

- I can investigate the effects of air resistance.

Part 1 - Air Resistance

Success Criteria

- I can explain how air resistance affects moving objects.
- I can plan and conduct an investigation into the effects of air resistance.

Key Vocabulary

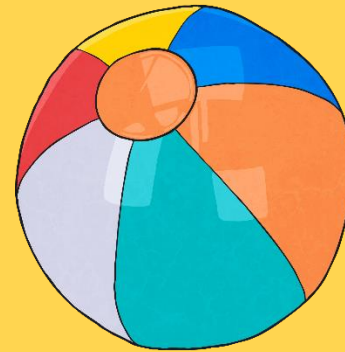
- Gravity
- Air resistance
- Galileo Galilei
- Mass
- Parachute
- Force

Gravity and Falling

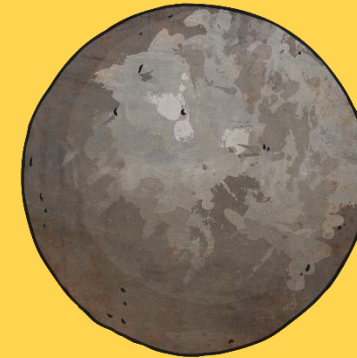
You have learnt that **gravity** pulls objects down towards the centre of the Earth.

But do you think all objects are pulled down as fast as each other?

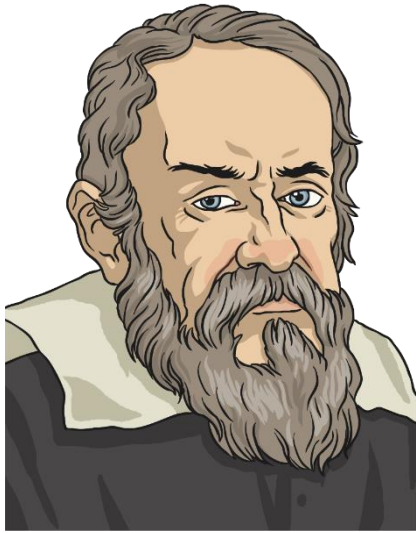
These two balls are the **same size**, but one has a much **larger mass**. Do you think they will hit the ground at the **same time** when dropped from a height?



beach ball



cannon
ball



Gravity and Falling

Galileo Galilei (1564 – 1642) was an Italian scientist and mathematician who wondered about this.

In 1590, he decided to carry out an investigation to find the answer.

He climbed to the top of the Leaning Tower of Pisa with two balls of similar shape and size, but of different masses.

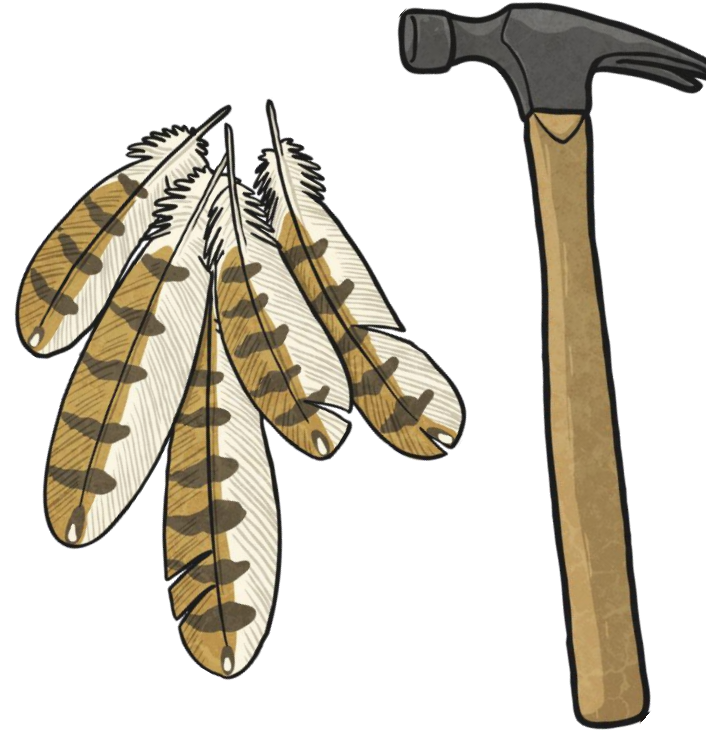
He dropped both of the balls from the top of the tower at the same time. Both balls hit the ground at the same time.

