

# MATERIALS AND FORCES



## Science

Key stage 2 and 3 (activities 1 & 2 could be used for key stage 1)

## LEARNING OUTCOMES

- 'Work scientifically' by setting up simple practical enquiries, gathering, recording, classifying and presenting data to help in answering questions.
- Use results to draw simple conclusions, make predictions, and raise further questions.
- Use straightforward scientific evidence to answer questions or to support your findings.
- 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
- Describe what is meant by the terms 'dense' and 'buoyant'

The activities in this pack require additional equipment, we recommend getting these together before you get started:

### Activity 1: Egg Drop

You will need:

- An egg (we suggest you hard boil it first to make it less messy!)
- Scissors
- Sticky tape
- An assortment of clean recycling
- Anything else that you're allowed to use to help with your challenge e.g. plastic bags, string, tape, glue.... You'll need to be creative!

### Activity 2: Float or Sink (part 1)

You will need:

- A container of water (washing up bowl is ideal... or even the bath tub!)
- A selection of household items that can get wet, and must be smaller than the container of water

### Activity 3: Float or Sink (part 2)

You will need:

- A small container of water e.g. a cup
- Some Blu Tack, plasticine, clay or playdough at least the size of a marble

# ACTIVITY 1: EGG DROP

1. If you were to drop the egg out of your bedroom window, can you predict (guess) what you think would happen?

Prediction: \_\_\_\_\_

## Why

A force called gravity acts between the egg and the Earth, and so the egg would get pulled down **towards the Earth**.

And the egg would break because the shell is made of a fragile material that can't stand the force of impact.

**Challenge:** Design something that will slow the egg down enough that it doesn't break? (You might need to give the egg some extra padding too!) Draw your design in the box below (or on a piece of paper) and then get making!

If you need any inspiration, think about how humans stay safe jumping out of aeroplanes.

Think: what properties am I looking for in the materials I use?  
Are they heavy or light? Thick or thin?  
Flexible or rigid?

2. What was the result of your investigation? *(Did your egg break? If your egg didn't break, why do you think it worked? If your egg did break, what could you do better next time?)*

Results: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

### **Explanation**

Parachutes work by increasing air resistance.

Without a parachute, there isn't much resistance compared to the force of gravity, and so the item falls really quickly. A parachute has a large surface area which means the air resistance increases and slows the parachute and egg down.

What do you think happens to the speed of the egg with

- a smaller parachute?
- a bigger parachute?

You could always conduct extra tests to find out!

3. What does this mean? (Why does the egg fall? Why was it slower with a parachute?)

Conclusion: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## ACTIVITY 2: FLOAT OR SINK (PART 1)

In this challenge you will test different objects to explore what floats and what sinks.

- Can you correctly recognise what material each item is made from? (ask an adult if you are unsure)
- Can you correctly predict what each item will do?

For each experiment, fill in the table as you go. We have given you one idea to get you started. (If you don't have access to a printer, you can always write your own table.)

Item	Material (what it is made from)	Prediction float or sink?	Results float or sink?
<i>pencil</i>	<i>wood</i>		

1. Why do you think some materials sink, whilst others float?

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*See if you can find objects made from the same material, but that have different results.*

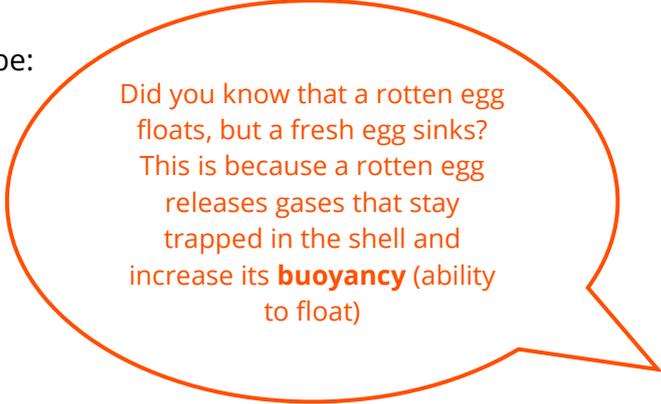
2. Write a theory why you think this might be:

