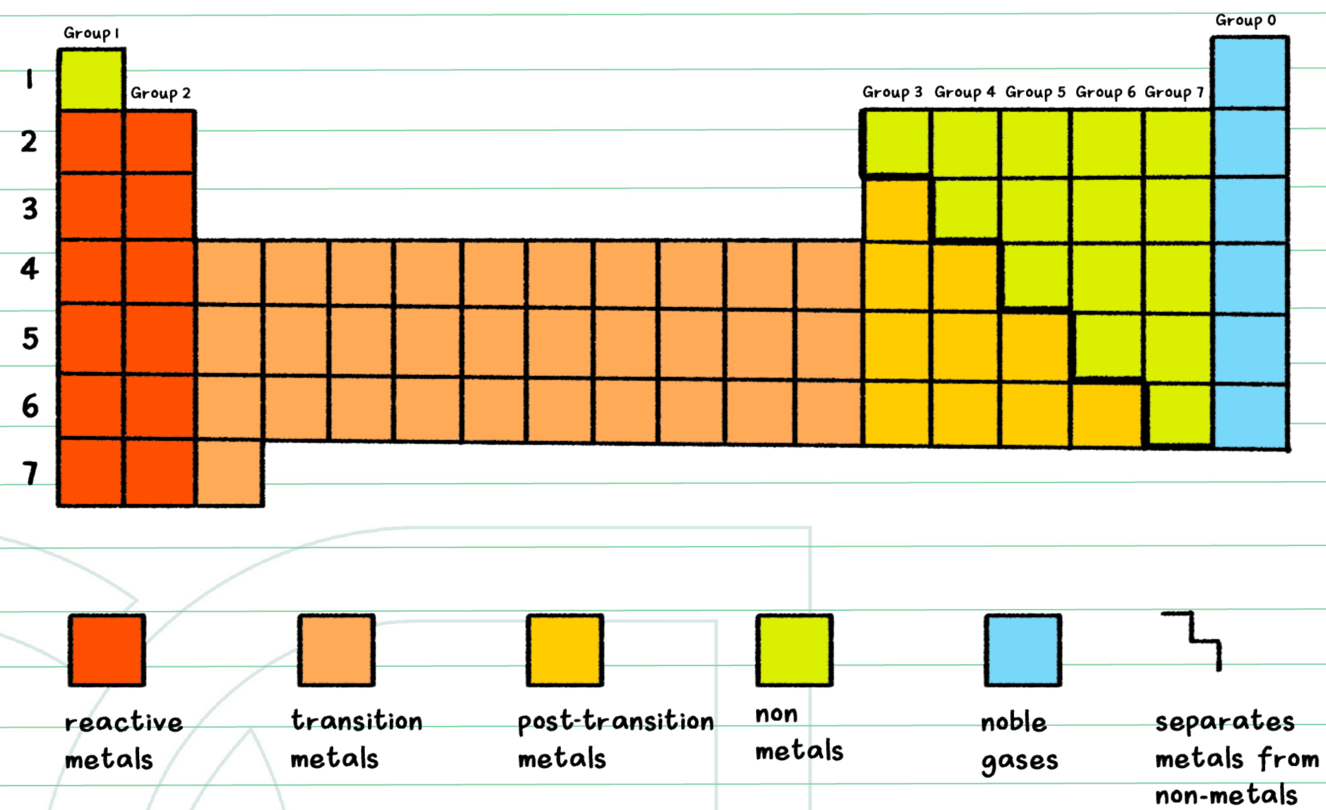
2 The periodic table and bonding

There are over 100 elements which have been identified.

