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

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

substance on test

A   B   C   control

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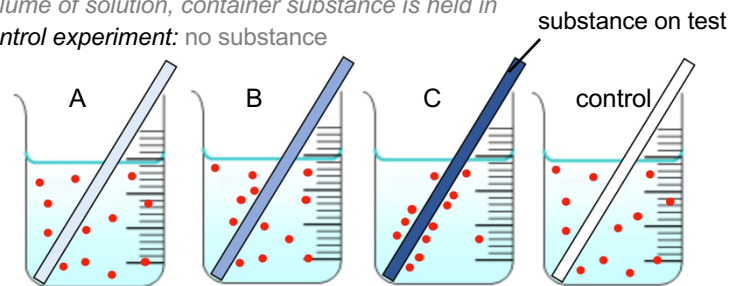
Sometimes we cannot control all the other variables and so we also use a **control experiment** (or **control**). To do this, we change the independent variable in one experiment but in an identical experiment we do not use the independent variable. The control gives us results to compare.

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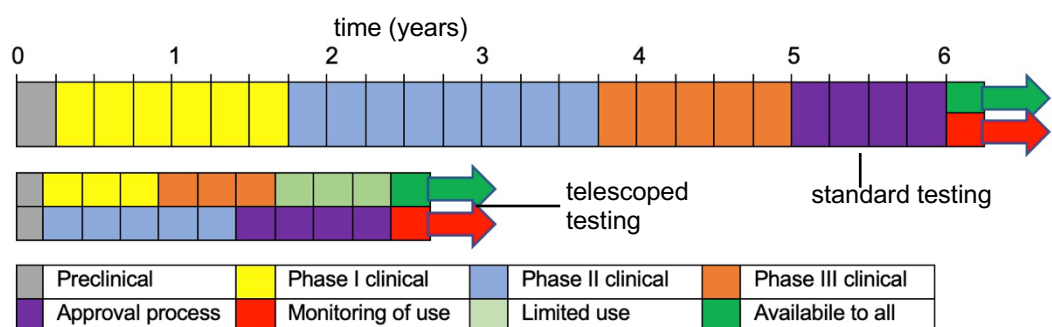
When scientists identify an illness they want to treat, they often use computer modelling to design or look for substances they think will work. They then do **preclinical** tests on cells. For example, a drug to treat COVID-19 will be added to a test tube containing human cells infected with the virus.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

time (years)

0   1   2   3   4   5   6

telescoped testing

standard testing

	Preclinical		Phase I clinical		Phase II clinical		Phase III clinical
	Approval process		Monitoring of use		Limited use		Availabile to all

Find out

1. A placebo is often used in Phase II of a clinical trail. 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 *not* 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 ✗)	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.

Answers

I. 1. a. sugar or starch   b. saline solution/salty water
    2. a. stops the virus from making copies of itself
       b. nausea, vomiting (students may have found others)
       c. The benefits outweigh the mild side effects.
    3. a. water temperature   b. mass of medicine (that dissolves)
       c. Two of: water volume, amount of stirring, size/shape of beaker, type of medicine
    4.

Statement	Independent variable	Dependent variable	Control variable
Is *not* changed by the experimenter		✓	✓
Must be measured		✓	
Should not change			✓

   5. Clinical stages use people (preclinical stages do not).

   6.

Phase	Number of people used	Control group used (✓ or ✗)	Purpose
I	10 - 30	✗	Check for safety/side effects
II	hundreds	✓	Check to see it works/further safety check
III	thousands	✓	Work out the best dose/make sure it works better than current treatments

   7. To find a treatment/vaccine as fast as possible.
   b. Sensible idea: e.g. more expensive, needs more people, important issues more likely to be missed

II. Suitable control variables include the amount/type of soap, the temperature of the water, how the hands are washed, the amount of cinnamon/oil used. The independent variable is the length of time of hand washing and the dependent variable is the amount of cinnamon/oil mixture removed or remaining. It is quite possible to do this experiment at home but it can get messy!