Cornwallis Academy
Ambitions for All

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Year 9 Science

Introduction to Cells

Learning Objectives

- Identify and describe the structure of plant, animal, and bacterial cells.
- Understand the functions of organelles: nucleus, cytoplasm, cell membrane, mitochondria, chloroplasts, vacuoles.
- Use a microscope to observe cells and calculate magnification.
- Explain cell specialisation and differentiation.
- Describe transport across cell membranes: diffusion, osmosis, active transport.
- Understand cell division (mitosis) and its role in growth and repair.

Key Facts & Examples:

- **Magnification formula:** Magnification = Image size ÷ Actual size
- Diffusion: movement of particles down a concentration gradient.
- Osmosis: water moves from high water potential → low water potential.
- Active transport: requires energy (ATP).
- Mitosis: Prophase → Metaphase → Anaphase → Telophase.
- Examples: Red blood cells (no nucleus), root hair cells (specialised for absorption).

What previous knowledge is required?

- KS3 cell structures.
- Particle theory (for diffusion/osmosis).
- Basic microscopy skills.

How will this term's content help with future learning?

- Forms the foundation for B1 Cells and B2 Organisation (tissues, organs, systems).
- Essential for understanding B4 Bioenergetics (respiration/photosynthesis).
- Provides knowledge for B6 Inheritance (cell division and DNA replication).

Common Misconceptions

All cells have a nucleus

- Reality: Some cells, like red blood cells, lose their nucleus when mature.

Osmosis and diffusion are the same

- Reality: Diffusion is the movement of all particles from high → low concentration; osmosis specifically refers to **water** across a semi-permeable membrane.

Enzymes are "used up" during reactions

- Reality: Enzymes are **biological catalysts** and are **reused**.

Bacteria are always harmful

- Reality: Many bacteria are **beneficial** (gut bacteria, nitrogen-fixing bacteria).

Cells are empty spaces with a "dot" nucleus

- Reality: Cells are highly structured with organelles and cytoplasm; the nucleus is just one part.

Mitosis happens only in humans

- Reality: **All eukaryotic cells** divide by mitosis for growth and repair.

Osmosis always requires solutes to move

- Reality: Only water moves in osmosis; solutes may be left behind.

Cell membranes are solid barriers

- Reality: Membranes are **semi-permeable and fluid**, allowing selective transport.

Diffusion is active transport

- Reality: Diffusion is **passive**; no energy is required.

All cells are the same size

- Reality: Cell sizes vary greatly; e.g., egg cells are much larger than bacteria

National Curriculum / Specification

KS3 3.8.1 Movement and 3.8.2 Cells

- AQA 8464 B1 Cell Biology.
- KS4 Biology: Cell structure, microscopy, transport, cell division.

Introduction to Organisation

Learning Objectives

- Describe tissues, organs, and organ systems.
- Explain digestive system and enzyme roles.
- Describe circulatory system and blood functions.
- Explain plant transport (xylem, phloem).

Key Facts & Examples:

- Enzymes: amylase (starch → sugar), protease (protein → amino acids), lipase (fat → glycerol + fatty acids).
- Heart: atria, ventricles, valves.
- Blood components: red cells, white cells, platelets, plasma.
- Plant transport: xylem (water), phloem (sugars).

What previous knowledge is required?

Introduction to cells

Basic nutrition and organs

How will this term's content help with future learning?

Links to the biology content of AQA Links to **B4 Bioenergetics** (energy transport), **B5 Homeostasis** (blood glucose regulation).

Common Misconceptions

Xylem transports food

- Reality: Xylem **transports water and minerals**; phloem transports sugars.

All blood in veins is deoxygenated and in arteries is oxygenated

- Reality: Pulmonary artery carries **deoxygenated blood** to lungs; pulmonary vein carries **oxygenated blood** to the heart.

The heart is a pump that only pushes blood one way

- Reality: Valves ensure **unidirectional flow**, but the heart has **two separate pumps**: right (lungs) and left (body).

Enzymes are "digestion machines" that destroy food

- Reality: Enzymes **break large molecules into smaller molecules**; they do not "eat" food.