- Elements are arranged on the periodic table in order of increasing atomic number
- Each element has one proton more than the element preceding it

The Periodic Table



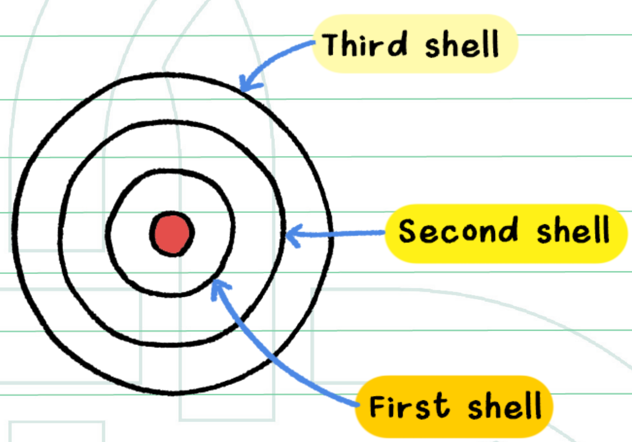
Electronic Shells

Remember in topic 1, we covered the structure of atoms. Electron is one of the components of an atom and it orbits the structure called nucleus at the centre. The table is arranged in columns called groups and in rows called periods

- Electrons orbit the nucleus in specific energy levels called electron shells or energy levels.
- The shells closest to the nucleus have lower energy, while those farther away have higher energy.
- Each shell can hold a specific number of electrons.

There are several rules which electrons have to follow in order to fill up the shells. Here are the three rules:

1. Electrons always occupy shells.
2. Shell with the lowest energy levels are prioritised and filled first. (shells with the lowest energy are the ones that are closest to the nucleus.)
3. Each electron shell can accommodate a fixed number of electrons.



Each electron shell can accomodate a fixed number of electrons

First shell:	2 Electrons
Second shell:	8 Electrons
Third shell:	8 Electrons

Electronic configuration refers to the arrangement of electrons in the energy levels or electron shells of an atom.

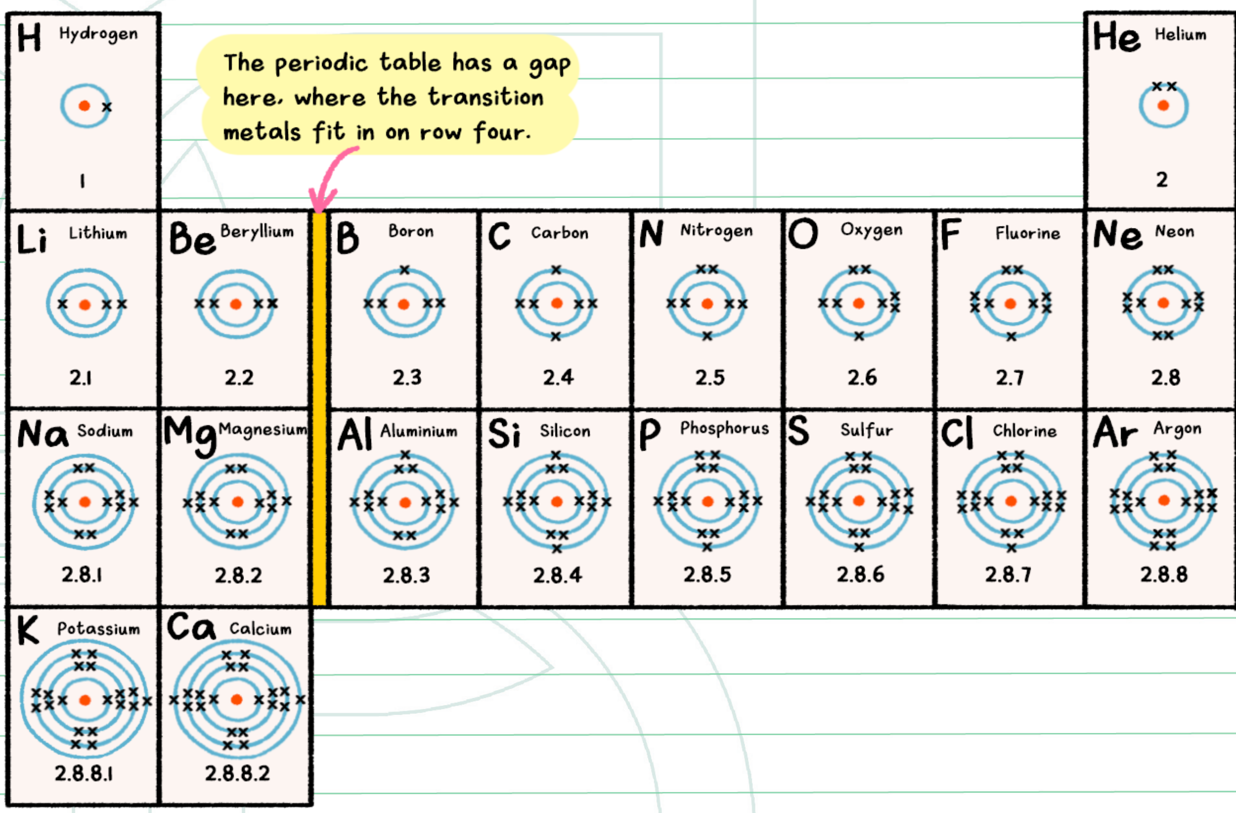
To determine the electronic configuration of an atom, the first step is to identify the number of electrons the atom has.