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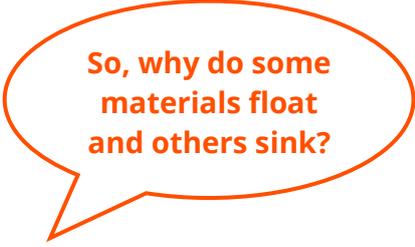
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Did you know that a rotten egg floats, but a fresh egg sinks? This is because a rotten egg releases gases that stay trapped in the shell and increase its **buoyancy** (ability to float)

## More floating and sinking....

Explanation:



So, why do some materials float and others sink?

Some objects are heavier for their size (volume) than others, and are said to be more **dense**. Objects that are lighter or that have trapped air inside them are less **dense**, they float meaning they are **buoyant**.

3. Identify one object from your test that was very **dense**

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4. Identify one object from your test that was very **buoyant**
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And what makes the same material behave in different ways?

A couple of things are important here:

Firstly, if something is hollow, there is air inside it. Air is a lot **less dense** than water.

5. If we had two objects that were made from the same material, but one was hollow, what might we expect the hollow object to do when placed in water?
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Secondly, the shape is really important. The greater amount of outside area (or surface area) that touches the surface of the water, the easier it is for it to float.

6. Think about how you float in a swimming pool, what do you do to help you float?
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## ACTIVITY 3: FLOAT OR SINK (PART 2)

You will need some Blu Tack, clay, plasticine or playdough, at least the size of a marble (we're using Blu Tack, so to keep it simple, we'll just refer to Blu Tack throughout this challenge).

1. Squash all the Blu Tack into a ball and drop it in the water. What happens?

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2. Now split it into quarters (4 equal pieces) Squash one quarter into a ball and drop it in the water. What happens this time?

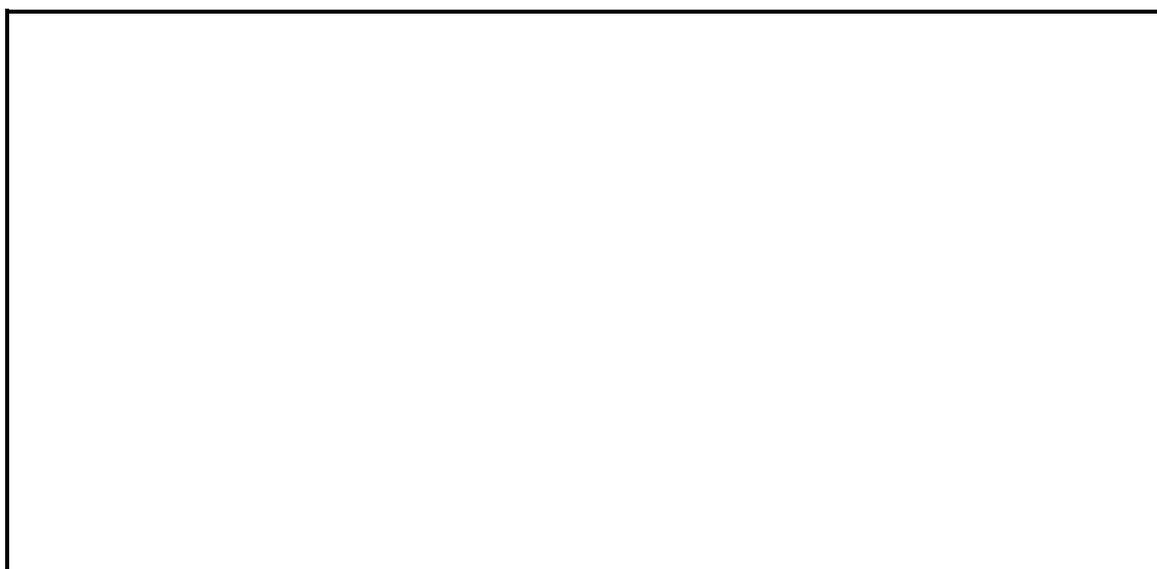
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Did the balls sink? This is because 'density' is the mass of the object divided by its size (volume), and as the mass of the Blu Tack decreases, so does its volume, the density is unchanged.

