Forces

In this unit we will
- Investigate the force of Gravity – take force measurements
- Investigate force of buoyancy, or up-thrust
- Investigate how forces can create movement - plan and carry out a fair test
- Investigate the force of friction – plan & carry out a fair test
- Explore the effect of air resistance – taking repeat readings

Science Skills that we will develop:

Explaining Science
- I use complex science words correctly
- I use a science model to describe and explain
- I draw & annotate diagrams to help describe/explain

Designing Experiments
- I plan a fair test & ensure controlled variables stay the same

Data, Tables & Graphs
- I measure/calculate in standard units
- I construct a complex table to show repeated data
- I plot mean values and draw a trend line for line graphs

Quick recap:

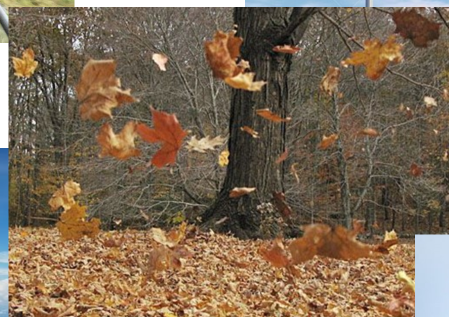
- What force is responsible for our weight?
- Who first figured this out?
- What do we measure weight in?
- What is measured in grams or kilograms?
- In which two ways can we reduce our weight?
- Can you think of another way to loose weight?


Imagine that the classroom is now flooded and we are up to our necks in water - how does it feel to walk around? Why?

It's hard work to walk around a room full of water, because there is so much **resistance;** the water is pushing back against our bodies. The water resistance is a force, pushing back against our muscle force. In air, their is much less resistance, so it is easier to move about. Why is this?

Can you think of any situations where we *can* feel the effects of air resistance?

