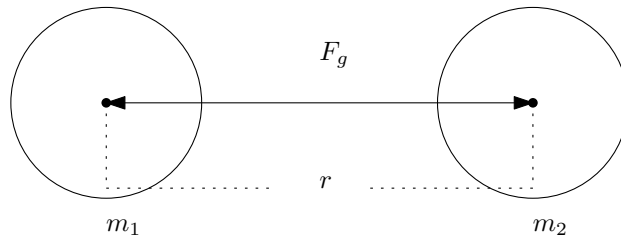Matter attracts matter - we call this force gravity.

Newton discovered that the force of gravity between two objects is directly proportional to the product of their masses and inversely proportional to the square of the distance between them.
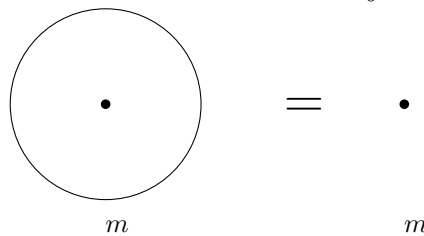
$$F \sim \frac{m_1 m_2}{r^2}$$

The constant of proportionality is experimentally determined. The first person to do this was Cavendish in 1798:

$$F = G \frac{m_1 m_2}{r^2}$$

$G = 6.674 \times 10^{-11} \text{ N·m}^2/\text{cm}^2$

When considering the gravitational attraction between two masses, all of the mass may be considered to be located at the center of mass of the object.

This is not an approximation.

Important Constants
mass of the sun $= 1.9891 \times 10^{30}$kg
mass of the earth $= 5.9722 \times 10^{24}$kg
mass of the moon $= 7.3477 \times 10^{22}$kg
radius of earth $= 6378$ km
radius of moon $= 1737$ km
distance of earth to moon $= 384400$ km
distance of earth to sun $= 149\,597\,870$ km

Draw diagrams and show work on a separate sheet to answer the following problems. Use Newton's Law of Universal Gravitation.

1. What is the force of gravity on a 25 kg mass located on the surface of the earth?

2. Felix Baumgartner jumped out of a hot air balloon at an elevation of 39 km on Oct. 14, 2012. Assuming he weighed 80 kg, what was the force of gravity on his body?

3. What was the acceleration due to gravity on Baumgartner's body?

4. What is the force of gravity on the Moon due to the Earth?

5. What is the force of gravity on the Earth due to the Moon?

6. What is the force of gravity on the Earth due to the Sun?

7. What is the acceleration due to gravity on the surface of the moon?

8. If an astronaut is exactly half way between the earth and the moon, calculate the net force on them. Be sure to include direction.