# Year 9 - Combined Science - Cycle 1

## Key vocabulary

- **Abiotic:** non-living factors which affect the distribution of organisms.
- **Biotic:**living factors which affect the distribution of organisms.
- **Community:** populations of different species.
- **Ecosystem:** all the organisms and the environment in which they live.
- **Habitat:** all the organisms which affect a species and the local environment.
- **Mixtures: impure substances**, containing 2 or more elements/compounds not chemically joined together.
- **Mutualism:** organisms live together and mutually benefit.
- **Parasitism:** a feeding relationship where one organism (the parasite) benefits from feeding off the host who is usually harmed.
- **Pollutant:** substances harmful to the environment.
- **Population:** all individuals within a species.

## Week 1 - Ecosystems

- Within an **ecosystem** there are different levels of organisation.
- Organism that live and interact in an ecosystem form a **community**.
- Within a community, populations of different species depend on each other for resources - they are **interdependent**.
- Each population of species lives within a particular **habitat** in the ecosystem.
- Different species within a community will have different effects on each other.
- **Competition** occurs when 2 species compete for the same resource. E.g. food, water, mates, light.
- **Predation** occurs when one species eats another and numbers are correlated in the predator-prey cycle
- The distribution of organisms is affected by:
  - **Abiotic factors** – temperature, light, water, pollutants.
  - **Biotic factors** – competition, predation.

## Week 2 - Sampling methods

- **Abundance** is a measure of how common something is in an area, such as population size.
- You can estimate population size by taking samples using **quadrats** - placed randomly along a line and each individual counted within the quadrat.
- **Distribution** of a species if determined using a **belt transect**.

**Population size = number of organisms in all quadrats x (total size of area/ total area of quadrats)**

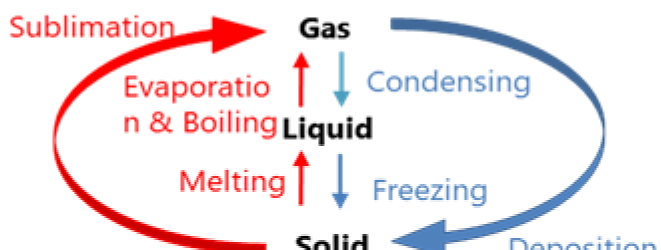
- Some organisms work together to survive in a **mutualistic** relationship, while others depend on a host in a **parasitic** relationship.
- Substances that cause harm in the environment are **pollutants**.
- Human interactions within ecosystems can be positive (+) and negative (-).
- **Fish farming: +** reduces overfishing, preserves wild stocks, **-** pollutants, spread of disease & parasites.
- **Non-indigenous species: +** used to control populations out of control, **-** out-competing native species.

## Week 3 - Material cycles

- **Eutrophication** occurs when water becomes over-enriched with nutrients and causes aquatic animals and plants to die.
- Conservation: **+** preserves the biodiversity of a habitat (difficult if the habitat is under threat).
- Reforestation: **+** increased number & type of trees grown leads to more habitats and species numbers.
- The main **nutrient cycles** are:
  - **Carbon cycle:** involves carbon dioxide in the air, photosynthesis, respiration, digestion and waste materials, death, decay and decomposition, fossil fuels and combustion.
  - **Nitrogen cycle:** involves lightning, decomposition & nitrogen fixing bacteria. Farmers rotate crops to increase nitrates in the soil for plant growth.
  - **Water cycle:** involves evaporation, condensation. Ground water is made potable (safe to drink) via using chemicals or desalination.

## Week 4 - States of matter

- **Solid:** Particles in fixed positions, regular arrangement, vibrate in fixed positions when heated. Lowest energy.
- **Liquid:** Particles are touching but can flow past each other & take the shape of an object. Has more energy than a solid but less than a gas.
- **Gas:** Random arrangement of particles, not touching, moving fast in all directions.
- Changes between the states are known as **physical changes** and are **reversible.**




## Week 5 - Separating mixtures

- **Mixtures** can be separated using **physical techniques.**
- **Filtration:** separating insoluble solids from a mixture.
- **Simple distillation:** separating a mixture from a liquid based on boiling point. Heating causes evaporation and then cooling causes condensation. It is used to make seawater **potable** (drinkable).
- **Fractional distillation:** evaporation followed by condensation, to separate a mixture from liquids with similar different boiling points into different fractions.
- **Paper chromatography:** the separation of mixtures of soluble substances by running a solvent (mobile phase) through the mixture on the paper (stationary phase) which causes the substances to move at different rates over the paper.