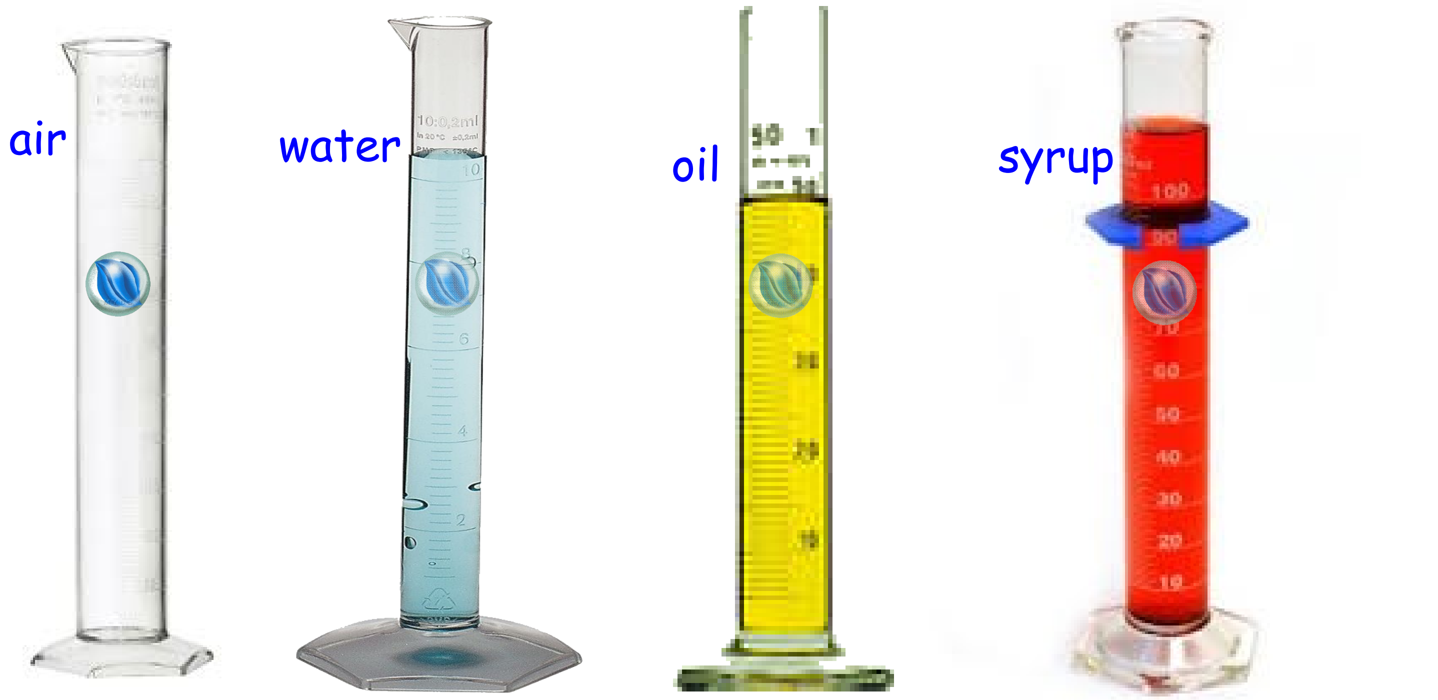


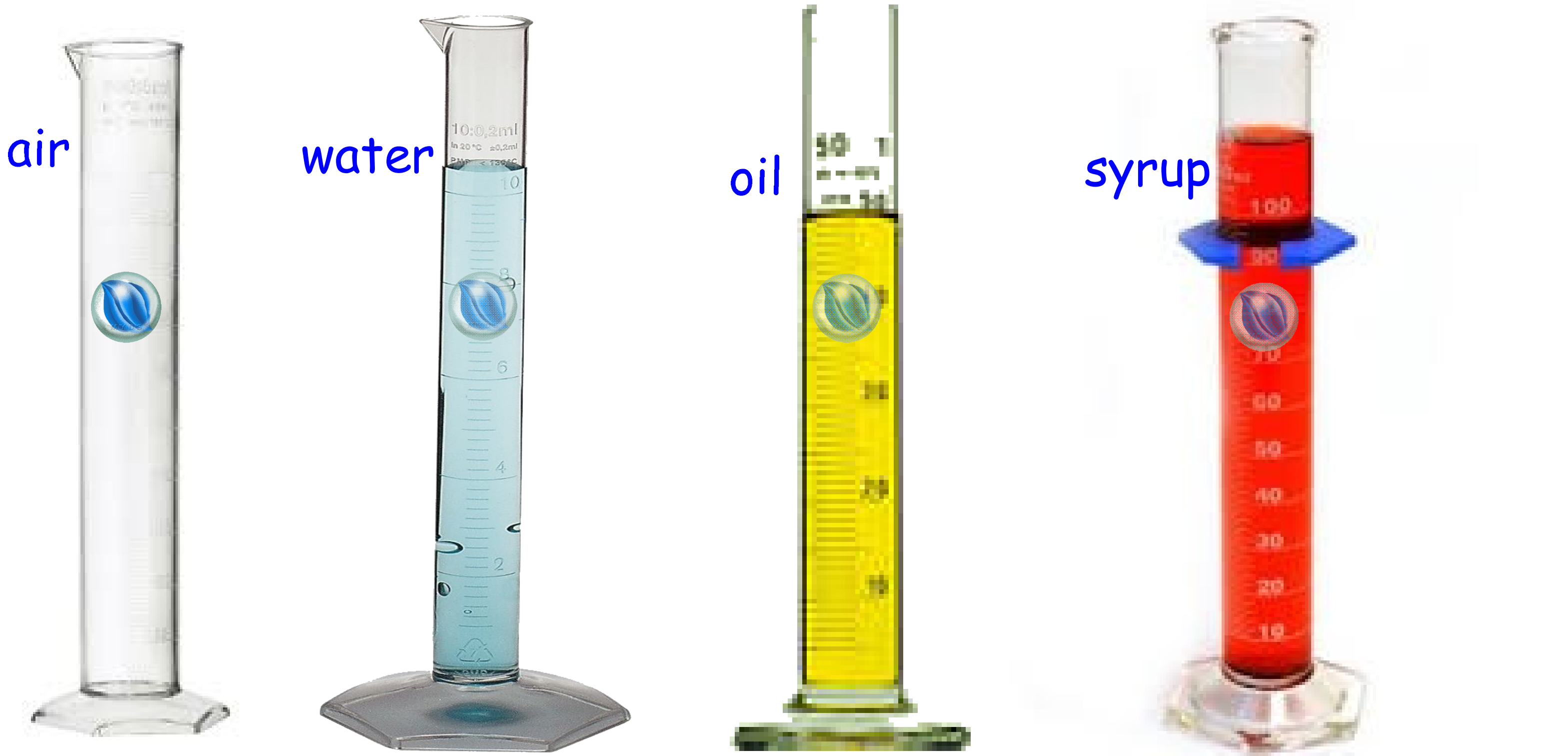

Today we are going to find out more about the force of

resistance