Gravity and Falling

Galileo's experiment proved that **all objects fall at the same rate**, no matter what their mass is.

But this can seem hard to believe!

Think about a feather and a hammer. If you dropped both objects at the same time, would they hit the ground at the same time?



Gravity and Falling

<https://www.bbc.co.uk/bitesize/clips/zqshfg8>

Watch [this clip](#) of astronaut David Scott dropping a feather and a hammer on the Moon.

What do you notice?



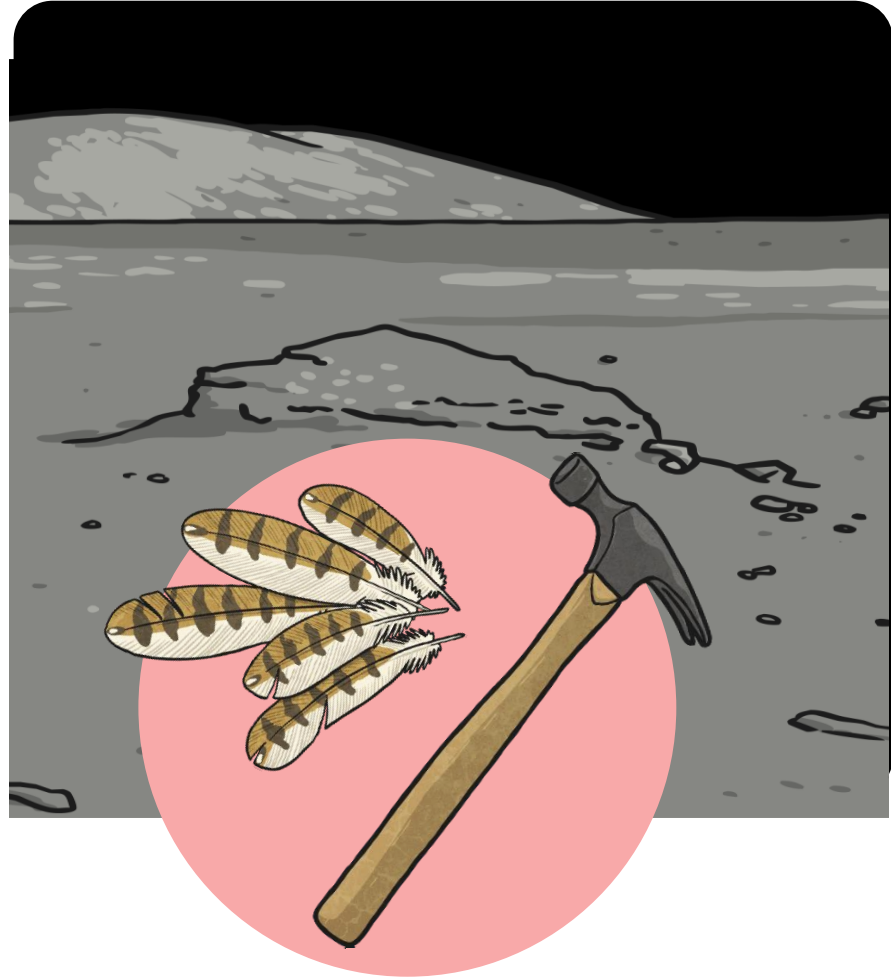
Gravity and Falling

The feather and the hammer hit the surface of the Moon at the **same time!**

This proves that Galileo's findings are correct.

Can you think why the two objects fall at the same speed on the Moon, but the feather falls so much more slowly on Earth?

What is different about the Moon and the Earth that could cause this to happen?

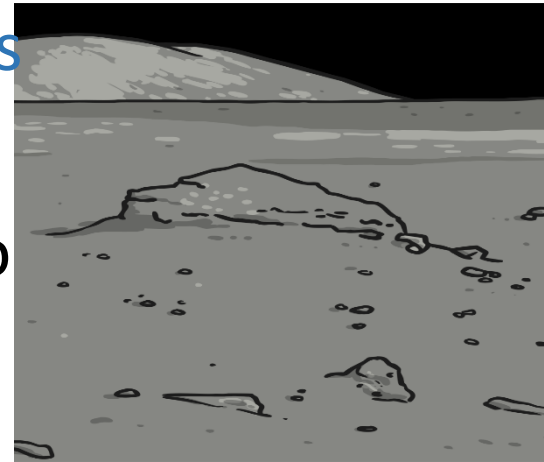


Air Resistance

There is **no air** on the Moon.

