanding

- 1. What acceleration will result when a 12 N net force applied to a 3 kg object? A 6 kg object?
- 2. A net force of 16 N causes a mass to accelerate at a rate of 5 m/s^2. Determine the mass.
- 3. How much force is needed to accelerate a 66 kg skier 1 m/sec/sec?
- 4. What is the force on a 1000 kg elevator that is falling freely at 9.8 m/sec/sec?

3rd Law



According to Newton, whenever objects A and B interact with each other, they exert forces upon each other. When you sit in your chair, your body exerts a downward force on the chair and the chair exerts an upward force on your body.

Newton's Third Law

- **Action-Reaction Pairs**

- The hammer exerts a force on the nail to the right.
- The nail exerts an equal but opposite force on the hammer to the left.