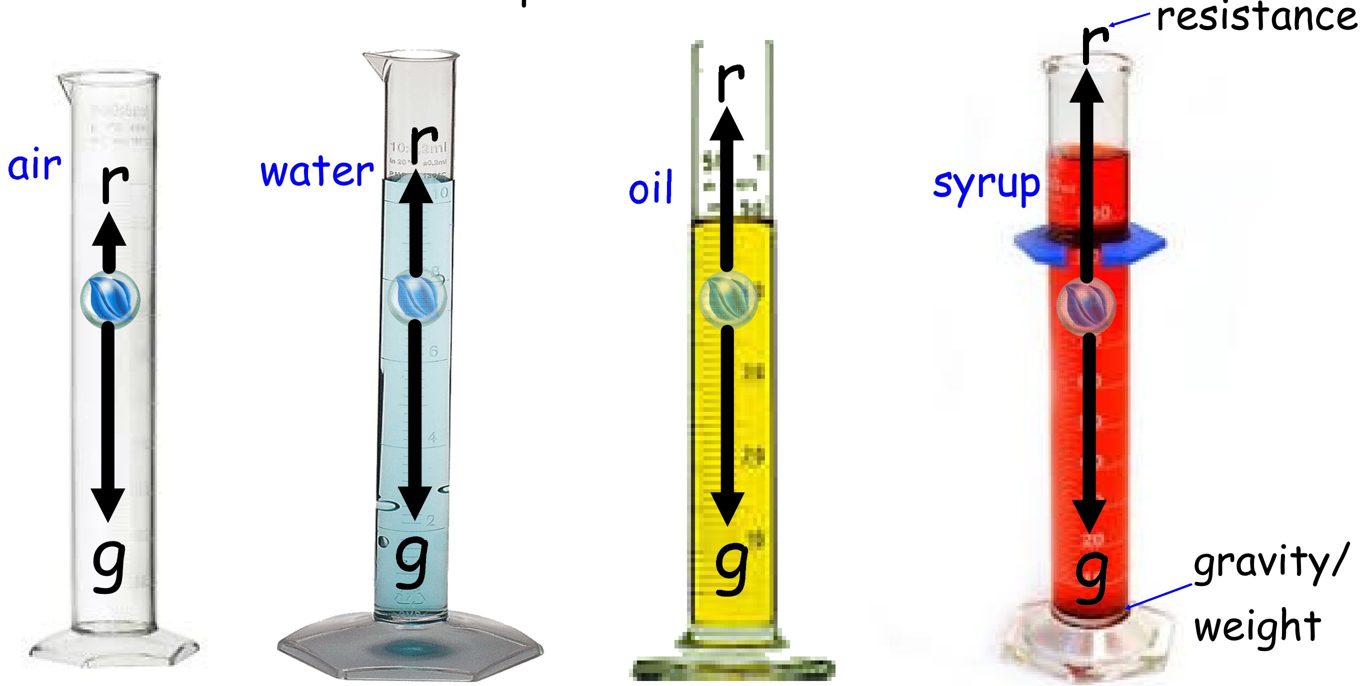
What do you predict will happen to the marble in each of these measuring cylinders? Discuss with a partner.



