Year 10 Combined Science - Cycle 1

Key vocabulary

- **Anion:** negatively charged ion, one that has gained electron/s.
- **Asexual:** producing new organisms with one parent only. These organisms are genetically identical to their parent
- **Cation:** positively charged ion, one that has lost electron/s.
- **Diploid:** a cell or nucleus that has 2 sets of chromosomes
- **Malleable:** able to be hammered or rolled into shape.
- **Meiosis:** a form of cell division where one parent produces 4 haploid cells
- **Neurone:** Cells of the nervous system.

Week 1 - Mitosis

- **Mitosis** is a form of cell division the produces two **genetically identical,** diploid daughter cells.
- The cells are **diploid** and the process is **asexual**.
- Produces body cells for growth and repair Interphase: **DNA** is replicated, happens first.
- Phases of Mitosis:
  - **prophase:** nucleus starts to break down, spindle fibres appear.
  - **metaphase:** chromosomes line up at the centre of cell.
  - **anaphase:** spindle fibres contract and chromosomes separate.
  - **telophase:** a membrane forms around each set of chromosomes to form nuclei.
- Finally, **cytokinesis** occurs - cell surface membrane forms (cell wall forms in plant cells).

Week 2 - Stem cells and the nervous system

- **Stem cells** are cells that divide repeatedly and can then differentiate. They can be:
  - **embryonic:** early embryo cells that can produce any cell type
  - **adult:** can only produce one type of cell, allow tissues to grow and replace damaged cells
- **Reflex arc:** a neurone pathway consisting of a **sensory neurone** passing **impulses** to a **motor neurone** often via a **relay neurone**.
- **Relay neurone:** a short type of neurone found in the spinal cord and brain.
- **Sensory neurone:** a neurone that sends impulses from receptor cells to the central nervous system.
- **Motor neurone:** a neurone that sends impulses to **effectors** (muscles or glands).

Week 3 - Meiosis and DNA

- **Chromosomes** are found in the **nucleus** of all cells.
- Human somatic cells contain **23 pairs** (46 individual) chromosomes.
- They are made out of tightly coiled **DNA** and are divided into sections called genes.
- **Genes** code for the **production of proteins** in the body. An entire set of genes is called a **genome**.
- DNA is made up of 4 individual **bases** - **A, T, C** and **G**. The order of these bases determines the protein that is produced.
- **Meiosis:** a form of cell division in which produces gametes (sex cells - sperm and egg).
- **One parent** cell produces Four **non-identical haploid** daughter cells. These cells contain **23 individual** chromosomes.
- Chromosomes in daughter cells contain different versions of same gene, resulting in **genetic variation** of offspring.

Week 4 - Ionic bonding

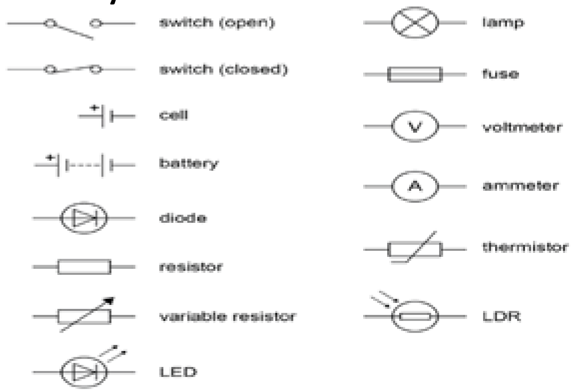
- The **transfer** of electrons to gain a full outer shell forming **oppositely charged ions** that attract due to **electrostatic forces of attraction**
- Occurs between a **metal** and a **nonmetal**
- Forms substances with have **high melting** and **boiling points.**
- When ionic substances are molten or dissolved in solution they conduct electricity as the free electrons can carry a current.
- For a substance to conduct electricity:
  - It must contain **charged particles**;
  - These particles must be free to move.
- Ionic substances will not conduct electricity in their solid form because their ions are not free to carry the current.
- Transfer or sharing of electrons can be shown with a **dot and cross diagram**.
- Strong ionic bonds join many atoms together to form regular, repeating **lattice structures**.