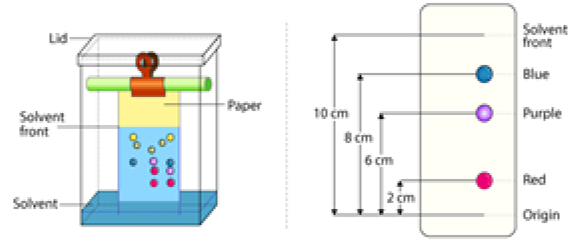
$$R_f = \frac{\text{distance moved by the spot}}{\text{distance moved by the solvent}}$$

## Key vocabulary

- **Acceleration, a:** a change in velocity. Measured in m/s2.
- **Efficiency:** the proportion of energy a system transfers usefully.
- **Energy:** the ability of a system to do work.
- **Gravitational potential energy:** energy stored in an object due to its position in a gravitational field. Measured in Joules (J).
- **Insulation:** method or material used to reduce energy transfer by heating.
- **Kinetic energy:** energy stored in a moving object. Measured in Joules (J).
- **Non-renewable (fuel):** an energy resource which is finite (will run out) as the supply cannot be replaced.
- **Renewable (fuel):** An energy resource that will never run out.
- **Speed:** distance travelled by an object in a certain time. Measured in metres per second (m/s).
- **Velocity:** speed in a given direction. Measured in m/s.

## Week 6 - Investigating inks

- **Paper Chromatography Core Practical -**
  - Insoluble inks stay on the sample line.
  - Greater solubility results in further movement.
  - $R_f$ can be calculated to compare inks.




- **Distillation of Ink Core Practical -**
  - Boiling point of ink is above boiling point of water.
  - Ink mixture raised to 100ºC.
  - Condenser traps the water vapour so all is condensed into liquid water.
  - Distillate - pure water.
  - Residue - ink.

## Week 7 - Energy stores and transfers

- **Energy** can be **stored** in different forms: Gravitational potential, Kinetic, Elastic potential, Chemical, Nuclear, Magnetic.
- Energy can be **transferred** between these stores by: Heating (thermal), Light (radiant), Sound, Electrical Current.
- The **Conservation of Energy** states that energy cannot be created or destroyed, only transferred between stores in a system.
- **Useful energy** is energy in the form needed, in the place it is needed.
- **Wasted energy** is energy in an unwanted form or in an unwanted place. It often **dissipates** (spreads out) to the surrounding by heating.
- The **efficiency** of a system can be calculated as:

$$\text{Efficiency} = \frac{\text{Useful energy transferred}}{\text{Total energy transferred}}$$

- Useful and wasted energy transfers can be shown using **Sankey Diagrams.**

## Week 8 - Energy resources

- Electricity can be generated using **non-renewable** fuels including fossil fuels (coal, oil and natural gas) and also with nuclear fuels (uranium).
- Fossil fuels are burnt to heat water to produce steam, which turns a **turbine** connected to a **generator**.
- Burning fossil fuels produces **greenhouse gases** including carbon dioxide ($CO_2$) that contribute to **climate change**.
- **Nuclear power** stations produce no $CO_2$, but do produce dangerous radioactive waste. Nuclear fuel is very energy dense.
- Most **renewable resources** do not emit carbon dioxide as no fuel is burned. The energy resource is usually free.
- **Renewable resources** include olar; wind, wave, geothermal, tidal, hydroelectric power.
- Renewable resources can be unreliable and have low power output.

## Week 9 - Motion

- **Scalar quantities** only have a magnitude (size) E.g. mass and volume.
- **Vector quantities** have both magnitude and direction E.g. velocity and force
- **Gravitational potential energy** is calculated as:

$$\Delta GPE\ (J) = m\ (kg) \times g\ (N/kg) \times \Delta h\ (m)$$

- **Kinetic energy** can be calculated as:

$$KE\ (J) = 0.5 \times m\ (kg) \times v^2\ (m/s)$$

- Motion of objects can be plotted on **distance/time** (d/t) graphs.
- The **gradient** shows the speed of the object – a steep gradient shows a high speed.
- A flat section shows an object is **stationary.**
- **Speed**, **v,** can be calculated as:

$$\text{velocity (m/s)} = \frac{\text{distance (m)}}{\text{time (s)}}$$

## Week 10 - Velocity time graphs

- **Acceleration** of an object can be plotted on a **velocity/time (v/t)** graph.
- The gradient shows the acceleration/deceleration of an object.
- The area under the line on a v/t graph is the distance travelled.
- **Acceleration**, **a**, can be calculated as:

$$a\ (m/s^2) = \frac{v - u\ (m/s)}{t\ (s)}$$

$$V^2 - u^2\ (m/s) = 2 \times a\ (m/s^2) \times d\ (m)$$

Where $v$ = final velocity and $u$ = initial velocity