

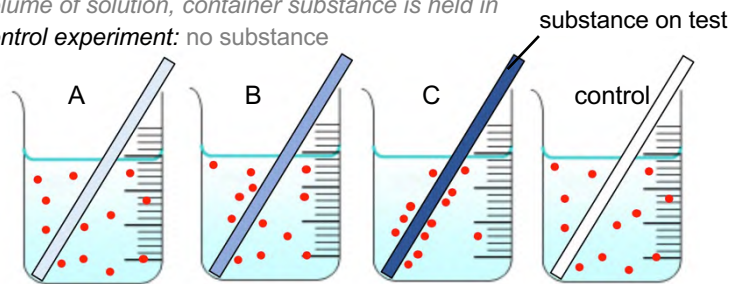
## Controls

In investigations, we find out how one variable affects another. We change the **independent variable** and measure changes in the **dependent variable**.

We only want to see the effect of the independent variable. So, we must stop changes in other variables that can affect the dependent variable. These are **control variables**.

Sometimes we cannot control all the other variables and so we also use a **control experiment** (or **control**). To do this, we change the independent variable in one experiment but in an identical experiment we do not use the independent variable. The control gives us results to compare.

How water organisms are attracted to different strengths of a substance  
*independent variable*: concentration (strength) of substance  
*dependent variable*: number of organisms found next to substance  
*control variables*: type of substance, total number of organisms, time, volume of solution, container substance is held in  
*control experiment*: no substance



## Medical trials

New vaccines and medicines are tested to make sure that they are safe and effective. Control experiments are used because humans are very complex and there are too many control variables.

When scientists identify an illness they want to treat, they often use computer modelling to design or look for substances they think will work. They then do **preclinical** tests on cells. For example, a drug to treat COVID-19 will be added to a test tube containing human cells infected with the virus. This will show the scientists whether the drug can enter cells and if it can stop the virus.

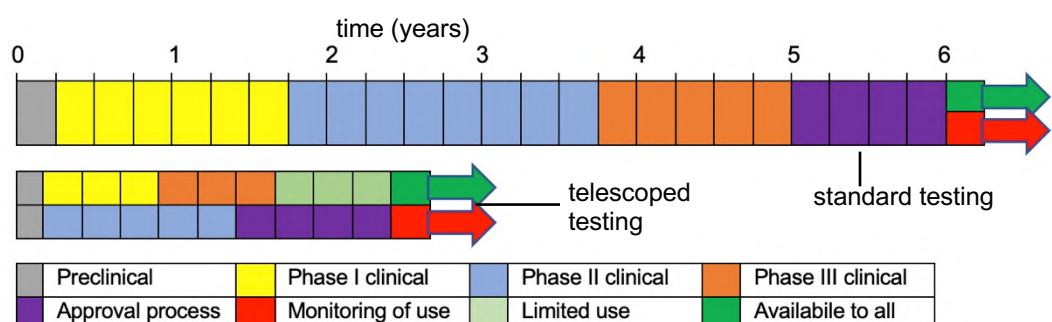
A substance that passes this stage may be given to animals to look for unwanted **side effects**. Or it directly enters Phase I **clinical** trials, in which it is given to 10 - 30 healthy people to check it is safe.

In Phase II, hundreds of people take the substance. This phase finds out if the substance works and if it is safe for most people. Those in the control group often get a **placebo** (a pretend treatment).

Phase III is used to find the best **dose** of the substance and involves thousands of people (with and without the disease). Those in the control group get a placebo or an existing treatment for the illness.

Drugs to treat people with COVID-19 and vaccines to stop people getting it are being tested now. We

must work quickly and so the usual timeline for trials is being 'telescoped' and speeded up.



## Find out

1. A placebo is often used in Phase II of a clinical trial. Find out what these placebos contain.
  - a. placebo tablets (when testing medicines) \_\_\_\_\_
  - b. placebo injections (when testing vaccines) \_\_\_\_\_
2. Remdesivir is a drug that is being tested to help people with COVID-19. Find out:
  - a. how it may help COVID-19 patients \_\_\_\_\_
  - b. two of its side effects \_\_\_\_\_
  - c. why trials continue even though it has side effects. \_\_\_\_\_

## Test yourself

3. In finding out how water temperature affects the mass of medicine that dissolves, state:
  - a. the independent variable \_\_\_\_\_
  - b. the dependent variable \_\_\_\_\_
  - c. two control variables. \_\_\_\_\_
4. Complete this table about variables by adding ticks (✓).

Statement	Independent variable	Dependent variable	Control variable
Is <i>not</i> changed by the experimenter			
Must be measured			
Should not change			

5. State the difference between clinical and preclinical trials. \_\_\_\_\_
6. Complete the table to describe the different states in clinical testing.

Phase	Number of people used	Control group used (✓ or X)	Purpose
I			
II			
III			

7. a. Explain why trials of new medicines and vaccines for COVID-19 are being telescoped.  
\_\_\_\_\_

b. Suggest one drawback of this. \_\_\_\_\_

## Check-up

- I. Check your answers.
- II. Cinnamon powder can be used as a model to represent microorganisms. Plan an investigation to find out how the number of seconds of hand washing (with soap and warm water) affects how much of a vegetable oil and cinnamon mixture is removed. Results can be recorded as photos. Identify the independent, dependent and control variables.