- The atomic number represents the number of protons in the nucleus of the atom, which is also equal to the number of electrons in a neutral atom.
- The first shell can hold a maximum of 2 electrons, the second shell can hold a maximum of 8 electrons, the third shell can hold a maximum of 8 electrons, and so on. And according to the electron shell rule above, electrons should fill up shells starting with lowest energy level and fill up one by one.

For example, let's consider magnesium.
Magnesium has an atomic number of 12 which also means that it has 12 protons. And in a neutral atom, an equal number of protons and electrons should be present, so there are 12 electrons.

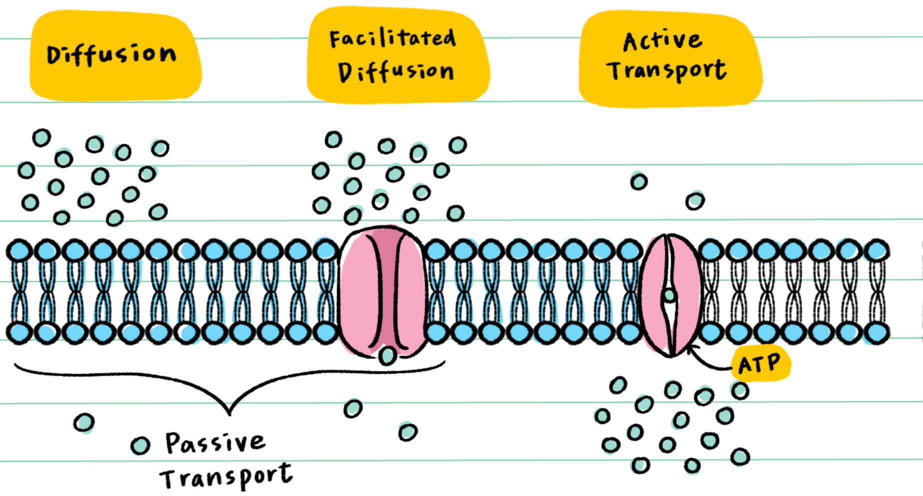
The electronic configuration of magnesium is 2, 8, 2. This means that the first shell is filled with 2 electrons, the second shell is filled with 8 electrons, and the third shell is filled with 2 electrons.

The electronic configuration of elements with proton number 1 to 20 are shown below.