Which forces were acting on each of the falling marbles?



To show forces on a picture or a diagram, we use **force arrows.** These not only point in the direction of the force, but they can also show the sizes of different forces compared to each other.

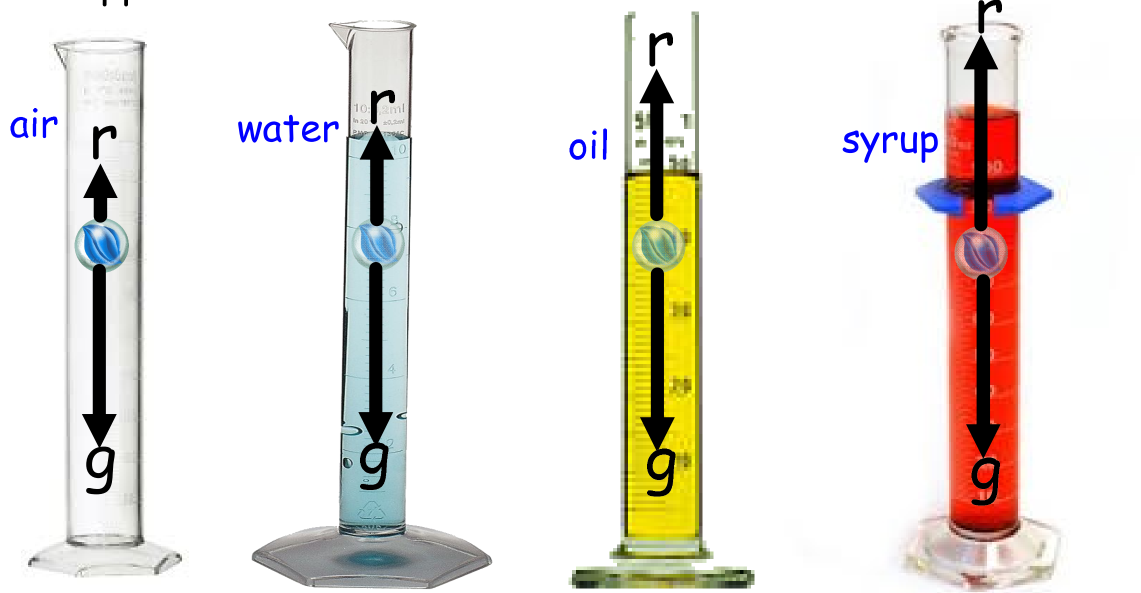


Why are all the gravity arrows the same length?

Why do the resistance arrows get longer each time?

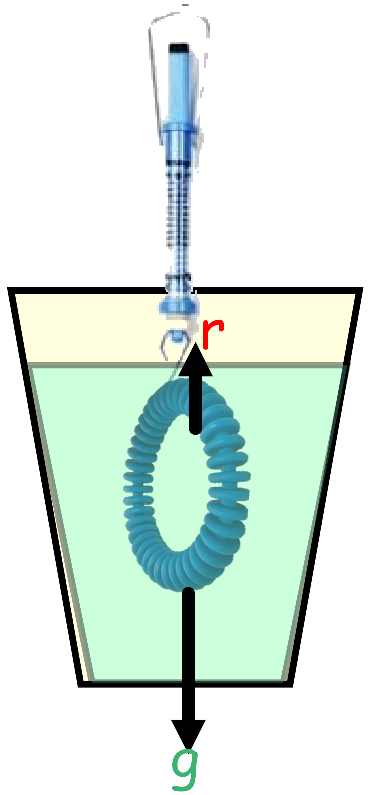
Why are non of the resistance arrows longer than the gravity ones?