All enzymes work in the stomach

- Reality: Different enzymes work at **different pH and temperatures** (e.g., amylase in mouth/pancreas, pepsin in stomach).

Bile digests fat

- Reality: Bile **emulsifies fat** (increases surface area) but **does not chemically digest** it.

Plants get their food directly from soil

- Reality: Plants make **glucose via photosynthesis**; soil provides **minerals** only.

Arteries always carry blood at high pressure

- Reality: Pressure **drops in capillaries and veins**; veins have valves to prevent backflow.

All blood is red

- Reality: Blood is **red due to haemoglobin**, but plasma is pale yellow; oxygenated vs deoxygenated blood differs in shade.

Organ systems work independently

- Reality: Systems are **interdependent** (e.g., circulatory + digestive + respiratory).

National Curriculum / Specification

3.8.3 Breathing, 3.8.4 Digestion

- AQA 8464 B2
- KS4: human/plant systems

Introduction to Atomic Structure and the Periodic table

Learning Objectives

- Describe atomic structure (protons, neutrons, electrons).
- Explain isotopes and relative atomic mass.
- Understand electronic structure and the periodic table.
- Explain how elements are arranged by properties.

Key Facts & Examples:

- Proton = +1, neutron = 0, electron = -1.
- Atomic number = number of protons.
- Mass number = protons + neutrons.
- Isotopes = same protons, different neutrons.
- Electronic structure example: oxygen = 2,6.
- Group 1 = very reactive metals; Group 0 = noble gases (inert).

What previous knowledge is required?

KS3 particles and elements.

How will this term's content help with future learning?

- Foundation for bonding (C2), reactions (C4), and quantitative chemistry (C3).
- Essential for understanding chemical properties

Common Misconceptions

- Atoms are indivisible → actually made of **protons, neutrons, electrons**.
- Electrons are in the nucleus → actually in **shells/orbitals**.
- Protons and neutrons have the same charge → protons **+1**, neutrons **0**.
- Neutrons determine the element → **protons (atomic number)** do.
- Isotopes are different elements → isotopes are **same element, different neutrons**.
- All atoms of an element are identical → isotopes differ in **neutron number**.
- Mass number = atomic number → mass = **protons + neutrons**.
- Relative atomic mass is always a whole number → usually **decimal (average of isotopes)**.
- Electrons orbit like planets → electrons occupy **energy levels/shells**.
- Nucleus takes up most of the atom → nucleus is tiny; **most of the atom is empty space**.
- Atoms are created/destroyed in reactions → atoms are **rearranged**.
- Elements in the same period have similar properties → elements in the **same group** do.
- Group number = number of shells → group = **outer electrons**; period = **shells**.
- Noble gases are reactive → they are **very unreactive** (full outer shell).
- Group 1 metals less reactive down group → reactivity **increases**.
- Halogens more reactive down group → reactivity **decreases**.
- Periodic table always looked like modern → it **evolved over time**, Mendeleev left gaps.
- Metals and non-metals are randomly arranged → metals **left/centre**, non-metals **right**.

National Curriculum / Specification

- 3.5.3 Periodic Table and Elements
- 3.5.2 Separating Mixtures
- AQA 8464 C1
- KS4 atomic structure & periodic table.

Introduction to Bonding, structure and properties of matter

Learning Objectives

- Explain ionic, covalent, and metallic bonding.
- Relate structure to properties.
- Describe giant structures and molecules.

Key Facts & Examples:

- Ionic: metal + non-metal (NaCl).
- Covalent: non-metal + non-metal (H_2O, CO_2).
- Metallic: sea of delocalised electrons.
- Diamond = very hard, no conduction.
- Graphite = conducts electricity.

What previous knowledge is required?

Introduction to atomic structure.

How will this term's content help with future learning?

Essential for materials science and reactions in C4–C7.

