CultureStreet

The Force of Gravity

lesson plan

National Curriculum: KS1&2 Science

Artist Sean Henry makes sculptures of human figures. The sculptures are painted and look very realistic but this figure, Man with Potential Selves, floats in mid air in a position we would find impossible to copy on Earth. If you don't believe us try to balance on your elbow with your legs straight out.

Gravity is the invisible force that pulls us to earth and stops us floating in mid air like this Sean Henry sculpture. Who discovered gravity and how does it work and what is air resistance?

https://www.culturestreet.org.uk/lesson.php?id=76

Learning Objectives

Through using this lesson plan students should:

-Plan different types of scientific enquiry to answer questions, including recognising and controlling variables where necessary

-Ask relevant questions and use different types of scientific enquiries to answer them.

-Take measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate

-Record data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs

-Identify scientific evidence that has been used to support or refute ideas or arguments. -analyse and evaluate their own work, and that of others.

Overview

A lesson plan inspired by the work of sculptor Sean Henry. This lesson can be used to:

-explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object

-identify the effects of air resistance, water resistance and friction, that act between moving surfaces

- explore the effects of air resistance by observing how different objects such as parachutes fall.

-find out how scientists, for example, Galileo and Newton helped to develop the theory of gravitation.

Background - Gravity

The word gravity comes originally from the Greek word for weight. If we throw any object up in the air it will go so far then start to fall back to earth. How quickly it falls back will be affected by air resistance but the fact that it falls is due to gravity.

In 1665 Isaac Newton was in his garden when he saw an apple fall to the ground. Newton then spent years trying to work out why objects fall to earth. He published his ideas in the 1680's and they were widely accepted until in the twentieth century Albert Einstein came up with his own theory.

Newton's Law of Universal Gravitation

Sir Isaac Newton's idea was that all objects are attracted towards each other and that the bigger the object the more gravity it will have. He also suggested that the closer you are to that object the more pull it will have on you. The gravitational pull of the Earth is what stops us flying off into space but also makes us fall towards it. The further you get away from Earth the less pull you feel. This is all proven but nobody fully understands how gravity works.

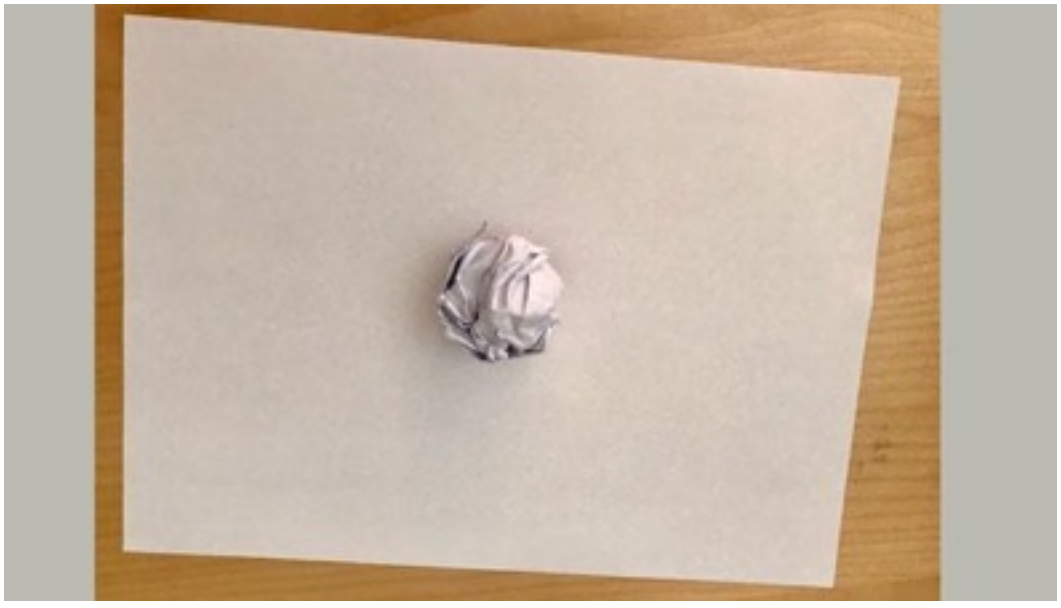
Planets and Moons

Newton worked out that it was the Earth's gravity that keeps the Moon in orbit around Earth. The Sun's gravity keeps the Earth in orbit around the Sun. The weaker gravity of the moon causes the oceans to rise and fall with the tides. Because the Moon is smaller and less dense than Earth, gravity on the moon's surface is only 17 percent of that on Earth. Which is why astronauts on the moon can jump six times higher than on Earth.

Air resistance

In a vacuum all objects would fall at the same speed but on Earth that speed is affected by air resistance. Air resistance is a collision of the object falling with the molecules of the air. Some shapes have less air resistance than others to allow them to move faster through air. An example of a fast moving object is a streamlined jet aircraft. An example of a slow moving object with lots of air resistance is a parachute.

Working in pairs try this experiment. With your arm out straight in front of you hold a sheet of A4 paper flat. Now drop the sheet and using a stopwatch time how long it takes the sheet to fall to the ground. You should do this three times so you can get an average time. Then screw the same A4 sheet up into a ball and time how long it takes the ball to drop to the ground. Again do it three times and get an average time. The weight of the paper does not change when you screw it into a ball so why is there a time difference?



Make a parachute

Working in small groups make a parachute to test. You will need a plastic sheet or plastic bag, marker pen, tape, a hole punch, string, scissors and some kind of weight to attach to your parachute. Lay your plastic flat on the table and draw the shape of your parachute canopy on the plastic. Cut out the shape with scissors. Put a piece of tape where you want the holes and then using the hole punch create at least four holes. Attach string to each hole. Make sure all the strings are the same length and then knot at the bottom and attach your weight. https://www.culturestreet.org.uk/lesson.php?id=76 Video 1

Test your parachute

Very Important. Find a safe high place to drop your parachute. Make sure there is no danger of falling. Test your parachutes by dropping them from the same height and timing how long they take to reach the ground. Some things in your experiment must be constant. Keep the height from which you drop the parachute the same and it is best if the same person operates the stopwatch. Plastic bags can be a danger to wildlife so if you are conducting your experiment outside make sure your parachute doesn't blow away.

Variations

If you have made different shaped or different sized parachutes you can test them against each other to find out which has the greatest air resistance and falls slowest. Try a heavier weight and see if that affects the results. Try cutting a small hole in the top of your parachute to let air pass through and see if that affects times. Write up the results of your experiment including what went well and what you learnt.

Suggested Classroom Activity

Using what you have learnt about air resistance discuss what would happen to a parachute on the moon where is no air. A famous experiment was carried out by the astronauts of Apollo 15 when Commander David Scott dropped a feather and hammer on the moon. Discuss what the results would be be before searching for Apollo 15 Hammer Feather Drop.

Development Activity

Students could continue their investigations by moving on to look at water resistance and friction. A similar experiment to the parachute one but using different shapes moving thorough water will look at water resistance. Try to push an inflated balloon into a bucket of water to demonstrate buoyancy. This exploration of air and water resistance can be developed further by looking at hovercrafts and how they work. With an old CD, a bottle cap and a balloon you can easily make a hovercraft.