GRAVITY

Equipment:

1. Dropping things of different weight: One piece of paper, a stone
2. Dropping two things of same weight but different shape:
   Two pieces of paper (*the same weight and size*)
3. Dropping things in different parts of the world:
   Orange, cocktail sticks, plasticine:
4. Design and Make a Parachute:
   Tissue paper, sellotape, thread, plasticine or small Lego figure

Source: www.freewebs.com/littlemilysiencenlightenment/scientistsofthe1500s.htm

Suggested Class Level:

All

Preparation:

Collection of materials

Background information:

Source: http://upload.wikimedia.org/wikipedia/commons/2/22/Christa_McAuliffe_Experiences_Weightlessness_During_KC-135_Flight_-_GPN-2002-000149.jpg

Gravity is a very useful force – it holds everything together. It keeps us on the Earth, and keeps the Earth and the other planets revolving around the Sun. Without it everything would float around. That is why it has been described as 'The Universal Glue'.

Every object in the world has this pulling force of gravity – the bigger the object the greater the force. Earth is so big and heavy that its force of gravity is very great. The nearer things are to each other the greater the force of gravity between them.

Because the Moon is much smaller than the Earth – it is about the same width as Australia - it is not nearly as heavy as the Earth, and so gravity is much weaker there. In fact, it is only about one-sixth of gravity on Earth.

Until Galileo's time (*around 1600 A.D.*) people thought that heavier things fell faster than light things. Galileo was an Italian scientist who **experimented** (*up to then they mainly just **thought!***) and found that things with different weight fell at approximately the same speed.

WHAT IS 'WEIGHTLESSNESS?'

Why do we see pictures of astronauts bouncing around 'weightless' inside their spacecraft? Is this because there is no gravity in space?
No! THERE IS GRAVITY IN SPACE (*or otherwise the spacecraft would just float off into the Universe!*).

The astronauts appear to 'float' because of 'Weightlessness' inside the spaceship. The spacecraft and the astronauts **are both moving together under the influence of gravity.**

This is called **'freefall'** or **'weightlessness'.**

(*The nearest feeling we get to this is being in a lift which goes down very quickly, or a rollercoaster going down quickly, or being in an aeroplane which hits an air pocket and goes down very suddenly*).

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Trigger questions:	**All classes:** When you let go of something, in what direction does it go? What makes it go in this direction? (*Gravity*) (*Pointing to Australia or New Zealand on a globe*) "What will happen to a stone when you drop it in Australia or New Zealand?" "Does it fall off into space?" If you drop a heavy thing and a light thing at the same time, which do you think will hit the ground first? **LET'S INVESTIGATE!** Older children (*on topic of 'weightlessness'*). Have you ever been in a lift which suddenly went down very quickly? What did it feel like? Or have you ever been in a plane which went down very suddenly and quickly when it got into an 'air pocket' of low pressure? Or been on a roller-coaster or Big Wheel that suddenly went down? Can you remember what it felt like?
Content:	**SCIENCE:** Forces **MATHS:** Number: operations Measures: Weight – estimate and measure
Skills:	Predicting, observing, experimenting Exploring, planning, making, evaluating
Cross-curricular Links:	**Geography:** Natural Environments: Planet Earth in Space **History:** Aristotle was a very early Greek scientist (*384-322 B.C.*), who said that heavy objects fall faster than light ones. His ideas on this and many other areas in science (*e.g. he said the Earth was at the centre of the universe*) were believed by most people for nearly two thousand years. Then Galileo and Newton came along and proved him wrong.
Activities:	**All Ages:** 1. Dropping Things of Different Weight Take a piece of paper in one hand and a stone in the other. Which is heavier? Which do you think will fall faster? Why? Roll the piece of paper up into a tight ball. Drop the stone and paper from the same height at approximately the same time. On account of the air resistance surrounding the Earth the lighter object may fall very slightly slower. If this activity was done where there is no air, (*e.g.in Space or on the Moon or in a vacuum*) then they would reach the ground at exactly the same time. Which landed on the ground first? (*They land at the same time*).

