Setting Up Experiments

National curriculum objectives:

- asking relevant questions and using different types of scientific enquiries to answer them
- setting up simple practical enquiries, comparative and fair tests

Science in the news today

An experiment was recently conducted that suggests hot water can actually cool faster than cold water. Think about that, it's very strange, isn't it? This is an idea that people have thought may be true for a while, but until now, there hasn't been a fair enough test to prove it. The idea has come from an observation by a lot of scientists that hot water often freezes faster than cold water.

From this observation, an experiment was set up. Instead of a liquid, miniscule glass beads were used, this was so that each bead was sure to be the same size. Half the beads were heated to a high temperature and the others to a medium temperate. From here all the beads were cooled in the same way - in a bath of water. These measurements were repeated 1000 times! The very accurate instruments used to measure the time taken and the temperature of the beads consistently showed that the hotter beads took less time to cool down than the colder ones.

This was a simple study but by using controls, repeating measurements and using accurate equipment to measure, they were able to make a fair test and find out something very bizarre! If you want, read the original article with an adult to find out why this happens.

Here is a picture of an ice cube

Sometimes hot water can freeze faster than cold.

Credit: ARTISTEER/ISTOCK/GETTY IMAGES PLUS

Setting up an experiment

This lesson is going to be all about setting up experiments and making fair tests. Follow these steps to set up your own experiment:

1. Ask a question - What could I investigate? What would I like to find out?
2. Make sure it is a fair test - What ONE thing will you change? What will you keep the same?
3. Make a prediction - What do you think will happen in your experiment?
4. Plan the practical experiment - What do you need? How will you carry out the experiment? Write a list. Draw a diagram.
5. Carry out the experiment - Note what happens in your experiment
6. Record the results - Produce a table of results. You could also draw graphs.
7. Explain the results - What is the conclusion? What would you do differently if you were doing the experiment again?

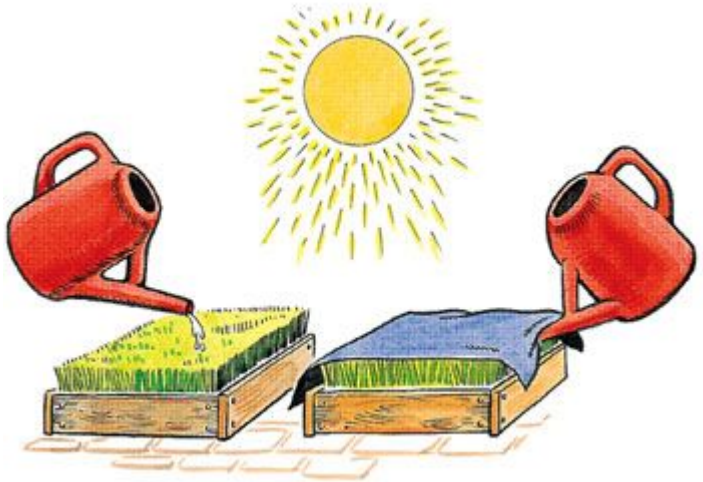
Be organised!

When setting up an experiment you need to be organised.

- Make a list of all the things you need
- Make sure an adult knows what equipment you need and what you're about to do
- Make sure you have everything
- Make sure you know how to use everything
- Get everything ready before you start the experiment

What is a fair test?

When you are testing something, you need to make sure it is a fair test. To do this everything should be the same except the thing you are testing. With one thing that is different, you can compare fairly.



In scientific terms, a fair test is a test which controls all but one variable when attempting to answer a scientific question. Only changing one variable allows the person conducting the test to know that no other variable has affected the results of the test (the things which could change are called variables).

Read the next slide for some examples.

Is it a fair test?

Read these examples of science experiments and see if you think they are fair or not (go to the next page for the answers!)

1. A scientist wants to see if milk evaporates at the same speed as water. It is a hot, sunny day so she pours 1 litre of water onto the pavement and, a few metres away, she pours 2 litres of milk. Then she switches the timer on and waits to see which one gets evaporated first. The water evaporates first. Is this a fair test?

