

# Forces – Gravity

Name \_\_\_\_\_

Class \_\_\_\_\_

**What you will need for this lesson: Investigation 1** - a washing up bowl or a bucket, a clear plastic cup, a piece of plastic or card that has no ridges or holes in it and some water.

**Investigation 2** – two tennis balls, kitchen scales, water, scissors or sharp knife. **You must have an adult work on this investigation with you!**

**You will also need a pen, a pencil and if you have it, access to a computer, tablet or iPad.**

## LESSON STARTER

We are looking at gravity and its effect on the world around us.

Look at the following questions and write down your answers underneath. You do not need to carry out this investigation.

**What will happen when I let go of an apple that is in my hand?**

---

---



**Why do you think this will happen?** \_\_\_\_\_

---

**What will happen when I let go of a whole apple and half an apple at exactly the same time?**

---

---



**Why do you think this will happen?** \_\_\_\_\_

---



When you've finished, watch the video to see whether you were right!

Were you right? \_\_\_\_\_

Do you understand why? \_\_\_\_\_

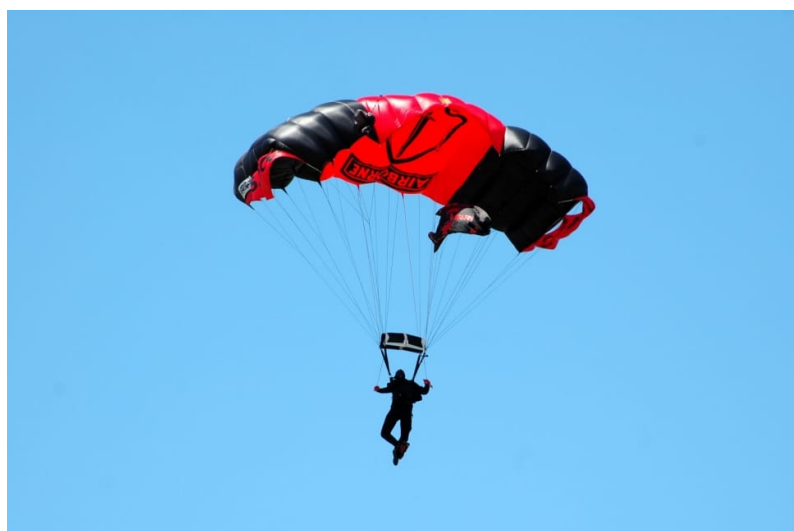
When anything falls to the ground there are two forces affecting any object.

One is **GRAVITY**. Gravity makes any object fall to the ground at the same rate, no matter how big or small, heavy or light.

However, all objects fall to the ground through the air. The air that the objects travel through slows the fall of the objects. This is the second force and is called **AIR RESISTANCE**.

When anything falls to the ground, there is a **balance** between gravity pulling it down and the air resistance slowing down its fall.

In this picture we can see a parachute using the balance between gravity and air resistance to get the parachutist down to the Earth safely.



## The Investigation

Today we are going to do 2 investigations.

### Investigation 1



Let us look at the method.

1. Fill your cup with a quarter of water.
2. Place your piece of card or plastic over the cup.
3. The next step should be done over a washing up bowl. Invert your cup with the water and piece of card or plastic ensuring you have one hand on the cup and the other hand holding the piece of card or plastic in place.
4. Slowly remove the hand you have holding the piece of card or plastic in place. Do not pull on the piece of card or plastic. What have you noticed is happening?
5. If the piece of card or plastic does not stay in place once the cup is inverted or water leaks out. Just replace the piece of card or plastic with a smaller lighter piece.
6. Health and Safety - You are working with liquids so please notify your adults of any spillages so they can be cleaned up. Ask your adult for help with some of the steps.