Source: www.srcf.ucam.org

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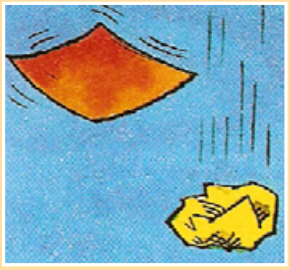
Why? (*Because gravity is the same for all weights*)

(*See Galileo's famous experiment from the Leaning Tower of Pisa*). N.B. It may be a legend that it was Galileo who actually performed this experiment himself.
www.pbs.org/wgbh/nova/galileo/expe_flash_1.html

N.B. This activity could also be done with any two similar containers, e.g. butter cartons, with different amounts of, say, sand in each; or two identical bottles - one empty and one full.

2. Take two pieces of paper and roll one up into a ball like last time and leave the other one flat. Do you think they will fall at the same speed?

Drop them from the same height at the same time. What happened this time? (*The paper in the ball probably landed first*)



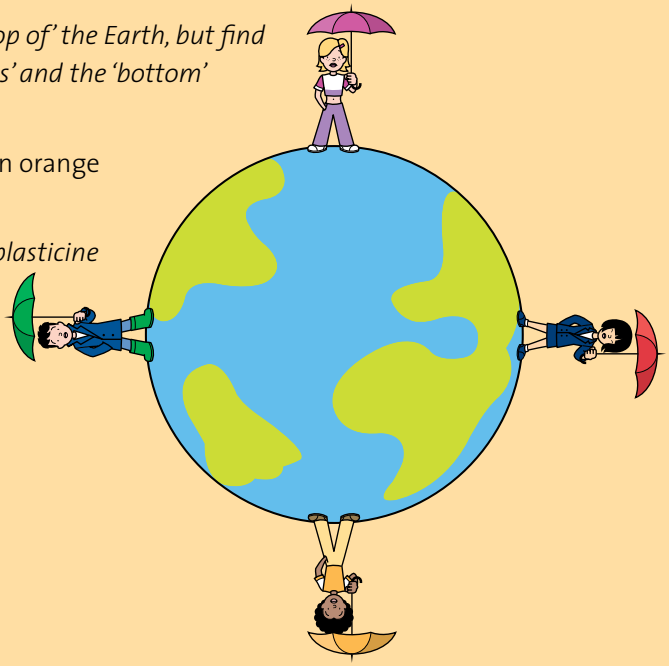
Why? (*Because there is more air under the flat one, pressing up on it and slowing it down (Air Resistance). This is how a parachute works*).

3. Dropping things on different parts of the Earth.

(a) Paper, pencil. (b) Orange, cocktail sticks, plasticine.
Question? What way will gravity act in different parts of the Earth?

(a) Ask the children to draw a large circle on a piece of paper, to represent the Earth. Now ask the children to draw lots of people (*not to scale*) standing on different parts of the Earth.

(*Children find it easy to draw people 'on top of' the Earth, but find it more difficult to draw them on the 'sides' and the 'bottom' of the Earth.*)



(b) If supplies permit, give the children an orange and cocktail sticks and some plasticine.

Can they place the 'people' (*one piece of plasticine for the head, and one stick for the legs*) onto the orange to represent how these people feel gravity in different parts of the world?
(*They should all have their 'legs' pointing into the centre of the orange*).

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Older children:

Reducing the effect of gravity – design and make a parachute.

Can you make a parachute?
Gravity pulls a parachute down, but as it falls air gets trapped under the canopy. The trapped air pushes up against the canopy, making the parachute fall slowly.

Can you Design and Make a Parachute?
(*Remember to Explore, Plan, then Make, then Evaluate*)

Using a tissue and 4 threads, some sellotape, and plasticine or a small Lego man, can you design and make a parachute, and hang the plasticine/Lego man from it?

Source: www.gnurf.net/v3/clip-art/clip-art-parachute-sky-jumper.html

What happens if you add more plasticine? Does the parachute fall faster or slower?

Maths: (*Older children*)

CALCULATING WEIGHTS ON THE MOON AND OTHER PLANETS.

N.B. Weight and Mass are slightly different. Mass is the amount of 'stuff' in something and is the same everywhere. It is measured in grams or kilograms. Weight is a force : the force of gravity on something, so it varies under different gravities, e.g. you weigh less on the Moon (*but your mass is the same*). Weight, being a force, is measured in Newtons. You will learn more about this at second-level.

For a bit more on this see the following website: http://www.askaboutireland.ie/learning-zone/primary-students/please-select/5th-+-6th-class/science/gravity/some-ideas-about-gravity/weight/

We will just use numbers, without units, for the following exercises.

