

# Gravity

## Discussion Questions:

- 1) What is gravity?
- 2) Who were the first scientists to describe gravity?
- 3) What experiments did they create to demonstrate gravity?
- 4) Is gravity equal in all parts of the universe?
- 5) What causes gravitational forces?

Gravity is the force that pulls us back to the earth when we jump.



# Early Views About Gravity

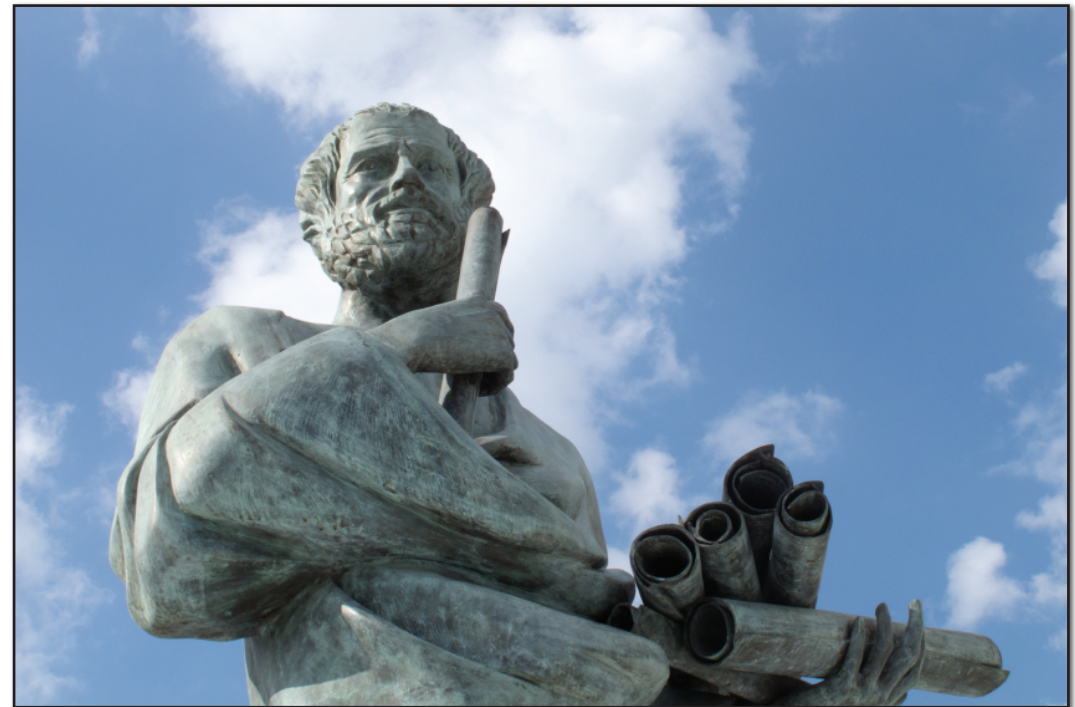
Many people have contributed to the discovery of Gravitational Forces. The story begins, way back in time, with the Great Greek Scholar Aristotle.

## Aristotle (384 - 322BC)

Aristotle was a Greek philosopher and scientist who was one of the first to theorise about gravitational force.

He theorised that the Moon, the Sun and the planets orbited around the Earth. He believed that all objects on Earth fall to their 'natural place', by which he meant the centre of the earth.

He believed that objects with a greater mass fall faster than objects with a smaller mass. This idea was accepted as truth until Galileo proposed that mass did not play a part in the force of gravity.



# Galileo Galilei (1564-1642)



Galileo Galilei, known simply as 'Galileo', was an Italian scientist whose discoveries laid the foundations for much of modern day astronomy and physics.

It is thought that in 1589 he conducted a demonstration in which he explored the theory that gravity was a force that pulled objects to the Earth's core at a constant rate.

Up until then people believed that heavier objects would fall faster than lighter objects.

He dropped two similarly shaped balls, of different masses from the top of the Leaning Tower of Pisa. He noted that the two balls landed at the same time. Theoretically a feather and a brick should land at the same time also. The brick would, however, land first because air resistance makes the feather float down like a parachute.