**What forces do you think are at work in this investigation?**

Force 1 is \_\_\_\_\_

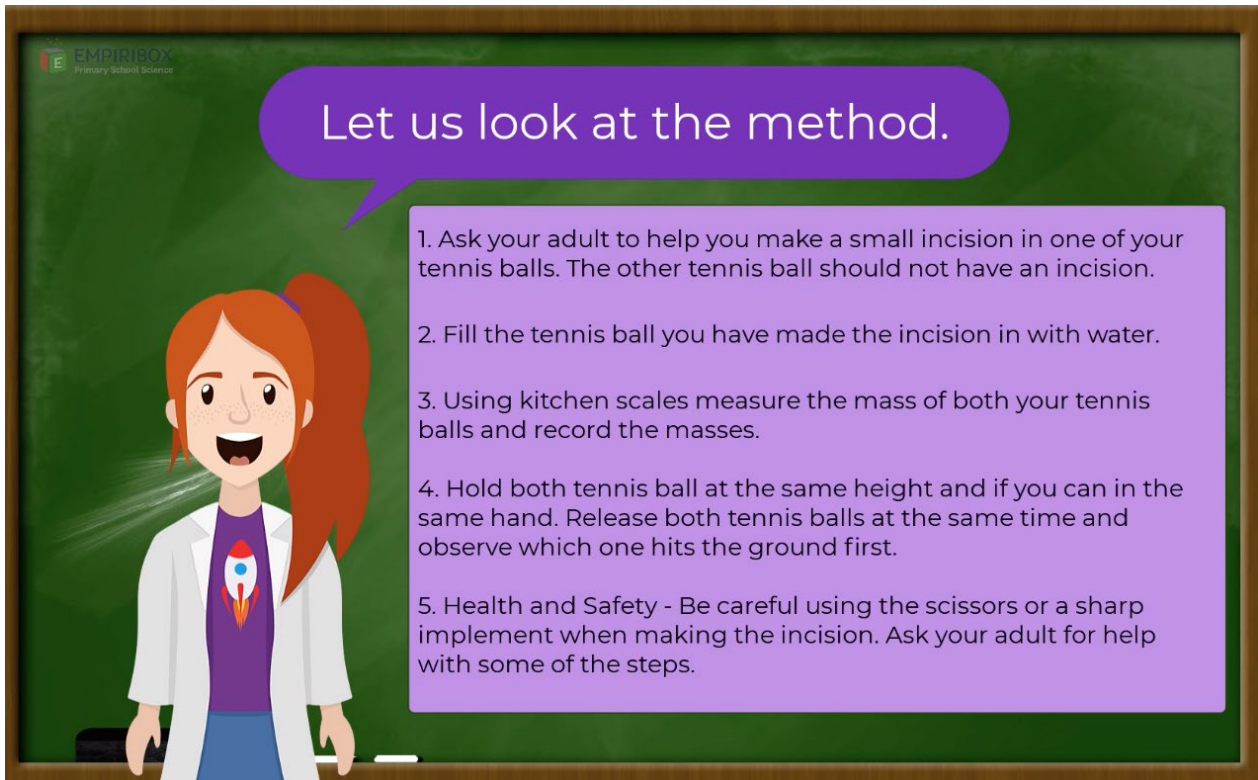
Force 2 is \_\_\_\_\_

We know these two forces work against each other when things fall. Some objects appear to fall more quickly to the Earth than others. We know that gravity makes things fall to the Earth at the same rate and that it is the air resistance that slows an object's fall.

So, what makes the air resistance slow down an object's fall? Is it the weight of the object or the shape of the object? Let's carry out our next investigation.

## Investigation 2

You will need to ask an adult to help you with this investigation



Let us look at the method.

1. Ask your adult to help you make a small incision in one of your tennis balls. The other tennis ball should not have an incision.
2. Fill the tennis ball you have made the incision in with water.
3. Using kitchen scales measure the mass of both your tennis balls and record the masses.
4. Hold both tennis ball at the same height and if you can in the same hand. Release both tennis balls at the same time and observe which one hits the ground first.
5. Health and Safety - Be careful using the scissors or a sharp implement when making the incision. Ask your adult for help with some of the steps.

What did you find out?

---

---

---

### WORKING SCIENTIFICALLY

Our next focus is about working scientifically. All scientists apply these principles whenever they are investigating anything and we've divided them into different skill units.

**Find the section your teacher has asked you to focus on and answer the questions in the relevant section.**

**A. Planning or**

**B. Presenting and analysing data or**

**C. Evaluation**

## A. Planning

Every scientist wants to solve a problem and so takes the following steps

1. **Decides on a question that needs answering.** e.g. does the shape of the objects affect the speed of its fall?
2. **Decides what the independent variable (the thing that is changed) might be in order to work out the answer to the question** e.g. we will have 3 different parallel experiments with different shaped objects.
3. **Decides what the dependent variable might be (how to measure the differences in each different example)** e.g. we will time the length of time it takes an object to fall.
4. **Last of all decide what elements have to stay the same in order to make it a fair test** e.g. we will drop the objects from the same height.

**Now using this knowledge, see if you can answer the questions below!**

Write below one or more examples of a question you might want to find the answers to.

---

**Year 3** -What might be the independent variable you would use in your investigation, in other words what would be the thing that you would change to investigate your question?