Active Transport

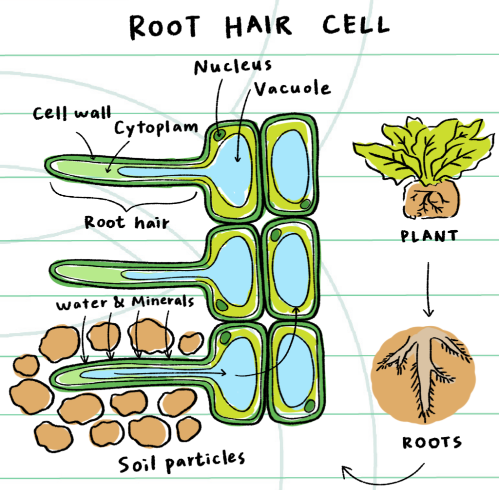
Definition:
The movement of particles against a concentration gradient (i.e. from an area of lower concentration to an area of higher concentration) using energy released during respiration.



Active Transport Works Against a Concentration Gradient

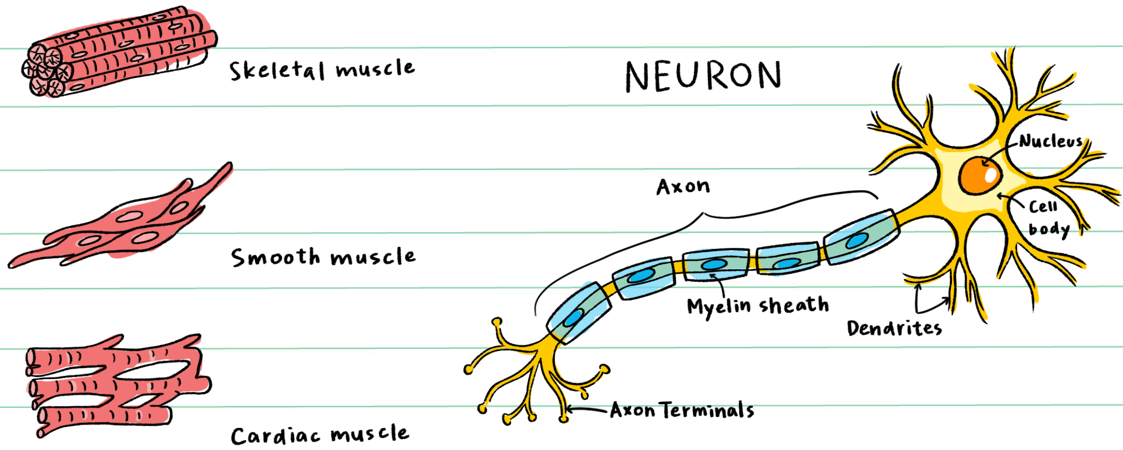
- Similarly to both diffusion and osmosis, active transport moves substances in and out of cells.
- However, the direction of particle movement is opposite to both diffusion and osmosis, and molecules are moved from areas where their concentrations are lower to areas where their concentrations are higher.
    - E.g. - Moving nutrients from the gut to the bloodstream which has a higher nutrient concentration than the gut.
        - An essential function of the digestive system to ensure nutrients are continually entering the bloodstream -> prevents starving.
- Requires ENERGY from respiration to work.

In plant root, the root hair cells mainly uses active transport to absorb minerals from the soil, creating a water potential difference, therefore water will go into the plant by osmosis.