What would happen to the marble if resistance *did* increase to be the same as gravity?

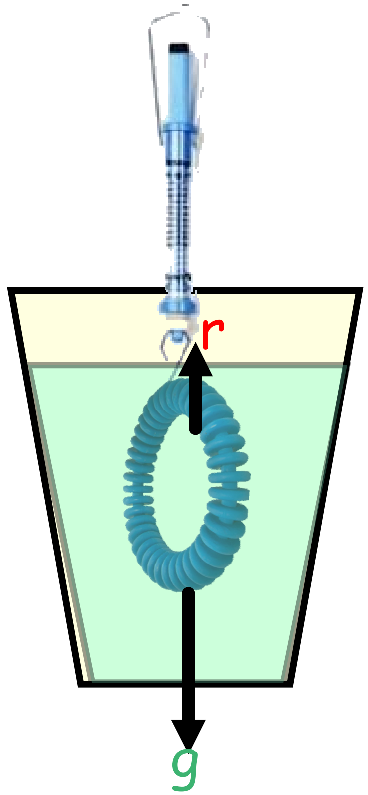


Today, you are going to observe the effect of water resistance on the weight of objects. Water resistance is also called **buoyancy** or **up-thrust.**

What do you think will happen to the weight of a quoit when it is weighed again in water?

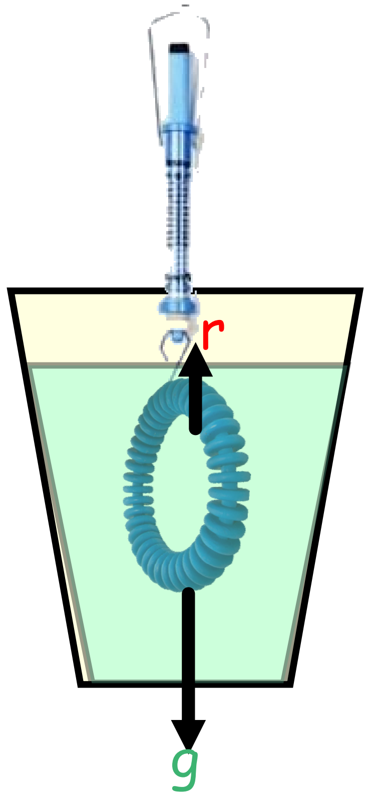


Can you use the force diagram to explain what happens?



The force of gravity acts downwards (at 1N for every 100g of mass), while at the same time, the force of water resistance (also known as buoyancy) pushes back up on the quoit.

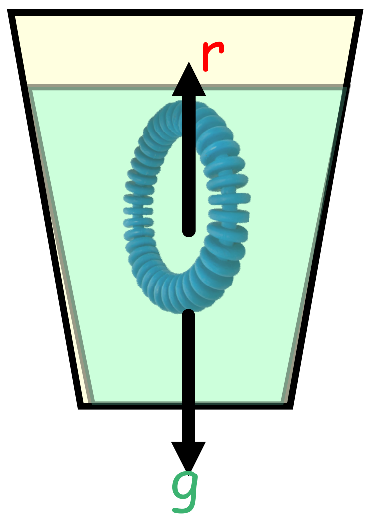
This causes the mass of the quoit to pull down on the force meter spring **less** than it would in air; it weighs less in the water than it does in the air.



