



9Aa Environmental Variation

Organisms need **resources** to grow e.g. plants need light, water, warmth and mineral salts.

Physical environmental factors are non-living factors that can affect an organism.

Examples of physical environmental factors are amount of light or temperature.

The features of an organism are its **characteristics**.

Variation is the differences between the characteristics of organisms.

Environmental variation is variation caused by an organism's environment.

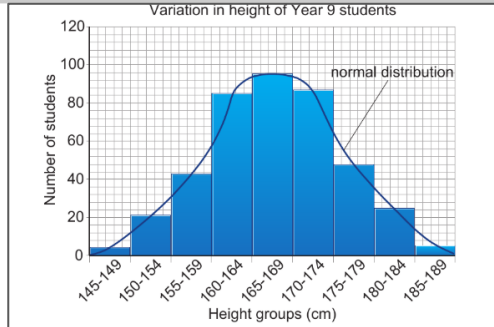
Examples of environmental variation in humans are scars and hairstyles.

Continuous variation can have any value between two points.

Discontinuous variation can only have a value from a limited set of values.

Classification is sorting organisms into groups.

The smallest group that an organism is classified into is its **species**.



9Ab Inherited Variation

Offspring **inherit** their characteristics from their parents.

The variation in these characteristics is **inherited variation** e.g. eye colour and blood group.

Genetic information stored in the **nuclei** of cells determines these characteristics.

In **sexual reproduction**, the **gametes** from the parents **fuse** during **fertilisation** to form a **zygote**.

Inherited variation can also be **continuous** or **discontinuous**.

Characteristics that show continuous variation usually show a **normal distribution** on a bar graph.

9Ac DNA

The scientists who first modelled the structure of DNA were James **Watson** and Francis **Crick**. They used data from other scientists Rosalind **Franklin** and Maurice **Wilkins**.

DNA is found in the nuclei of cells, in structures called **chromosomes**.

Body cells contain **23 pairs** of chromosomes.

The 23rd pair of chromosomes are the **sex chromosomes**. They are **XX** in females and **XY** in males.

Gametes only contain **23 chromosomes**.

Genes are sections of DNA that determine our characteristics.

Most characteristics are controlled by **many genes**.

9Ad Genes and Extinction

The **adaptations** of an organism are due to its **genes**.

Changes in an **ecosystem** can affect the species that live there as they may not be so well adapted to the new conditions.

Changes to an ecosystem can include: changes to the **physical environmental factors**, **competition** from other organisms, **disease** or **human activities**.

Organisms can become **endangered** or **extinct**.

Extinction can change **food webs** and reduce **biodiversity**.

Parts of organisms such as seeds or gametes can be stored at low temperatures in **gene banks** in case they become extinct

9Ae Natural Selection

A **change** in the environment can select certain **genetic variations** in characteristics.

Individuals with those characteristics can **survive** to **reproduce**, and the genetic variations are **inherited** by their offspring.

Natural selection occurs over **many generations**.

Evolution is a gradual change in characteristics over time as a result of **natural selection**.

Charles **Darwin** and Alfred Russel **Wallace** both developed a hypothesis of evolution by natural selection.



9Ba Reactions in Plants

Photosynthesis:

carbon dioxide + water → glucose + oxygen
 reactants products

Chlorophyll inside **chloroplasts** in plant cells trap **light energy** for photosynthesis.

Limiting factors are variables that slow down the rate of a reaction.

Limiting factors of photosynthesis are **light**, **carbon dioxide** and **temperature**.

Aerobic respiration:

glucose + oxygen → carbon dioxide + water
 reactants products

Phloem vessels carry the **glucose** made by photosynthesis as a **sugar solution** to all parts of the plant.

Waterlogged soil lacks oxygen and can cause roots to die.

9Bb Plant Adaptations

Roots are branched and spread out.

Root hair cells have a large surface area.

Xylem vessels are hollow tubes for carrying **water** and dissolved **mineral ions**.

Water is needed for photosynthesis, keeping leaves cool and stopping the plant from wilting.

Stomata are opened and closed by **guard cells**.

Stomata allow **gaseous exchange**. They open when it is light so that carbon dioxide can enter the leaf by **diffusion**.

Leaves are thin so there is a shorter distance for diffusion.

Leaves are broad and have a large surface area.

The **waxy cuticle** reduces water loss from the leaf.

Palisade cells contain many chloroplasts.

9Bc Plant Products

Lipids (fats and oils) are found in the leaf cuticle, cell membranes and as an energy store in seeds and some fruits.

Glucose is stored as **starch** or made into other **carbohydrates** such as **cellulose**.

Iodine solution turns blue-black in the presence of starch.

Proteins are made of **amino acids**. Plants need nitrates to make amino acids.

Enzymes are proteins.

Seeds store proteins.