Common Misconceptions

- All solids are the same → solids can be **giant lattice (ionic/covalent/metallic)** or **simple molecular**.
- Ionic compounds are made of molecules → ionic compounds form a **giant lattice of ions**, not discrete molecules.
- Covalent compounds conduct electricity → only **graphite** or ionic compounds in solution/molten conduct.
- Metals are soft → most metals are **strong and malleable**.
- Covalent bonds are weak → **strong bonds** between atoms in molecules or lattices.
- Electrons in metallic bonding are fixed → electrons are **delocalised**, allowing conductivity.
- All molecular compounds have low melting points → depends on **bonding and intermolecular forces**.
- Solids always conduct electricity → only **metallic or ionic (when molten/aqueous)** do.
- Liquids do not have particles in motion → particles **move past each other**.
- Gases do not exert pressure → gas particles **collide with container walls**, causing pressure.
- Covalent bonding only occurs in small molecules → **giant covalent structures** exist (diamond, graphite, silicon dioxide).
- All metals are shiny → depends on **surface and type of metal**.
- Ionic compounds dissolve in any solvent → only **polar solvents like water** dissolve them well.
- Covalent molecules are always soft → depends on **intermolecular forces** (e.g., diamond is extremely hard).
- Boiling/melting is due to breaking atoms → actually **bonds or intermolecular forces**.

National Curriculum / Specification

- KS3 3.5.1 Particle Model
- AQA 8464 C2
- KS4 bonding and structure

Introduction to Energy

Learning Objectives

- Describe energy stores (kinetic, thermal, chemical, gravitational, elastic, nuclear).
- Explain energy transfers (mechanical, electrical, heating, radiation).
- Calculate work done, power, and efficiency.
- Apply conservation of energy principles.

Key Facts & Examples:

- Work done: $W = F \times d$ (force × distance).
- Kinetic energy: $KE = \frac{1}{2}mv^2$.
- Gravitational potential energy: $GPE = mgh$.
- Efficiency = $\frac{useful\ energy}{total\ energy} \times 100\%$.
- Energy cannot be created or destroyed, only transferred.

What previous knowledge is required?

KS3 energy concepts, basic forces.

How will this term's content help with future learning?

Foundation for electricity (P2), waves (P6), motion (P5).

Common Misconceptions

- Energy can be created or destroyed → **energy is conserved**, only transferred or transformed.
- Objects "contain" energy → objects **store energy in forms** (kinetic, chemical, gravitational, etc.), not as a substance.
- Kinetic energy always equals potential energy → KE and PE **depend on motion and position** separately.
- Energy transfer always produces movement → energy can transfer as **heat, light, sound, or electrical energy**, not just motion.
- Machines create energy → machines **transfer or transform energy**, they do not create it.
- Heat always flows from cold to hot → heat **flows from hot to cold spontaneously**.
- Fuel is energy → fuel **stores chemical energy** that is released in reactions.
- Efficiency can be over 100% → efficiency **cannot exceed 100%**; energy is lost as waste heat.
- Energy is only needed when something moves → energy can be **stored (e.g., chemical, elastic, gravitational)** even if not moving.
- Power and energy are the same → power = **rate of energy transfer**, not total energy.

National Curriculum / Specification

- 3.3.1 Energy Costs and 3.3.2 Energy Transfers
- 3.3.3 Work, 3.3.4 Heating and Cooling
- AQA 8464 P1
- KS4: energy, work, power

Introduction to Electricity

Learning Objectives

- Describe current, potential difference, and resistance.
- Use Ohm's Law and calculate electrical quantities.
- Understand series and parallel circuits.
- Explain domestic electricity (mains supply, fuses, safety).
- Understand energy transfer in electrical appliances.

What previous knowledge is required?

- P1 Energy: work and power concepts.
- Basic atoms and electrons (C1 from Chemistry helpful).
- Simple circuit diagrams and symbols.

How will this topic content help with future learning?

- Foundation for **P5 Waves and EM spectrum** (electromagnetic devices).
- Supports **P6 Forces and motion** (electrical energy powering devices).

• Essential for understanding **renewable energy and electricity generation**.
Common Misconceptions
• Current is "used up" → current is the flow of charge, same everywhere in a series. • Voltage is "energy itself" → it is **energy per unit charge**. • Batteries only supply energy once → they convert stored chemical energy continuously. • Resistance is only present in wires → all components have resistance.
National Curriculum / Specification
• KS4 Physics: "Electricity: current, voltage, resistance, circuits, power, energy transfer." • AQA 8463 P2: Electricity. • Practical: measuring current, voltage, resistance; series vs parallel investigations.