Air pushes against any object moving through it. This is known as **air resistance**. Air resistance pushes on different objects with a different force, which is what causes the feather to fall much slower than the hammer on Earth. Air resistance pushes the feather up with a bigger force than it pushes the hammer.

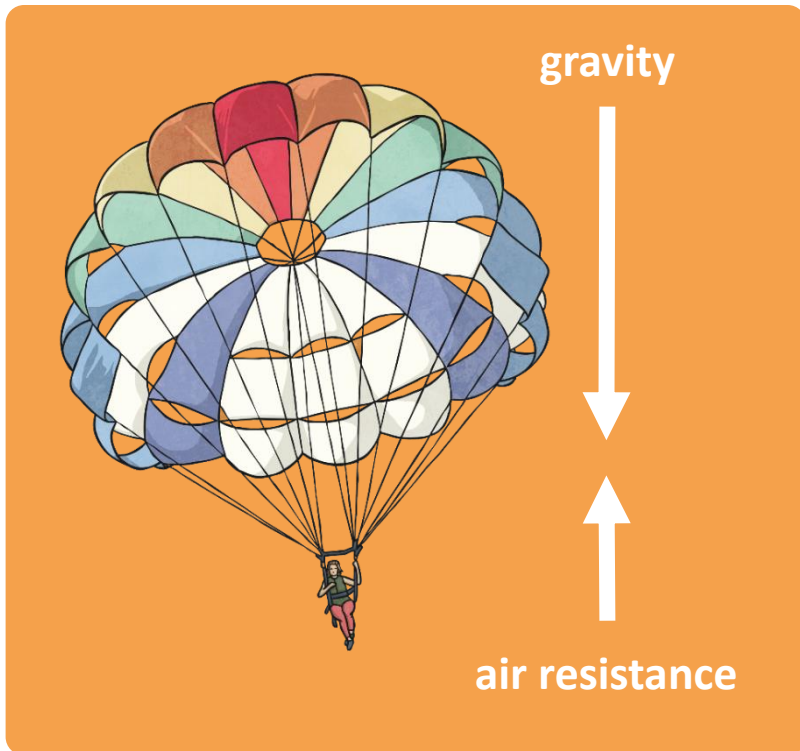
Since there is no air on the Moon, there is no **air resistance** to push on the feather, so the two objects are able to fall at the **same speed**.



Air Resistance

Air resistance can be a useful force, but it can also be unhelpful in certain situations.

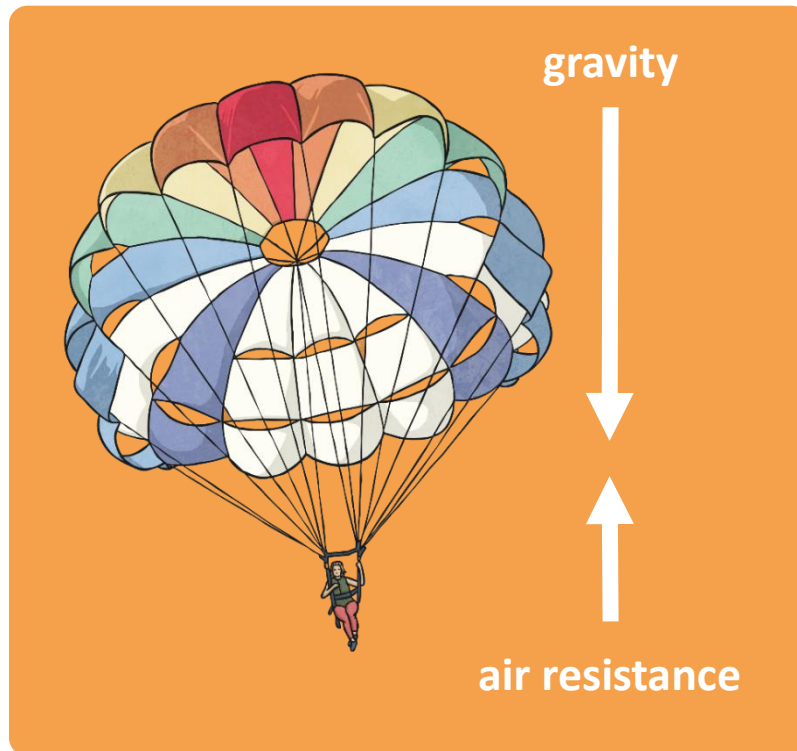
Look at the two diagrams below. Which one shows a **useful** effect of air resistance, and which one shows an **unhelpful** effect of air resistance?