The experiment was repeated in 1971 during a live television broadcast of the Apollo 15 moonwalk. Astronaut David Scott dropped a feather and hammer while standing on the moon. Both objects landed at the same time because the moon, having no atmosphere, is considered to be surrounded by a vacuum, which means that there is no air resistance.



# Isaac Newton (1642-1727)

Isaac Newton was an English physicist and mathematician who formulated the Laws of Motion and Gravity.

Legend says that Isaac Newton thought of his theory for gravity while sitting in the garden watching apples fall from the trees. Whether he got the idea after he was hit on the head by an apple is unknown!

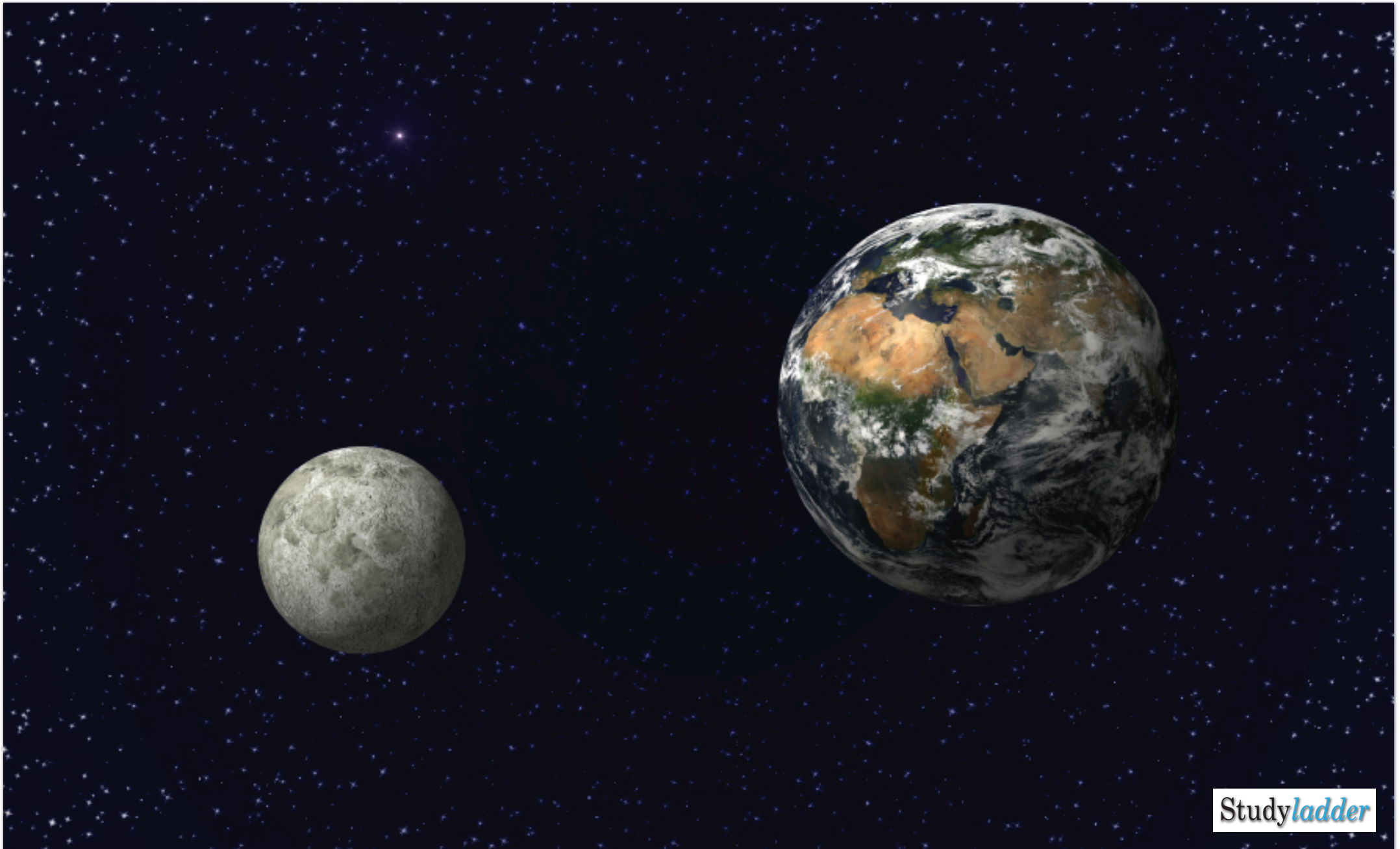
He certainly would have spent some time watching the apples falling from the trees. He would have noticed that they began at a speed of zero and accelerated as they fell toward the ground.

