Gravity - Teacher's Notes

Gravity – the second weak force that built the Universe.

Gravity is "the glue that binds the Universe together". It is weak but acts across great distances.
What was the first force that started pulling matter together? **Static electricity**

As the clumps of nebula dust held together by static electricity increased in mass, they would also have been attracted together by the much stronger force of gravity. The more mass a body has, the greater is its gravitational pull. Matter moved to the center of the disc and crashed together to become our massive Sun. Over 99% of all the matter in our Solar System is within the Sun. The planets, moons, Asteroid Belt and other objects became assembled from what was left over. It was held in place by the gravitational pull of the Sun and nearby planets.

"Honestly Miss, It is gravity that pulls us together"

Student may realise that each one of their bodies has a gravitational pull on the others. Their bodies have so little mass however that the attractive pull is negligible!

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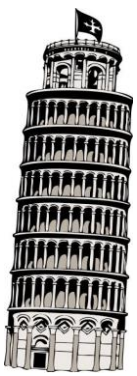
Note

The ***mass*** of a body is the amount of matter or atoms it contains. The weight of an object however is the mass multiplied by the force of gravity where it is being measured. Your body is made of a certain amount of matter. This is its mass. If you ***weighed*** yourself on Earth and then moved to the Moon you would find that you weighed more on Earth. This is because the Earth is much more massive than the Moon and has a stronger gravitational pull.
The mass of a body causes the space and time around it to bend and curve.

Gravity and weight on other planets

Students might like to visit this site and note that although their body has a constant mass, their weight varies from planet to planet because of the different gravitational pull that each planet has.
http://www.schoolsobservatory.org.uk/discover/activities/weight_on_planets
Someone who weighs 35kg on Earth is: 9.8kg on Mercury, 31.9kg on Venus, 13.3kg on Mars, a whopping 81.9kg on Jupiter, 32.6kg on Saturn, 27.7kg on Uranus and 39.2kg on Neptune.
NOTE: Some students are very wary about declaring their weight in public. They may wish to use 35kg as the weight of an average year 5 student.

A brief history of Gravity Theory



Gravity gets its name from the ancient Roman virtue of "gravitas". Which referred to the capacity to cope with heavy or solemn ideas. A good citizen treated all things with due gravitas.

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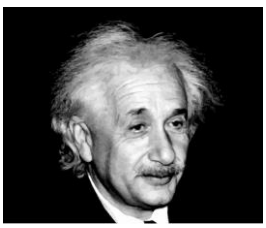
Legend has it that ***Galileo Galilei*** (1564-1642) first recognized the force of gravity when dropping balls from the Leaning Tower of Pisa. This is incorrect. He first considered this universal force when watching hailstones of different sizes fall at the same speed during a thunderstorm. If students visit the Gravity Discovery Centre at Gingin they can copy Galileo's experiments.

"What goes up must come down"
Isaac Newton (1643-1727) was the first modern scientist who tried to work out the laws of gravity. His statements relied on observation and measurement. It is said that he first noticed this Universal force when an apple fell on his head from the tree he was sitting under. He realised that objects must attract each other and that explained why the Moon stays orbiting the Earth. Although gravity is weak, its pull can act over enormous distances.
He worked out that the force of gravity is inversely proportional to the distance of a planet to the Sun. His laws remained useful for almost 300 years.



Albert Einstein (1879-1955) said in 1905 that mass distorted the space-time continuum.
"Matter tells space how to curve and space tells matter how to move."

Gravity and Orbit – Teacher Demonstration

Space tells matter how to move
A massive object produces a dip in the space-time continuum. Objects with less mass are pulled down

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Gravity - Teacher's Notes

towards the more massive one. Massive objects, like the Sun, attract less massive objects such as planets, comets and asteroids towards it. Their movement energy will allow them to orbit the Sun for a while but in time they will be drawn closer and closer by gravitational force until they crash into it. This activity is also available at the Gravity Discovery in Gingin.
More information at: http://gravitycentre.com.au

The plastic sheet representing the space-time continuum is undistorted until mass is added. The heavy weight/mass in the center represents a massive sun and the lighter mass spinning round it a planet. The larger the stretched circular surface is, the better the demonstration will be. Plastic stretched over a hula hoop is excellent.

Lead weight placed in center

Marble spun round center in an ellipse

Materials

- Large sheet of plastic uniformly stretched over a circular container. Garbage bags can be cut into single sheets.
- A rubbish bin or hula hoop.
- Tape or elastic
- A massive/heavy round or spherical object such as a lead fishing weight or metal nut (nuts & bolts).
- A very much lighter/less massive spherical object such as a marble

Gravity - Teacher's Notes

or pea.

Method

1. Wrap the single plastic sheet tightly over the bin or hoop and fix in place with tape or elastic
2. Place the lead weight or nut in the centre of the plastic and ask students to observe any changes. The weight made the centre of the plastic sheet depress. Mass changed the surface.
3. Flick the less massive ball round the inner edge of the plastic sheet. *This may need some practice as too much force will just send it over the edge.* The ball spun round the large central mass in an elliptical orbit but was soon pulled down to the central massive body.
   Gravity pulls the less massive pieces towards the more massive ones.
4. Gently flick the marble across the depressed plastic sheet. Observe the pattern of its movement around the center. The marble moved in an elliptical orbit, not a concentric circle. *Planets also move in elliptical orbits round the Sun.*