Planning an experiment

To be a fair test, a scientific experiment should vary only one thing at a time to see what effect it has on something else. We call the thing you deliberately vary the independent variable. The thing it affects is the dependent variable, and things you need to keep constant are control variables.

Investigating insulation

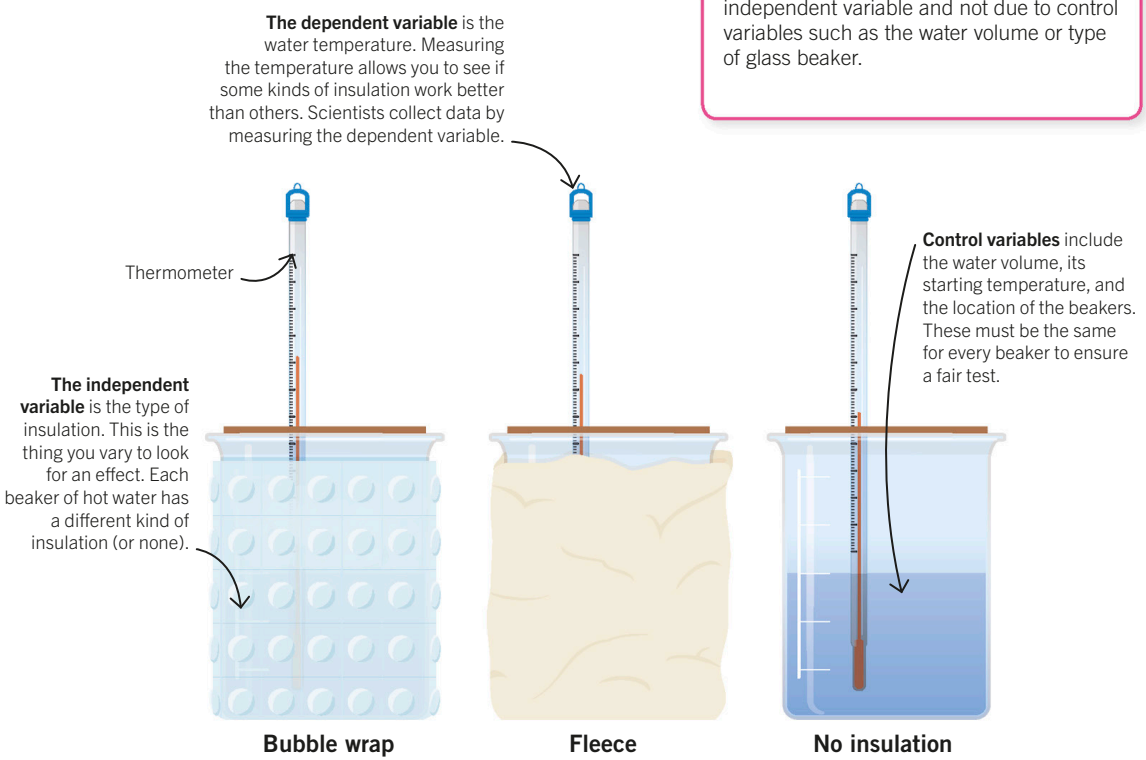
In the scientific method, you test a hypothesis (an idea) by carrying out an experiment. Air is a poor conductor of heat, so you might form a hypothesis that materials containing lots of trapped air will be good insulators. To test this hypothesis, you could carry out an experiment like the one shown here. Three beakers of hot water are given different types of insulation, and the water temperature is measured regularly as the beakers cool down.

Key facts

- ✓ **Experiments must be carefully planned to ensure a fair test.**
- ✓ **Things that change in experiments are called variables.**
- ✓ **The independent variable is the thing you change.**
- ✓ **The dependent variable is the thing you measure.**
- ✓ **Control variables are the things you keep the same to ensure a fair test.**

Experimental controls

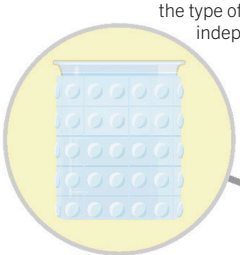
The uninsulated beaker is an experimental control. It allows you to compare the temperature change with insulation to how it would change if no insulation had been used. Any differences must be due to the independent variable and not due to control variables such as the water volume or type of glass beaker.



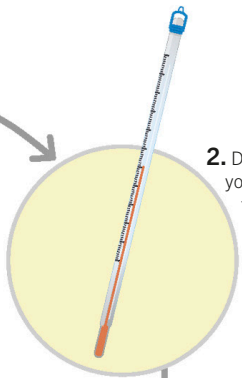
The planning process

Experiments should always be carefully planned in advance. The most important part of the planning process is to decide what the independent and dependent variables are. It's also important to work out what equipment you need and ensure the experiment can be conducted safely.

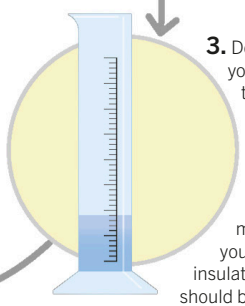
1. First, decide which variable you will deliberately change. This is the independent variable. In the insulation experiment, the type of insulation is the independent variable.



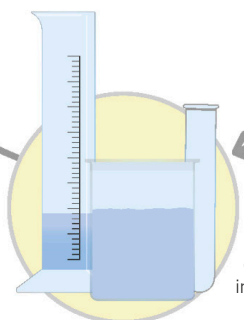
2. Decide which variable you'll measure to look for an effect. In the insulation experiment, the temperature of the water is the dependent variable.



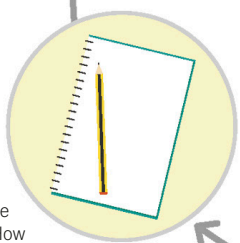
3. Decide which variables you need to keep constant to ensure the test is fair. These are your control variables. For example, the volume of water in each beaker and the starting temperature must be the same. If you compare different insulation materials, they should be equally thick.



4. Make a list of all the equipment you'll need, including measuring instruments.



5. Plan the steps you'll take during the experiment in detail. How often will you take the temperature? How long will you leave the beakers standing? What volume of water will you use, and what should the starting temperature be?



6. Decide what safety precautions you need to take and write them down. For this investigation, be careful with the hot water, and make sure you wipe up any spills right away in case someone slips.

Collecting data

All experiments involve collecting data, which we use to see if a hypothesis is supported or not. Planning how and when to collect data is important. For this experiment, taking the temperature regularly allows you to create a graph of your results. The graph helps you spot possible errors in the measurements, and it helps you reach a conclusion.