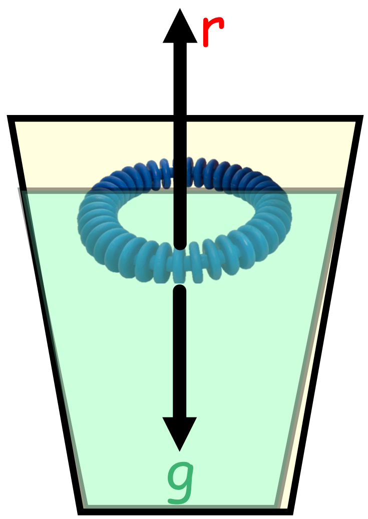
We know that because gravity is stronger than the water resistance, the quoit will sink when we take it off the hook.

What would happen if **resistance** and **gravity** were exactly the same?

What about if **r** became bigger than **g**?



If **resistance** and **gravity** were exactly the same, the quoit would remain in the same position, neither sinking, nor rising, even with the Newton meter removed.



If r became bigger than g, (or if g became smaller) the quoit would rise to the top and float on the surface of the water. What might the quoit be made of, to make this happen?

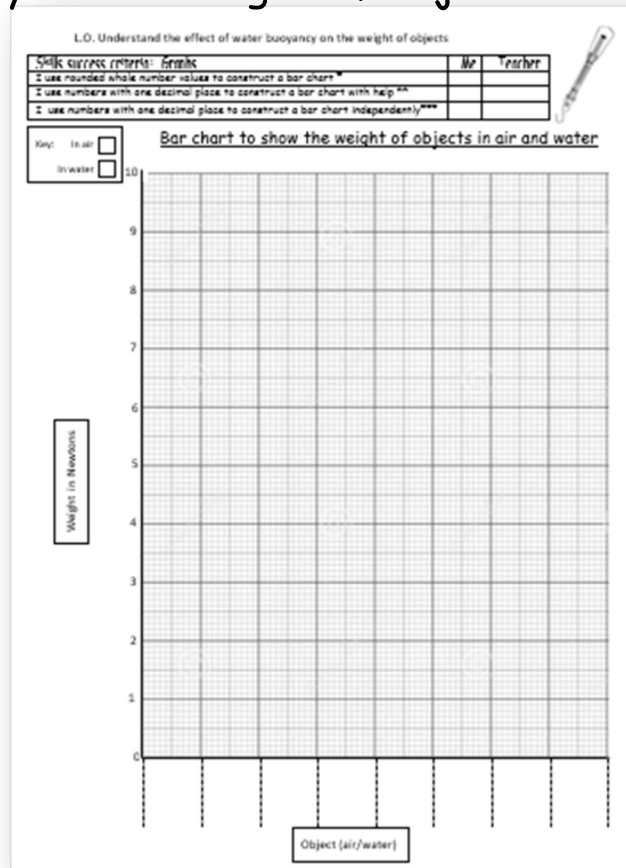
Work in groups to fill in this table - make sure you take turns, check the Newton meter readings and work quickly to get your results.

Weighing in Air and Water

Object	**Mass in air** (grams)	**Weight in air** (Newtons)	**Weight in water** (Newtons)

Bar chart to show the effect of water buoyancy on the weight of objects.

1. You will need two bars for each object weighed, one for weight in air, and one for water.
2. Use one colour for bars showing weight in air and another colour for the bars that show weight in water. Fill in the key with these colours.
3. The grid is divided into tenths, so you should be able to use it to plot numbers to one decimal place.



Things weigh less in water because there is an **up-thrust** created by the water on anything in it. Even if something sinks, the water is still pushing up on it, so the object sinks more slowly than if it was falling through air - the water particles are much closer together than the air particles, so they cause a lot more resistance.

Remember that on the Moon, the effect of a weaker gravity is to reduce the weight of any mass, so it feels lighter; in the same way, the up-thrust of water acts against gravity, so objects weigh less in it.

So to lose weight, we now have three options: eat less (reduce our **mass**), go to the Moon (reduce **gravity**) or get in a pool (increase **up-thrust**).

Look back at your results again; can you estimate what the same objects would weigh in a bucket of oil? How about a bucket of treacle?