Specialized cells and Stem cells

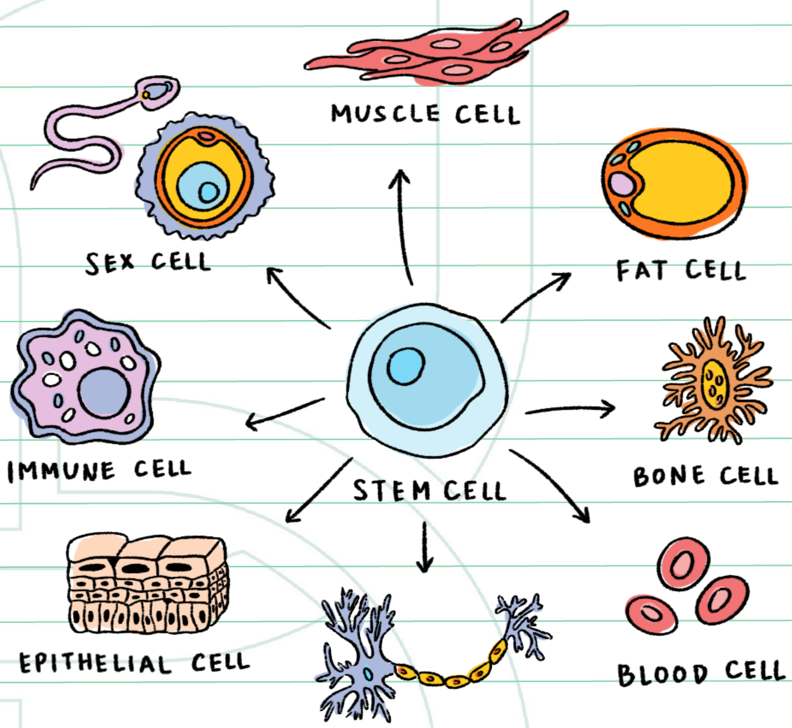
Specialized cells are cells designed to carry out a particular role in the body, such as red blood cells which are designed to carry oxygen. Nerve cells help contraction of muscles or the relaxation of muscles according to what specific job you need them to do. respiration.



- However, one kind of cell can turn into all types of cells, and that is stem cells.

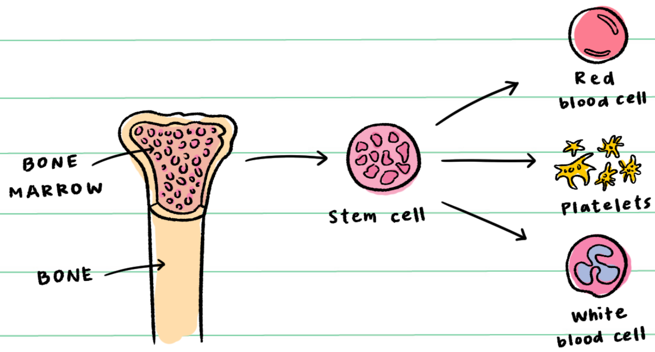
Stem cells

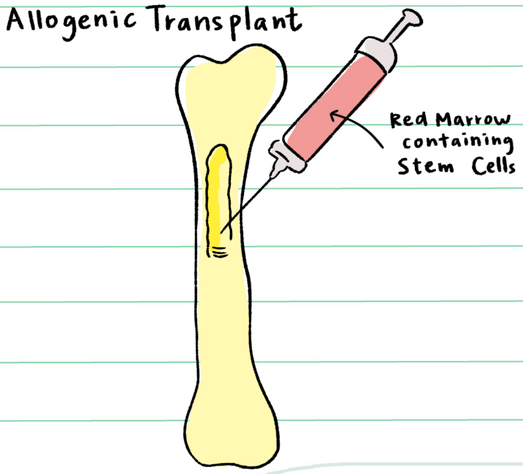
- To carry out a particular role, a cell must first undergo a process called cell differentiation, which change the cell to become specialized for its job.
- Stem cells are undifferentiated cells, which can divide to produce more stem cells, also they can differentiate into different types of cells, depend on the instruction they are given.



Where can stem cells be found?

- Stem cells are found in early human embryos, these embryonic stem cells can turn into all kinds of cell, which make it very valuable in medical research.
- Adults also have stem cells, but they can only be found in bon marrow, and unlike embryonic stem cells, these stem cells can only turn into a few types of cells.





Pros and cons of stem cells

Stem cell can be used to cure a lot of diseases, healthy adult stem cells from bone marrow can be transferred to replace faulty blood cells in a leukemia patient.
Embryonic stem cells can be used to replace all kinds of faulty cell due to its ability to turn into all type of cells, such as treating type I diabetes by replacing faulty pancreas cell, replace damaged nerve cells for paralyzed patient.

Some people think that stem cell research is harming potential life as it involves using human embryos.