For a seed to **germinate**, **water** and **oxygen** must enter.

9Bd Growing Crops

Fertilisers contain mineral salts e.g. potassium, phosphate, nitrates.

Pesticides kill pests. **Insecticides** kill insect pests. **Fungicides** kill fungi that cause plant diseases. **Herbicides** kill weeds.

Selective herbicides kill weeds but not crop plants.

A **variety** is a group of plants that have been bred to have certain characteristics.

Cross-breeding is breeding different varieties to produce offspring with characteristics of both breeds.

Selective breeding is when only plants with certain characteristics are used to breed.

9Be Farming Problems

Fertilisers can wash into rivers and lakes causing algae to grow quickly.

Decomposers break down the dead algae and plants, using up oxygen.

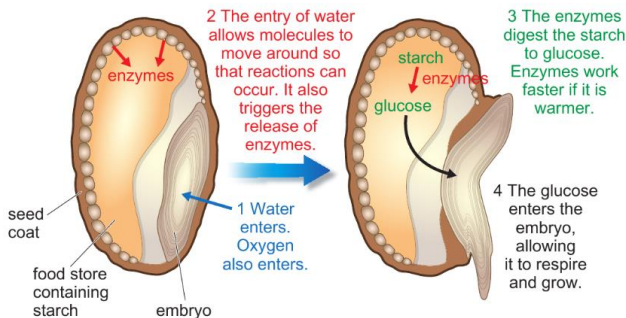
Insecticides can kill useful insects.

Some insecticides are **persistent** and build up in food chains.

Selective weedkillers can kill broad leaved plants in hedges.

Deforestation and **burning fossil fuels** increases the amount of carbon dioxide in the atmosphere, causing increased **global warming**.

Planting a single crop variety reduces **biodiversity**.



**9Ea About Ceramics**

Ceramics have similar **physical properties** which make them useful:

- **Strong and hard** when compressed and **brittle**
- **high melting points** and **heat resistant**
- good **insulators** of heat and electricity
- very **unreactive**

The **raw materials** for **traditional ceramics** are **clay** (for **pottery**) and **sand** (for **glass**).

Clay is heated and **chemical reactions** occur to make new compounds such as **china** and **porcelain**.

Slow cooling produces **large crystals** as the atoms form a **lattice structure** held by strong bonds.

9Eb Polymers

A **polymer** is a **long chain** molecule, made of **repeating units**.

Natural polymers rubber, DNA, proteins, starch and cellulose.

The properties of rubber can be changed by **vulcanisation**. The rubber is heated with sulfur to make the rubber harder and tougher and to stop its properties changing with temperature.

Synthetic polymers can be made using **raw materials** from **crude oil**.

Polymerisation is the joining of many small molecules (**monomers**) in a chain e.g. polythene is made from the polymerization of ethene.

Polymerisation is an **exothermic** reaction. Heat is transferred to the surroundings.

9Ec Composite Materials

Composite materials are combinations of **two or more materials**, with some **properties** of each.

Examples are concrete, paper, plywood.

Concrete is made from cement, sand, aggregate (crushed rocks) and water.

The cement and water can be molded into shape before setting and the **aggregate** makes it strong.

Reinforced concrete has **steel rods** added to make it stronger and stop it cracking under pressure.

Limestone is broken down by heating to produce the **lime** used in cement.

$\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$ This reaction is **thermal decomposition**.

It is an **endothermic reaction**. Heat is taken in from the surroundings.

9Ee Recycling Materials

Recycling means using the same materials again.

Recycling reduces the use of **valuable resources**, **saves fuel**, **reduces energy** use and **reduces landfill** use.

Metals can be easily recycled by melting them down, saving finite metal ores.

Many **polymers** can be recycled but because there are many different types, separating them can be difficult and costly.

Paper can be recycled easily by adding water and heating to make a pulp.

Concrete can be recycled by crushing it to form aggregate for road and building foundations.

9Ed Problems with Materials

Combustion of fossil fuels to release energy produces compound which damage the environment.

Fossil fuels such as coal and oil are **finite resources**.

Incomplete combustion produces **carbon monoxide** and **soot**.

Sulfur dioxide and nitrogen oxides which cause **acid rain**.

Carbon dioxide which increases the **greenhouse effect** leading to **climate change**.

Solutions include:

- Increasing the oxygen available during combustion to prevent incomplete combustion.
- Removing sulfur impurities from fuels.
- Reducing the amount of fossil fuels used.
- Carbon capture to remove carbon dioxide from waste gases and storing it underground.

Biomagnification is how the concentration of toxic chemicals can increase up a food chain.

Materials that take a very long time to break down are **non-biodegradable**.

Combustion of polymers can produce **toxic gases**.

Many new polymers are made from plant products which are **renewable resources** and **biodegradable**.