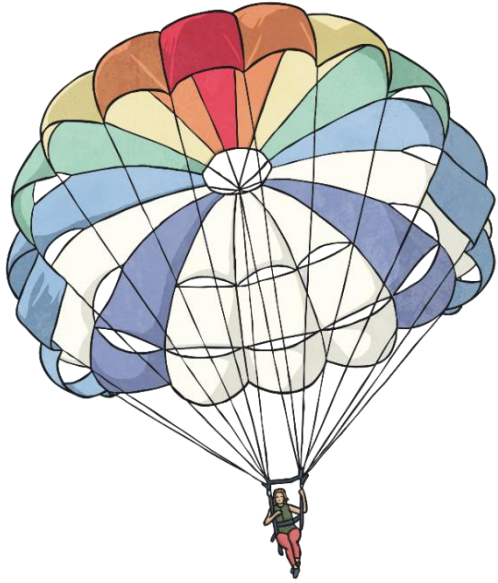


Air Resistance

Air resistance pushes up on the parachute, **opposing** the force of **gravity** and making the parachute and the person fall more slowly. This is a **useful** effect.

But **air resistance** pushes the cyclist back, **opposing** the **driving force** of the cyclist pedalling the bicycle. This is an **unhelpful** effect.





The Perfect Parachute

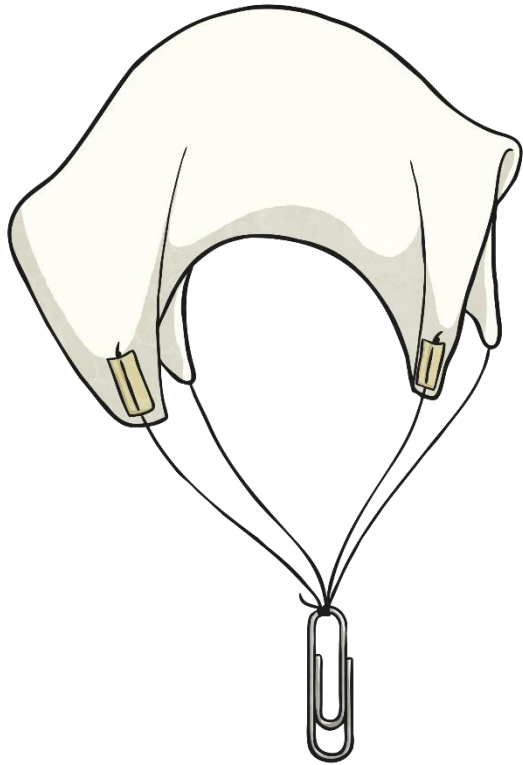
The Super Skydiving Company are redesigning the parachute they use to allow people to perform skydives from aeroplanes. They want to make sure the parachute they use is perfect, and allows their customers to fall from the aeroplane as **slowly** and **safely** as possible.

You are going to investigate a helpful effect of **air resistance**, by finding the best design for their new parachute.

The perfect parachute will be the one that makes a person fall the **slowest**. It will cause **air resistance** to push it up with the **biggest force**.



The Perfect Parachute

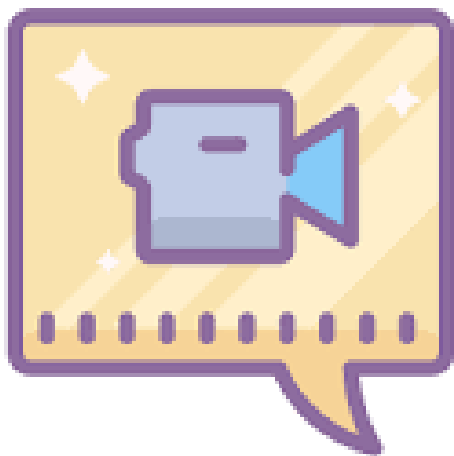


You will make three parachutes and drop them from a height. Each of the three parachutes should be slightly different.

