Buoyancy

This activity will look at buoyancy in fresh water and saltwater and illustrate how to conduct a fair test.

What is buoyancy?

Buoyancy is the upward force of water that allows objects to float. **Objects that can float in water**, or other liquids, are said to be buoyed in the water. An object's ability to float comes from the upward force of the liquid in which it is placed.

Displacement

When an object is placed in water, the water level rises (as it does when a person gets into the bath). The water that rises is called **displaced water**, which is the water that the object has pushed out of the way. The amount of displaced water is the same as the volume (how much space an object occupies) of the object. If, for example, a golf ball is placed into a full glass of water, then the water that spills out is the displaced water. The amount of displaced water that spills is equal to the volume of the golf ball.

For an object to float, the displaced water pushes back on the object. The weight of the displaced water needs to be equal to or greater than the total weight of the object, otherwise the object will sink.

- Objects that are too heavy and cannot be supported by the weight of the displaced water will sink.
- Objects that are heavy, but are partially supported by the weight of the water, will be suspended in the water.
- Objects that are able to be completely supported by the displaced water will float on top of the water.

Fair-testing buoyancy

To find out if an object floats or sinks (or becomes suspended) a fair test must be conducted. Fair-testing (experimenting) of objects means that all objects are tested under the same conditions, otherwise the results of the tests would not be correct or accurate.

The following fair test looks at the buoyancy of different objects. This is a fair test that can easily be done at home. Can you guess which objects will float or sink in water?

Gather these objects: a coin, a cotton ball, a pencil, a pen, a paper clip, a clay ball, and a small scrap of fabric, a cup or bowl of water

Test each one to see if it will float or sink in regular tap water (water from the sink).

Now that we know how to conduct a fair test and have discovered which things can float, and which things cannot, can you think of characteristics that are shared by all the things that floated? Or all the things that sank?

Why did it sink?
The things that sank (the coin, the cotton ball, the clay ball and the paper clip) are all very dense materials. The cotton ball became denser and heavier than the water around it as it absorbed the water. The coin and paperclip are made of metals which are much heavier than the water they displaced.

Why did it float?
The things that floated (the piece of fabric, the pencil and the pen) are all made of light materials, which means that their weight is less than the water they displaced, so the water held them up. They are buoyant.

Making changes to objects will help them float. Changing the size and shape of the clay ball, for example, will help it float. By making it flatter and wider, more water is displaced, which then creates more support for the clay, helping it to float.

Archimedes

Buoyancy was first explained by a Greek philosopher called **Archimedes**, which is why the science behind buoyancy is called the **Archimedes' principle**.

Archimedes was born in Syracuse in Sicily, a Greek settlement of the time. It is believed he was schooled in Egypt and then spent the rest of his life in Sicily. Archimedes was a mathematician and inventor who made many discoveries about basic science. He became well known for testing all his ideas with different experiments. He was killed by a Roman soldier in 212 BC.

Buoyancy in saltwater and fresh water

Saltwater (or seawater) and fresh water are very different. Salt water is a 'salty' solution that has developed over time. The saltiness of this water comes from many components, for example eroded rock particles, soil particles and other salt chemicals, which are

mixed with fresh water. These components dissolve in the water which is why we cannot see the, but we can feel and even taste their effects. These components add weight and density to the water.

Buoyancy in saltwater and fresh water is also very different. The salt in saltwater adds weight to the water and makes it is easier for an object to float. This is because the displaced water (refer to 'What is buoyancy') is heavier and able to lift objects more easily. In some cases, objects that sink in fresh water can float in saltwater. This applies to humans. Many swimmers will find it easier to swim in saltwater because they are more supported by the saltwater and sit higher in the water. The Dead Sea, situated between Israel and Jordan, has approximately nine times more salt than the average ocean.

Now do the following fair test for buoyancy in saltwater vs. fresh water. You will need two identical cups, a raw egg, salt, and warm water.

Put the same amount of warm water in each of the cups. Add 6 tablespoons of salt to ONE of the cups of water. Stir it until the salt is dissolved. Now place the egg into the tap water. What happened? Remove the egg from the tap water and place it into the salt water. What happened? Try it again to see if you get the same results.

*Information and activity *adapted* from Skwirk Online Education http://www.skwirk.com/p-c_s-11_u-90_t-182_c-587/buoyancy/nsw/buoyancy/sailing-sinking-soaring/properties-of-water