Week 5 - Covalent bonding

- **Covalent bonding** takes place to form atoms with a full outer shell.
- It occurs between a **nonmetal** and a **nonmetal** when a pair of electrons is **shared** between two atoms.
- The structure and bonding of substances results in different properties such as melting point and boiling point.
- Covalent substances typically have:
  - **low melting points;**
  - **low boiling points;**
  - **poor conductivity of electricity.**
- Examples of simple covalent structures include: hydrogen, water, methane, oxygen and carbon dioxide.
- **Monomers** are small, simple molecules that can be joined together in a chain to form **polymers**.
- **Carbon atoms** can form up to 4 **covalent bonds**, forming long polymer chains.

Key vocabulary

- **Current, I:** the rate of flow of electrical charge, measured in Amperes (A).
- **Potential difference (pd), V:** amount of energy transferred per unit of charge, measured in Volts (V).
- **Resistance, R:** The opposition to the flow of electric charge, measured in Ohms (Ω).
- **Circuit symbols:**



Week 6 - Metallic bonding and Allotropes

- Atoms in metal pack closely together to form a **giant lattice structure**.
- **Outer electrons** are lost from metal atoms, forming a giant lattice of **positive ions** surrounded by **delocalised electrons**.
- **Strong electrostatic attraction** between the ions and electrons, resulting in metals having high melting and boiling points.
- Carbon atoms can form 4 covalent bonds and join in different structural ways. These are known as **Allotropes** of carbon. Examples are:
- **Fullerenes:** C bonded to 3 other C atoms. Often form nanotubes or "bucky balls". Weak intermolecular forces mean low melting points.
- **Graphene:** Thin layer of C atoms. Very light but very strong due to intramolecular forces.
- **Graphite and diamond:** giant mol. structure, very strong intramolecular forces, high melting point.

Week 7 - Circuit components

- Rubbing two **insulating** materials together will build up of a **static electric charge** as negatively charged electrons are transferred.
- **Components** in an electric circuit can be represented using **circuit symbols**.
- Electrons carry the electric charge in an **electric current**. For a current to flow, the circuit must be complete.
- Current is always **conserved** in a circuit – the current leaving the positive terminal and arriving at the negative terminal is the same.
- **Series circuits:** Current is the same through all components. Pd across the individual components in the circuit adds up to the total pd across the power supply.
- **Parallel circuits:** Current through the main circuit is divided across the separate branches. Pd across each branch isequal to the pd across the supply

Week 8 - Current electricity

- **Potential difference (pd)** is the difference in energy carried by electrons before and after they flow through a component.
- **Resistance** occurs when charges collide with the particles which make up the wire. Electrical resistance causes wires to become hot.
- **Current/Potential difference (I/V) graphs** show the characteristic relationship between current and pd values for different components:
  - **Fixed resistor**: ***I*** is directly proportional to ***V*** - straight line **through** the origin.
  - **Filament lamp:** resistance increases as the bulb gets **hotter**.
  - **Diode:** Very low **resistance** if current flows in one direction, very high resistance if current flows in opposite direction.

Week 9 - Investigating resistance

- Connect up a circuit of a power supply, an ammeter and a fixed resistor with a voltmeter connected in parallel across the resistor.
- Connect a voltmeter across the resistor.
- Switch on the circuit and record the readings of **current** and **potential difference.**
- Repeat for a range of **pd settings** between 1 V and 6 V.
- Replace the resistor with 2 filament lamps and repeat steps 1-4.
- **Calculate** the **resistance** of the resistor and lamps using:

$$\textbf{Resistance } (\Omega) = \frac{\textbf{potential difference (V)}}{\textbf{current (A)}}$$

- **Ohm's Law:** The current through a resistor is **directly proportional** to the pd across the resistor at a constant temperature.

Week 10 - Power and electrical safety

- Energy, *E*, transferred by a component can be calculated as:

Energy (J) = current (A) x pd (V) x time (s)

- The higher the **power** of an appliance, the more quickly it can transfer energy.
- Power, P, is calculated in the following ways:

$$\textbf{Power (W)} = \frac{\textbf{Energy transferred (J)}}{\textbf{time (s)}}$$

Power (W) = current (A) x pd (V)

Power (W) = current^2 (A) x Resistance (Ω)

- Mains electricity in the UK is **an alternating current** with a frequency of **50 Hz** and a peak voltage of **230 V**.
- Electrical devices use **fuses**, **circuit breakers** and the **earth wire** as safety features.
  - Fuses **melt/blow** when the current through them is too high.