In this case, a pea-sized amount of Blu Tack weighs more than a pea-sized amount of water so the Blu Tack sinks, and a tennis ball sized amount of Blu Tack stills weighs more than a tennis ball sized amount of water, so again, the Blu Tack sinks.

3. Now take all of your Blu Tack, and using your knowledge of surface area, change the shape of it to make it float. (*clue - think about boats and rafts, what sort of shape do they have?*)

Draw a picture of your final floating shape in the box below.



Why does the water level rise when I add an object to the water?

The object **displaces** the water (pushes it out of the way). The water has to go somewhere and so the water level rises.

# SCIENCE STORY

Watch the following YouTube video and answer the questions below.

<https://youtu.be/ijj58xD5fDI>

1. Archimedes realised that how much water was displaced from the bath depended on how much of his body was immersed in the water. What did he shout when he made this discovery?

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2. What is density?

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3. Which is more dense, gold or silver?

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4. Why is it hard to measure the volume of a crown?

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5. How did Archimedes measure the volume of the crown?

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# ANSWERS

## Activity 1

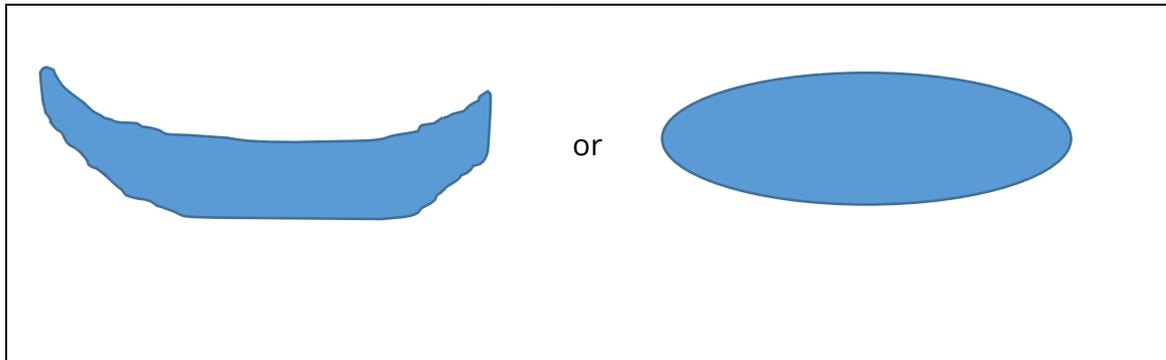
1. The egg would fall and break
2. If the egg didn't break – The parachute slowed the egg down as it fell to the ground and the padding around the egg helped to protect it  
If the egg did break – a better parachute with a greater surface area would slow down the egg more and a better padding around the egg to protect it would help stop it getting broken
4. The egg fell because of the force of gravity pulling it towards the earth. The parachute created additional air resistance which slowed the egg down as it fell

## Activity 2

1. Because some objects were heavier than others
2. The heavier objects sink whereas the lighter objects float because the water is able to hold them up, they are more buoyant.
3. Any object that sank
4. Any object that floated
5. The hollow object would float
6. You spread out

## Activity 3

1. The Blu Tack sinks
2. The smaller ball also sinks
3. Boat shaped or flattened like a penny



## Activity 4

1. Eureka
2. Measure of an objects mass divided by its volume
3. Gold
4. It's an irregular shape
5. By placing it in water and seeing how much water is displaced