He came up with the theory that objects always fall toward the centre of the earth and that there must be a force drawing them to do so. The force of gravity.

He reasoned that the Moon orbits the earth due to gravitational pull and that all other celestial bodies are affected by gravitational forces.



What makes objects in our universe orbit around each other? How does gravity play a part? These are questions that scientists have pondered for hundreds of years.



# Quantum Mechanics

During the late 19th century and early 20th century scientists continued to attempt to explain how matter reacts with energy.

Max Planck, a German physicist was the first scientist to discover that very small particles of matter did not behave according to accepted Laws of Physics.

Scientists studied forces of nature such as electromagnetism to work out how subatomic particles move.

Their work led to the development of a new science: Quantum Mechanics.

Quantum (meaning very small sub-part)  
Mechanics (meaning movement)

But this new branch of science still could not explain how the force of gravity affected matter.



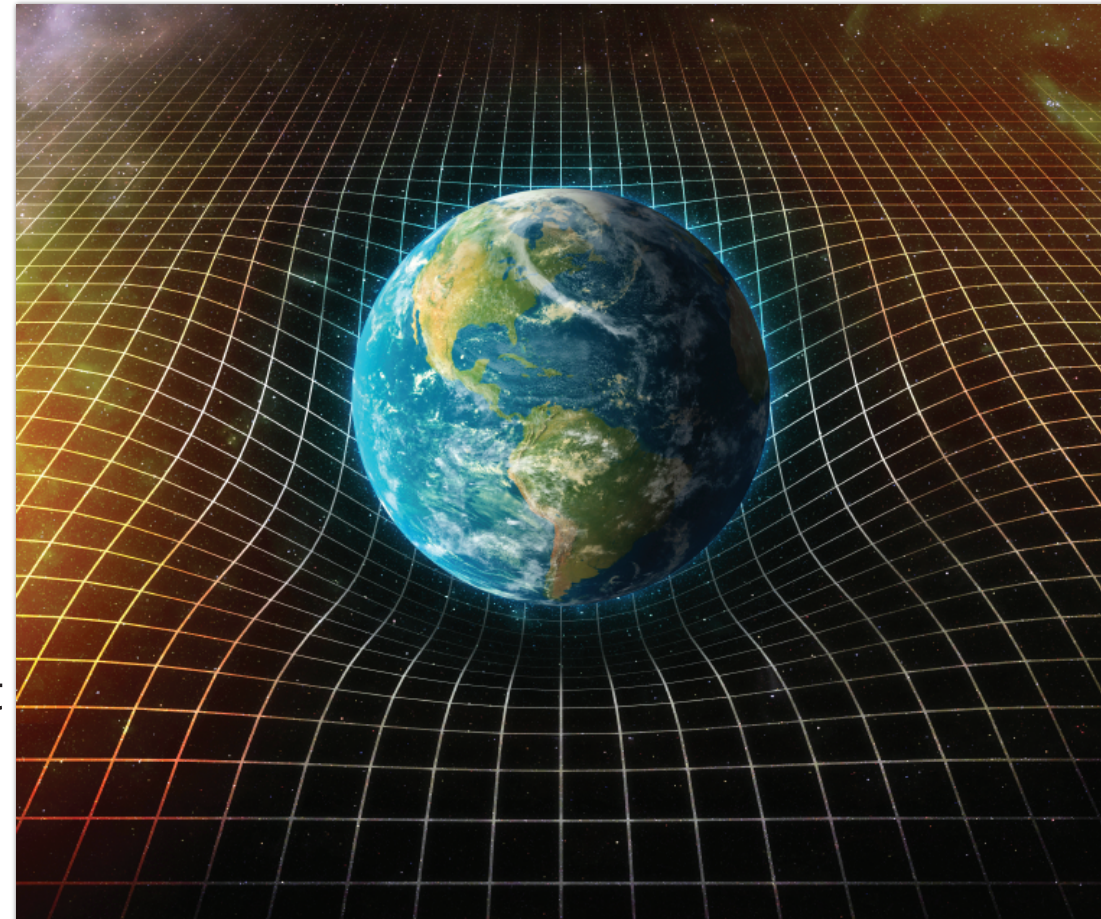
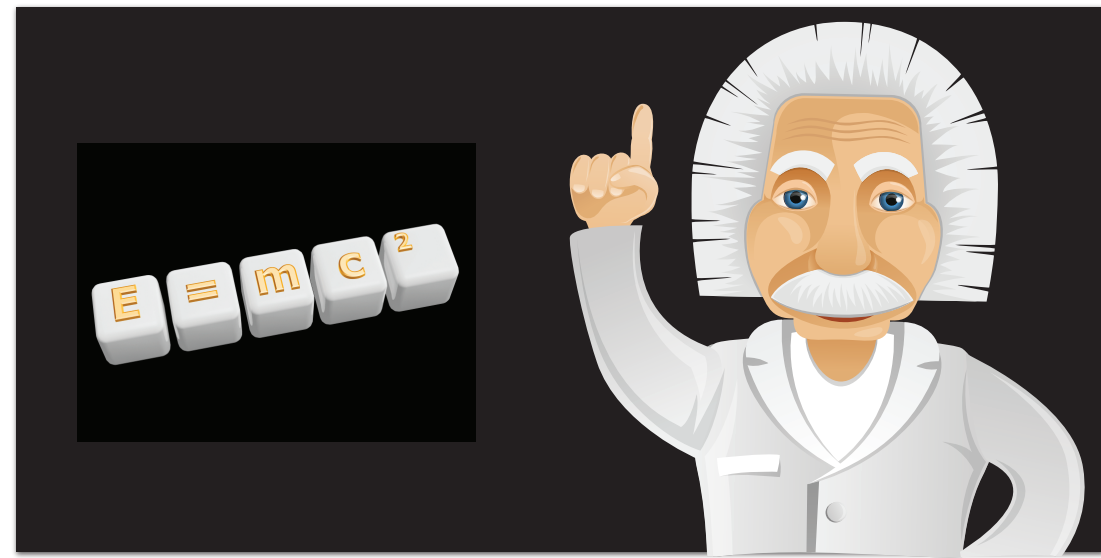
# Albert Einstein (1879-1955)

Albert Einstein modified Newton's Laws. He came up with his *Theory of General Relativity* in 1915.

He said that there was a fabric in the cosmos that held all the planets and stars of all the galaxies within it. He called this fabric *spacetime*. Spacetime could influence the movement of all bodies in the universe and spacetime, in turn, could be bent by these bodies.

He reasoned that the force of gravity was a distortion in the shape of spacetime. He said that larger bodies produced a greater force than smaller bodies.

Einstein wanted to be able to connect his Theory of Relativity to Quantum Mechanics but was unable to do so.





# Quantum Physics and Gravity

Scientists today are still working on the tricky question: What is gravity? Developments in Quantum Physics have led to new theories about the nature of matter and how it behaves.

Two of the latest theories include Loop Quantum Gravity and String Theories. However, there have been no definitive answers as to how gravity works in our universe.

In February 2016, scientists proved that Einstein's theory about spacetime was true. They detected 'ripples' in spacetime produced by two converging black holes.

This amazing discovery means that scientists are one step closer to unravelling the mysteries of the universe and to help us understand how gravity works!