You will observe which of your parachutes falls the **slowest**. This parachute will have the most **air resistance** pushing it up.

Make your parachutes using a sheet of plastic or card. Tie or tape string to the corners, and tie or tape the four pieces of string to an object such as a toy figure, paper clip or piece of modelling clay.

Watch Mrs Hickman talking you through this bit on this video!



https://youtu.be/1_toKXW3YeI

The Perfect Parachute

What variables will there be in this investigation?
Variables are the things that **can change** in an investigation.

How many variables did you think of? Did you come up with any of these?

Type of material

Shape of parachute

Size of parachute

Height of drop

Object attached to the parachute

Conditions of the drop

Length of string to attach the object



The Perfect Parachute

Identify now your independent variable, your dependent variable and your controlled variables.

The **independent variable** is the thing you will **change** in your investigation.

The **dependent variable** is the thing that you will **observe** or **measure**.

The **controlled variables** are the things you will keep the **same**.

Copy into your book or use sheet provided:

(sheet available for some chn who need support)

Remember your presentation/underlining/skipping a line between sections

Independent variable (the thing you will change about your parachute each time):

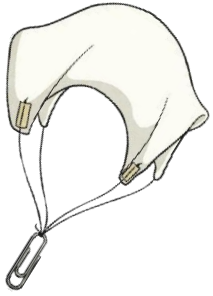
Think about material

Dependent variable (the thing that will be affected by the independent variable – this is the thing you will observe or measure):

Time it takes to hit the ground from a height

Controlled variables (all the other things that you will keep the same about the parachutes and your investigation):

Think about string length. Point of drop, person dropping it, using the same figure/Lego man each time!

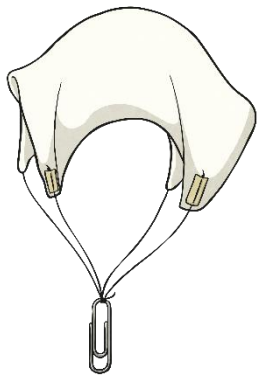


The Perfect Parachute

Once you have identified the different variables of your investigation, you need to make your **prediction**.

Do this now

Next session, we will conduct our **investigation** and complete our **results**. (I will do this through a video for you to watch, and you can try it at home too if you wanted to!)



Prediction:

What do you predict will happen? Which parachute will have most air resistance pushing it up, and will fall the slowest?

e.g.

I predict that the cloth parachute will have the most air resistance and push the parachute up more. It will fall the slowest so will be the safest.

OR

I predict that the paper parachute will have the most air resistance and push the parachute up more. It will fall the slowest so will be the safest.

OR

I predict that the plastic parachute will have the most air resistance and push the parachute up more. It will fall the slowest so will be the safest.

Part 2 – Air resistance investigation

Starter: Watch these Videos!

Weblinks: <http://www.bbc.co.uk/education/clips/zpvs34j> *Umbrella to parachute;*
<http://www.bbc.co.uk/education/clips/zsjd7ty> - *Air resistance (2mins 13secs)*

Could you use an umbrella to parachute?