---

**Year 3** - What would be your dependent variable, in other words what would you measure to record the difference?

---

**Year 3** -What was your control variable, in other words what did you keep the same to make sure that it was a fair test?

---

---

**Year 4 and 5** – Design the question you would ask if the following were your independent and dependent variables.

The independent variable is **the size of the ball.**

The dependent variable is the **time taken for the ball to drop.**

## Planning continued...

My question is: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Year 6** - Read the following question relating to Investigation 1:

**Does the material from which the card is made affect whether the water stays in the cup when it is turned upside down (inverted)?**

What do you think will happen? Write your **prediction** below.

Scientists will always write a **prediction** when they are carrying out an investigation.

My prediction is:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

## B. PRESENTING & ANALYSING DATA

When scientists carry out investigations, it is really important that they capture data to make sure they can then answer the questions that they have set themselves. The scientist on the video has asked you to complete the following:

**Year 3 pupils – You are carrying out experiments to answer the following question:**

**Does the mass or weight of the ball affect how quickly the ball hits the ground?**

What kind of data would you capture to show what happens and why?

---

---

---

---

---

**Year 4 & 5 pupils – You are carrying out experiments to answer the following question:**

**Does the size of the ball used affect the time taken for the ball to hit the ground?**

What kind of data table would you use and why?

---

---

---

---

---

## PRESENTING & ANALYSING DATA continued

**Year 6** – This is your question:

**Does the shape of the ball affect the time taken for the ball to hit the ground?**

Design a suitable data table to present your investigation results. Use the space below to draw your table. Then carry out the investigation and fill in your table!

**My Table**



## C. EVALUATION

Evaluating how an investigation went as well as the data that comes from a science experiment is a really important part of science. It may be that you feel your experiment could have been done better or more thoroughly and it is important to understand this.

Answer the question below and then explain why you came to this answer:

**Year 3 pupils:** Did your experiment work?

---

**Year 3 pupils:** Why? Try and explain your answer using diagrams if it helps.

---

---

---

---

---

**Year 4, 5 and 6:** Carry out your investigation, recording your data as you go. Try to spot any anomalies. **An anomaly is an odd result.**

Make a note of them below.

---

---

---

---

---

## EVALUATION continued

**Year 5 & 6** Can you work out why there were any anomalies? Explain below what you think caused those anomalies.

---

---

---

---

---

---

---

## The science behind the investigation

All forces work in pairs. GRAVITY and AIR RESISTANCE are an example of paired forces.

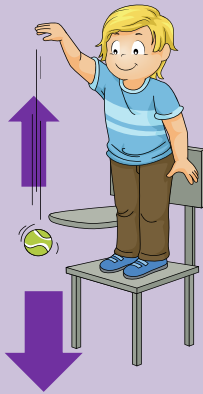


We know that forces can be pushes, pulls, or twists.

**GRAVITY** is a pull force that pulls objects down to the Earth.

**AIR RESISTANCE** acts as a push force that pushes upwards against any object falling to the Earth.

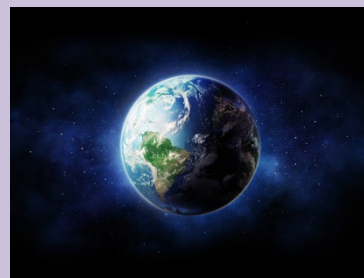
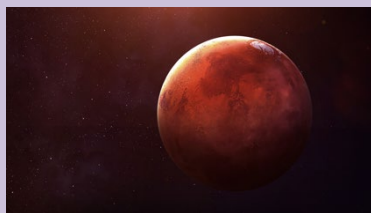
Forces are shown in diagrams as arrows. The larger the force the bigger the arrow. Take a look at the pictures below and see how the arrows are showing us the strength of the forces at work.



**Forces are measured in Newtons. This is a newton meter.**

Did you know that your weight will change as you visit different planets? A person's weight is calculated by multiplying the person's mass by that planet's gravity. Earth's gravity is 10 newton's per metre.

Mars' gravity is less than half of the Earth's so you would weigh less than half of your current weight on Earth!



## Your challenge!

Look at the pictures below. Can you draw in the arrows to show the strength of the forces at work? Remember to show which is the stronger force.



Can you name the forces at work in these pictures?

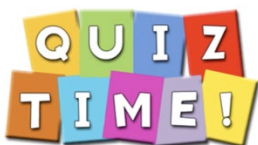
---

What do you think it means when an object reaches terminal velocity?

---

---

## What was your score?



---