1. WEIGHTS OF DIFFERENT THINGS ON THE MOON

Take some everyday things, e.g. bag of sugar, apple, stone, book, pencil, and estimate their weights. Record these in a chart. Then weigh them and record their actual weights.

Now pretend you are on the Moon, where gravity is about one-sixth that on Earth, and calculate what their weights would be. Record these weights in the last column.

Some sample weights are given below column (*in case enough balances are not available*):

Object	Estimated Weight on Earth	Actual Weight on Earth	Weight on Moon
Sugar		10	10/6 = 1.66
Apple		1.2	
Stone		4.8	
Book		3.6	
Pencil		0.24	

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2. YOUR WEIGHT ON THE OTHER PLANETS

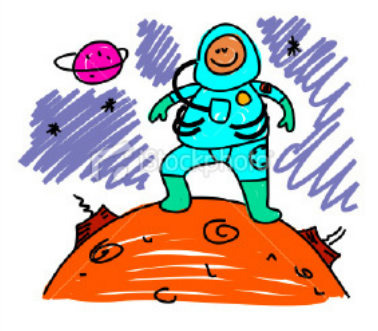
Let us give Gravity on Earth the number 1; then Gravity on the other planets and the Moon is greater or less than 1 depending on their mass and size compared with those of the Earth;

e.g. the Moon's gravity is one-sixth (*0.16*) that of Earth.

Let us say your weight on Earth is 40 kilograms.

How much would you weigh on the Moon?
(*6 kg. Other figures in green to be filled in by the children.*)

Body	Gravity	Your Weight
Earth	1	40
Moon	0.16	40 x 0.16 = 6.4 kg
Mercury	0.37	15
Venus	0.86	34
Mars	0.38	15
Jupiter	2.6	104
Saturn	1.1	44
Uranus	1	40
Neptune	1.5	60



Safety:

Care needed if children stand on chairs in order to drop things from a height.
Care needed with pointed cocktail sticks.

Follow-up Activities:

1. The children can carry out various investigations while designing and making parachutes.

e.g. "What do you think will happen to the speed of the parachute when you change (a) the weight hanging from it?

(b) the size of the material? (c) the type of material? (d) the shape of the material?
Remind them to change only one thing at a time:

"What do we keep the same?" (*e.g. type of material, shape of material, weight hanging from it*)
"What do we change?" (*e.g. the size of the material*)

2. As hands-on activites relating to 'Freefall' or 'Weightlessness' are not very practical to carry out in the primary classroom, a video would be more feasible (*see websites below*).

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Did You Know?

Because gravity is pulling with only about one-sixth of the force on Earth, astronauts can jump about 4 metres high on the Moon! How high do you think you could jump on the Moon?

Being 'weightless' may sound fun, but it can also cause problems. Liquids, foods, tools and sleeping people have to be strapped down in spacecraft to keep them from drifting away. Imagine trying to wash if the water keeps floating away!

Astronauts get a bit taller and their muscles get weaker if they are experiencing weightlessness over time. They usually recover when they return to Earth.

Scientists are experimenting with growing plants in weightless conditions in the International Space Station, in order to try to produce a biofuel faster. The results could help produce alternative energy crops on Earth.

The European Space Agency is building a super robot, called EUROBOT, with several hands and super strength, which will be able to do amazing things in space.

Useful Websites:

An interactive website testing Galileo's famous experiment: Dropping heavy and light objects from the same height on the Leaning Tower of Pisa:
www.pbs.org/wgbh/nova/galileo/expe_flash_1.html

The American space agency NASA's website has Galileo's experiment being performed, by an astronaut on the Moon, using a feather and a hammer:
http://er.jsc.nasa.gov/seh/feather.html

The learning zone of the Library Council's website 'askaboutireland' has lots of interactive science experiments on various topics, including 'Gravity': http://www.askaboutireland.ie/learning-zone/primary-students/please-select/5th-+-6th-class/science/gravity/index.xml

To test the speed of an astronaut going into freefall, see the European Space Agency's:
http://esamultimedia.esa.int/docs/issedukit/en/activities/flash/start_toolbar.html#c4_p49_01.swf

To see what it is like living in space, have a look at:
http://www.esa.int/esaKIDSen/Livinginspace.html