2. A scientist wants to know which surface causes the least friction, when sending a toy car down a ramp. He places bubble wrap on the ramp, sends the toy car down it and measures how far it goes. In the next experiment he wraps the ramp with sandpaper and sends the toy car down it, measuring again at the bottom of the ramp. The third time he does the experiment, he places aluminium foil on the ramp and also changes the toy car to one with huge rubber wheels. This car goes the furthest. Is this a fair test?

3. A group of scientists are investigating what the best thing is to plant a seed in. Each one gets a seed and plants it in something different e.g. soil, sand, gravel, foam. Then they put their plants on the windowsill in the sunlight. However, one scientist puts one of the plants in a cupboard with no light. The plant in the tissue paper does the worst out of all the plants. Is this a fair test?

Is it a fair test?

1. A scientist wants to see if milk evaporates at the same speed as water. It is a hot, sunny day so she pours 1 litre of water onto the pavement and, a few metres away, she pours 2 litres of milk. Then she switches switches the timer on and waits to see which one gets evaporated first. The water evaporates first. Is this a fair test? NO, this is not a fair test. The liquid (milk and water) should have been the only difference in this experiment. The quantities (amount of liquid) should have stayed the same. To make it a fair test she should repeat the experiment but with 1 litre of milk.

2. A scientist wants to know which surface causes the least friction, when sending a toy car down a ramp. He places bubble wrap on the ramp, sends the toy car down it and measures how far it goes. In the next experiment he wraps the ramp with sandpaper and sends the toy car down it, measuring again at the bottom of the ramp. The third time he does the experiment, he places aluminium foil on the ramp and also changes the toy car to one with huge rubber wheels. This car goes the furthest. Is this a fair test? NO, this is not a fair test. The surface on the ramp should have been the only difference in this experiment. The type of toy car should have stayed the same. To make it a fair test he should repeat the experiment but with the same toy car each time.

3. A group of scientists are investigating what the best thing is to plant a seed in. Each one gets a seed and plants it in something different e.g. soil, sand, gravel, foam. Then they put their plants on the windowsill in the sunlight. However, one scientist puts one of the plants in a cupboard with no light. The plant in the tissue paper does the worst out of all the plants. Is this a fair test? NO, this is not a fair test. The substance the plants were grown in (soil, sand, gravel) should have been the only difference in this experiment. The amount of light should have stayed the same. To make it a fair test they should repeat the experiment but with all the plants on the windowsill.

Lid on or off?

<u>What question are you answering?</u>
The question for this experiment is:
‘Do vegetables have a different colour depending on whether they are cooked with the lid on or lid off?’.

Let’s think about how to set up this experiment.
To test this, we will cook some vegetables with the lid on, and some with the lid off. Then, at the end we can compare the colours. How do we make it fair?

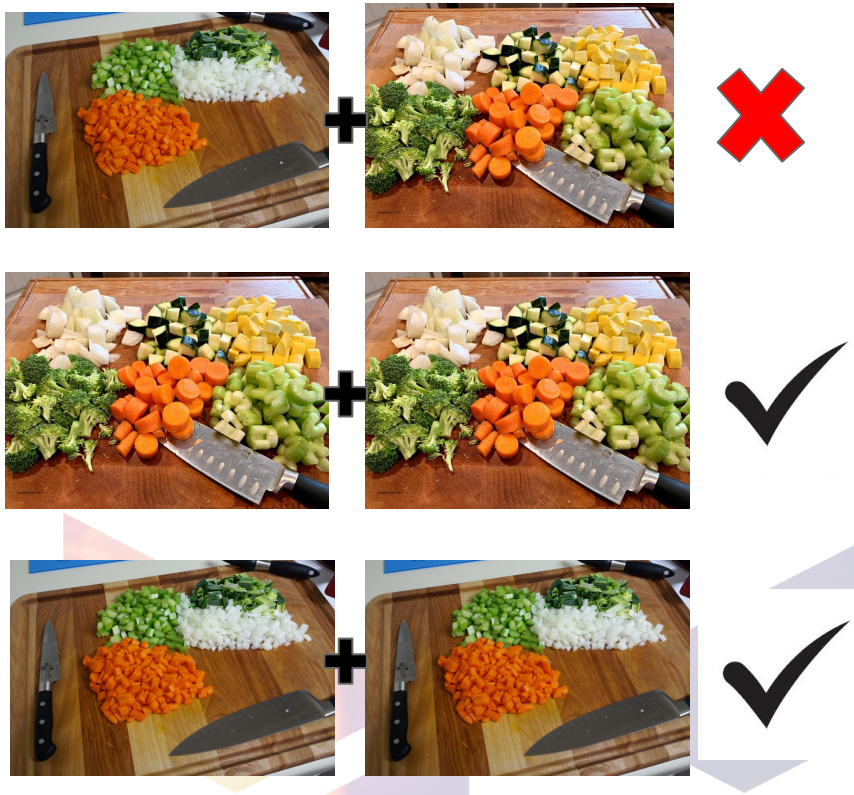
Lid on or off?

