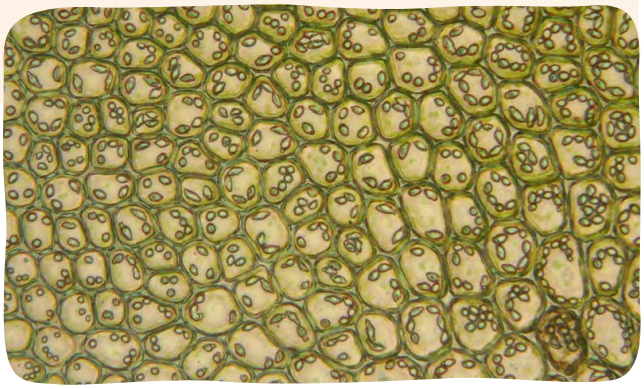
An introduction to cells

ALL living things – plant or animal – are made up of cells.



Cells are thought of as the 'basic building blocks of life' and living things usually contain thousands, millions or trillions of cells.

There are of course some very simple living things that are unicellular – that comprise just a single cell (eg. bacteria and fungi) and these are not classified as plants or animals. The majority of larger living things, are multicellular.

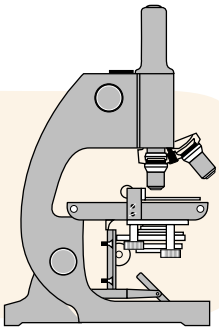
Plants and Animal cells do differ in how the cell is organised and some of the structures within it – some structures such as the nucleus, cell membrane and vacuole are found in both, while chloroplasts and the cell wall are only found in plant cells.

Vacuoles are large and contain cell sap in plant cells helping to maintain the water balance in the cell and they may take up 80% of the cell volume, adding rigidity to the structure. In animal cells, vacuoles are very small, and are used to eliminate waste products (animal cells also lack a large central vacuole often found in plant cells).

Cells are nearly always pictured in 2 dimensions (length and width) but it is important to remember they do have depth to them as well, even if very small (fractions of a millimetre), making them 3-dimensional (like bricks!). Explore some of the ideas reproduced here to **Build your own cell (ukri.org)** or search online for "3D cell models using a balloon or a shoebox".

Studying Cell Structure allows us to understand how plants and animals grow and reproduce as well as understanding what goes wrong when people develop diseases such cancer.

Magnification: a sense of Scale



In order to view the structures within a cell, or even a cell itself, a light microscope is used – to magnify the small structures making them easier to see. Magnification is the process of enlarging the apparent size, not physical size, of something. This enlargement is quantified by a calculated number also called "magnification". (when this number is less than one, it refers to a reduction in size, sometimes called minification).

Magnification = size of image / size of real object

So, if the diameter of an image of a red blood cell in a book is 1 cm and the actual diameter of a red blood cell is 0.001 cm then the magnification used must be: 1/0.001 = X1000 [one divided by zero point zero zero one equals times one thousand].

When using a microscope this is calculated by multiplying the magnification of the eyepiece lens (which is normally X10) by the magnification of the objective lens (printed on it, usually x4, x10, x40). It is important to remember that when you are magnifying something you are enlarging it in all dimensions and cells are 3-dimensional.

As objects become smaller, the unit of measurement that we use also becomes more unfamiliar – we often speak in terms of micrometres (uM). For reference, an average human hair is between 50 and 70 microns that is approximately the width of a single animal or plant cell.

The microscopic world has been opened up even further due to the invention of the electron microscope in the 1930's. These use beams of electrons to form images and have much higher magnifications and resolutions than light microscopes. They have enabled scientists to study objects in much more clarity and detail, from cell organelles like the nucleus and membrane, to even smaller structures like individual atoms.

We have provided a collection of SEM images of the Palm Oil plant but you can also explore more SEM imagery using this simulation, MyScope Explore **(myscope-explore.org)**.

To explore more about Scale and investigate just how different in size objects are visit **https://learn.genetics.utah.edu/content/cells/scale/**

Some practical ideas

The light microscopes you may use at school will have quite a low magnification and resolution but will still enable you to view individual cells. You can use them to look for some of these same structures in onion cells or many other cells.

Method 1 - To set-up a microscope and view onion cells

1. Start with a single layer of onion cells, peeled from a fresh onion. Red onions do make it easier. Peel onion and using forceps and scissors cut a 1cm strip of onion tissue, and mount it in a drop of water on a glass slide.

2. Place the slide - containing the onion skin - onto the stage and secure it using the clips.

3. Begin by using the lowest objective lens by turning round the nose-piece, and selecting one of the objective lenses, this is usually X4 or X10 [times ten] magnification.

4. Then turn on the light - this might be by using a built-in electric light or moving a mirror to reflect light onto the specimen.

5. Look down the eyepiece lense you will see the image but you will probably need to use the focusing knobs to move the stage up and down until the image is clear, and not blurry (there are probably 2 focus knobs – course focus and fine focus). Get it as sharp as you can to see as much detail as clearly as possible. You must be careful when moving the stage up not to knock into the objective lense as this might break the lense or damage the slide.

6. Now you can choose a higher magnification objective lense to see the specimen in more detail. You might have to re-adjust the focus. The fine focus has more effect at higher magnifications.

7. Once you can clearly see the specimen, you can draw it, label and work out the total magnification you used.

8. This method will allow you to easily view Onion Cells, which lack chlorophyll and so are easier to view.

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Method 2 - To examine other leaf surfaces using a microscope

1. Brush a thin layer of clear nail varnish gently over the leaf surface of a plant. Allow it to dry thoroughly (we recommend using a fresh bottle of 'quick dry' nail varnish which should be thoroughly dry in 10 mins, a warm environment will speed the drying process).

2. Once set, cover with Sellotape and peel away, giving a layer of epidermal cells that can be examined under the microscope by sticking the Sellotape/nail varnish to a glass slide and viewing as described above.

3. Experiment with a range of different plants (monocots and dicots) and you should see some great variation in cell shape. It is likely some plants will 'peel' more successfully than others.