Part of **Science** | **Friction and resistance**

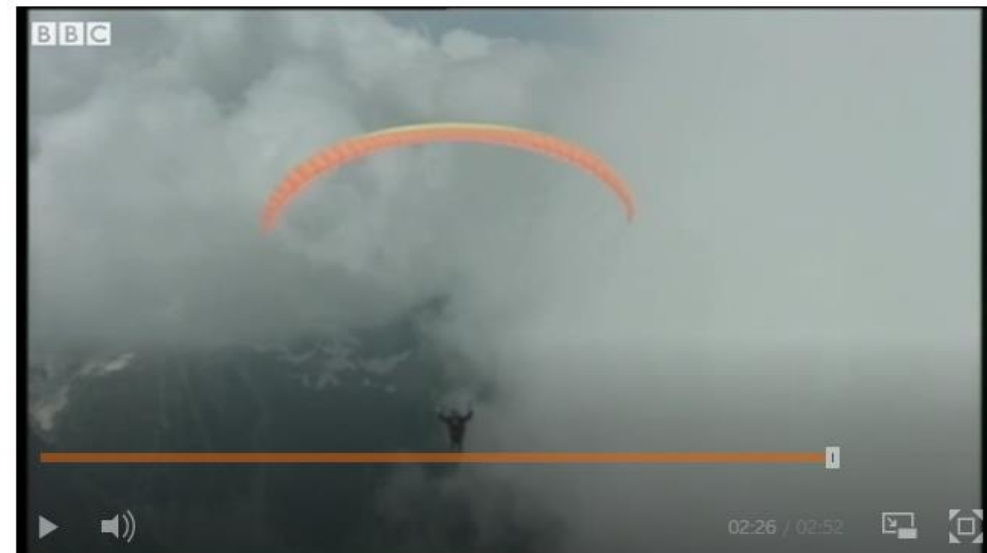
Duration 01:22



What is air resistance?

Part of **Science** | **Friction and resistance**

Duration 02:52



Forces, Friction and Gravity

Get two pieces of paper - screw one up into a ball (note force changing shape!) and the other left flat.

If you drop both from a height, what happens?



The larger surface area of the flat piece of paper **increases the air resistance and slows it down,** even though the mass of both pieces of paper remains the same.

Our enquiry question:

Does the material of the parachute increase or decrease the air resistance?

Other things we could investigate

- Does the size of the parachute increase or decrease the speed of descent?
- Does the size of the parachute increase or decrease the air resistance?
- Does the length of the parachute strings increase or decrease the speed of descent?
- Does the length of the parachute strings increase or decrease the air resistance?

Recap: Variables

The parachute **material** will change each time in today's investigation.

What will ensure a fair test? Which variables will stay the same?

These things need to stay the same EVERY time:

Height of drop

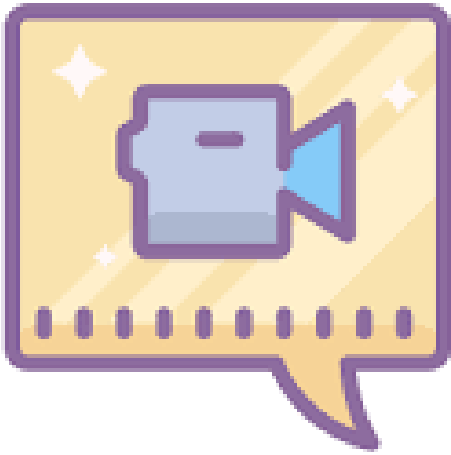
Person who drops it

Weight and mass of skydiver (paperclip/Lego man/lump of plasticine)

Number of strings

Length of strings

Watch Mrs Hickman talking you through this bit on this video! Conducting the investigation and writing the results.



<https://youtu.be/GjA9nSgLEqY>

Conduct your investigation

- You have been asked to help redesign a parachute for the Super Skydiving Company. You will make three parachutes and see which type of parachute falls the slowest. Which variables will you change, observe or measure and keep the same?
- For this investigation today you will be **testing different materials** – paper, plastic and fabric.

Complete your results in the table below:

| | Description of parachute (e.g. size / shape / material) | Time taken for parachute to hit the ground |
|-------------|--|---|
| Parachute 1 | paper | |
| Parachute 2 | plastic | |
| Parachute 3 | cloth/fabric | |

Super Skydiving Company report

You now need to report back to the Super Skydiving Company to **explain** your findings.

Let them know the best design for their new parachute, and explain why it works well.

Use your **Super Skydiving Report Activity Sheet** to complete your report.

REMEMBER: The best parachute is the one that falls the slowest. It catches more air so increases the air resistance.

Super Skydiving Report

The Super Skydiving Company are waiting for your report! How should they redesign their parachute to make it fall slowly? Use your results to tell the company what their parachute should look like or be made out of in order to create the most air resistance.

| | |
|---|--|
| Draw and label your suggestion for the new parachute: | Complete these sentences to explain which parachute fell the slowest, and why. Our results show that the parachute that fell the slowest was |
| | This parachute created the most air resistance because |
| | |
| | |
| | The new parachute should be |
| | |