How do we make it fair?

We are only going to change *one thing* in our experiment, and that will be whether the pot of vegetables has a lid or not.
Everything else must be the same.

- Vegetables - type and size
- Cooking time
- Pot used

All of these things must be the same for it to be a fair test.



Lid on or off?

Organise yourself!

Now that we have our question and we know what we are going to change, we need to get organised! First, write out a list of instructions for your experiment.

Instructions:

1. Measure out half of the vegetables and put in a saucepan.
2. Then, with an adult, put the kettle on, measure your boiling water out and pour over the vegetables. Put the lid on and set your timer for around 4 minutes.
3. When the timer goes off, drain your vegetables (you can use a strainer or the saucepan lid for this). Leave in a bowl.
4. After that, repeat the experiment with the other half of the vegetables but without putting the lid on.
5. Finally, make a careful observation of your vegetables. Is there a difference? If there is a difference, could there be another reason why?
   Top tip - Time your experiment just before teatime so you can eat all the vegetables you have cooked!

Now we can go through the instructions and see what is in there that we need for the test. Any equipment we need is underlined in these instructions.

Lid on or off?

Organise yourself!

Now, make a list of what you will need and make sure you have the right equipment.

What do you need?

- An adult to help you
- Green beans, peas or broccoli
- A saucepan with a lid
- Scales and a measuring jug
- Access to a cooker
- Access to boiling water
- A strainer
- A timer
- A bowl

Lid on or off?

You have now designed your own fair test and are ready to go:

What do you need?

- An adult to help you
- Green beans, peas or broccoli
- A saucepan with a lid
- Scales and a measuring jug
- Access to a cooker
- Access to boiling water
- A strainer
- A timer
- A bowl

Instructions:

1. First, write a detailed list to show how you are going to make this experiment a fair test. Things to think about: amount of water in each pot, type of vegetable, temperature, cooking time etc.
2. Next, measure out half of the vegetables and put in a saucepan.
3. Then, with an adult, put the kettle on, measure your boiling water out and pour over the vegetables. Put the lid on and set your timer for around 4 minutes.
4. When the timer goes off, drain your vegetables (you can use a strainer or the saucepan lid for this). Leave in a bowl.
5. After that, repeat the experiment with the other half of the vegetables but without putting the lid on.
6. Finally, make a careful observation of your vegetables. Is there a difference? If there is a difference, could there be another reason why?

   Top tip - Time your experiment just before teatime so you can eat all the vegetables you have cooked!

How could we improve this test?

Our lid on and lid off experiment is an easy and fair test.
But there could be ways to make the test more reliable.

<u>Repeat the experiment.</u>
Once you have done this once, repeat the experiment again using exactly the same conditions. Now you can compare the results from both times and see if they are the same. The more you repeat and experiment the more reliable it is.

<u>Try the same experiment with different vegetables.</u>
Once we have the results from one experiment we can expand our question to get more answers. Does the same thing happen with pepper and broccoli? How about pasta?

Once you get going the possibilities are endless! You can keep on experimenting and building on what you learnt before.