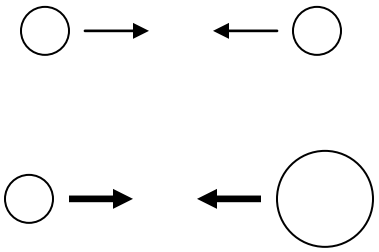
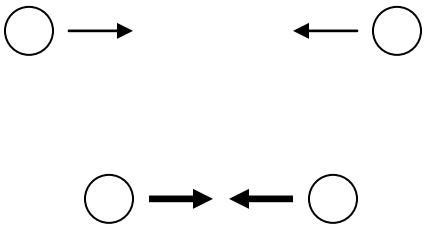
GRAVITY

The force of attraction that the earth exerts on all objects is called **gravity**. Gravity pulls all things towards the center of the earth. Objects dropped from a height fall because of gravity. Although gravity cannot be seen, there are things that happen on earth that let us know that it is present. Water flows downhill because of gravity. Earth's atmosphere exists because the gases that make it up are held close to earth due to gravity. Earth's gravity is strong enough to influence the motion of the other planets in our solar system as well as our own satellite – the moon.

Gravity is an attractive force between two objects. Gravity increases as the mass of one or both of the objects increases. Gravity will also increase as the objects move closer to one another.



If the mass of either object increases, the gravitational attraction between them increases.



If the distance between the objects decreases, the gravitational attraction between them increases.

You may not realize that there is a gravitational attraction between yourself and your notebook. You cannot feel the gravitational attraction between you and your notebook because the force is very weak. You are able to feel the gravitational attraction between you and the Earth because the earth is both close enough and massive enough. Our Sun is much more massive than the Earth, but it is too far away for us to feel it's gravity. However, the gravitational attraction between the Earth and Sun is sufficient so that the Earth remains in orbit around the Sun.

UNIVERSAL LAW OF GRAVITATION

The law of universal gravitation helps us find the force of gravity between two objects. We need only know the mass of both objects and the distance between them. The following equation is used to determine this force.

$$F = G \text{ (mass 1) x (mass 2) / distance}^2$$

"F" is the force of gravity that we are trying to determine. **"G"** is a constant called the universal gravitational constant. This is a constant because it never changes. Simply plug in the mass values (in kilograms) for each object along with the distance (in meters) between them to determine the force of gravity.

EARTH'S GRAVITATIONAL ACCELERATION

All objects dropped from the same height theoretically should hit the ground at the same time (regardless of their mass) and only if there were no air resistance. What this means is that a car and a pebble dropped from the same height should hit the ground at the same time. The reality here on earth is that we do have air resistance, so we need to test this idea in some place where there is very little if no air resistance.

The acceleration of an object in free fall is about 9.8 meters every second. This acceleration is s sometimes called the acceleration due gravity and is given the symbol **g** (sometimes referred to as "little g"). The force of Earth's gravity can be calculated using the following equation:

$$F = mg$$

"**F**" is the force of earth's gravity, "**m**" is the mass (in kilograms) of the falling object and "**g**" is the acceleration due to earth's gravity (9.8 m/s^2).

You can use this formula to determine the gravitational force exerted on a falling object with a mass of 50 kilograms.

$$F = (50 \text{ kilograms}) \times (9.8 \text{ m/s}^2)$$

$$F = 450 \text{ kg} \bullet \text{m/s}^2$$

$$F = 450 \text{ N (newtons)}$$

We use the unit Newton (N) to simplify the unit $kg \bullet m/s^2$. One Newton is actually 1 $kg \bullet m/s^2$.

DETERMINING WEIGHT

Weight is a measure of the force of gravity. The metric unit for weight is the Newton (N).

Weight can be calculated using the following equation:

$$W = mg$$

Where "W" is the weight in newtons (N), **"m"** is the mass in kilograms (kg) and **"g"** is the acceleration due to earth's gravity (9.8 m/s^2).

You notice that this formula is identical to the formula for determining earth's gravitational acceleration substituting weight (W) for force (F). You would be correct to say that weight is actually a force!! You can use this formula to determine the weight (in newtons) of a person with a mass of 50 kilograms.

$$W = (50 \text{ kilograms}) \times (9.8 \text{ m/s}^2)$$

$$F = 450 \text{ kg} \bullet \text{m/s}^2$$

$$F = 450 \text{ N}$$