

# Gravity: What is it and where does it come from?

Simple Definition: Gravity is the attraction between at least two objects that is dependent on their mass and distance from each other's centers.



"I have not as yet been able to discover the reason for these properties of gravity from phenomena, and I do not feign hypotheses." - Isaac Newton, in *Philosophiae Naturalis Principia Mathematica*, 1687.

## The History of Gravity

You may have heard the story about Sir Isaac Newton and gravity. The story starts - Once upon a time Newton was sitting under an apple tree when suddenly a gust of wind caused an apple to fall out of the tree and hit him on the head. In the story the falling apple made him suddenly realized the complex nature of gravity.

There's not enough evidence to prove one way or another that the story is true, but what is true is that Newton's observations about falling objects, like apples falling from a tree, helped him form his ideas about gravity. Newton didn't discover gravity - the effects of gravity have been around since man first kept track of things. After all, people, even in ancient times, constantly experienced gravity in their daily lives. Even ancient humans observed over and over again how things would always fall towards the ground. However, it wasn't until Newton, and his keen analysis of falling objects, that allowed him to develop his law of gravity.



Because of Isaac Newton, people started to truly understand how gravity influences everything in the known universe.

Newton was the first one to suggest that gravity is everywhere and affects all objects in the universe. That's why Newton's law of gravity is called the **law of universal gravitation**. Universal gravitation means that the force that causes an apple to fall from a tree to the ground is the same force that causes the moon to keep moving around Earth. The force that pulls the Earth into an orbit around the sun is the same force that interacts between a butterfly and a tree. We notice the apple falling from the tree but not the butterfly being pulled to the tree - why not? It's because of the masses involved and the distance between those masses. Notice that there have to be at least two objects for gravity to occur. Gravity is an interaction. Universal gravitation also means that while the Earth exerts a pull on you, you



exert a pull on Earth. In fact, there is gravity between you and every mass around you—your chair, your bed, your pen. Even the tiny molecules of air that surround you are attracted to one another by the force of gravity.

Isaac Newton first described gravity as the force that causes objects to fall to the ground and also the force that keeps the Moon circling Earth. Newton defined the Universal Law of Gravitation, which states that a force of attraction, called **gravity**, exists between all objects in the universe. The strength of the gravity depends on two ideas; on how much mass the objects have, and how far apart they are from each other. The greater

the objects' masses are, the bigger the pull. Looking at the picture above. There are two masses,  $m_1$  and  $m_2$ . If you notice,  $m_1$  pulls on  $m_2$  and  $m_2$  pulls on  $m_1$  - with the same amount of force because there are two masses with a distance labeled  $r$  between the masses. That force is gravity. If  $m_2$  suddenly became more massive, the amount of gravity between the two masses would get bigger, in addition, if the distance between the objects, increased, which means the two masses got farther apart the gravitational force would become less.

The force of gravity exists between all objects in the universe; the strength of the force depends on the mass of the objects and the distance between them.

So if you think about it, all of the planets in our solar system are being pulled by the sun. The distance between the Sun and each of its planets is very large, but the Sun and each of the planets are also very large. Gravity keeps each planet orbiting the Sun because the star and its planets are very large objects. The force of gravity also holds moons in orbit around planets.

## Defining Gravity

So if we have to give a definition it would go something like this - Gravity has traditionally been defined as a force of attraction between things that have mass. According to this idea of gravity, anything that has mass, no matter how small, exerts gravity on other matter. Gravity can act between objects that are not even touching. In fact, gravity can act over very long distances. Like a force field, however, the farther two objects are from each other, the weaker is the force of gravity between them. Less massive objects also have less gravity than more massive objects.

