

Topic Biology 1: Cell level systems

B1.1 Cell structures

B1.1	To know how to:	I know this I know some of this I don't know this.
a	Describe how light microscopes and staining can be used to view cells	
b	Explain how the main sub-cellular structures of eukaryotic cells (plants and animals) and prokaryotic cells are Related to their functions	
c	Explain how electron microscopy has increased our understanding of sub-cellular structures	

B1.2 What happens in cells (and what do cells need)?

B1.2	To know how to:	I know this I know some of this I don't know this.
a	Describe DNA as a polymer	
b	Describe DNA as being made up of two strands forming a double helix	
c	Describe experiments that can be Used to investigate enzymatic reactions	
d	Explain the mechanism of enzyme action	

B1.3 Respiration

B1.3	To know how to:	I know this I know some of this I don't know this.
a	Describe cellular respiration as a universal chemical process, continuously occurring in all living cells that supply ATP	
b	Describe cellular respiration as an exothermic reaction	
c	Compare the processes of aerobic and anaerobic respiration	
d	Explain the importance of sugars in the synthesis and breakdown of carbohydrates	
e	Explain the importance of amino acids in the synthesis and breakdown of proteins	
f	Explain the importance of fatty acids and glycerol in the synthesis and breakdown of lipids	

B1.4 Photosynthesis

B1.4	To know how to:	I know this I know some of this I don't know this.
a	Describe photosynthetic organisms as the main producers of food and therefore biomass for life on Earth	
b	Describe the process of photosynthesis	
c	Describe photosynthesis as an endothermic reaction	

d	Describe experiments to investigate photosynthesis	
e	Explain the effect of temperature, light intensity and carbon dioxide concentration on the rate of photosynthesis	
f	Explain the interaction of these factors in limiting the rate of photosynthesis	

Topic B2: Scaling up

B2.1 Supplying the cell

B2.1	To know how to:	I know this I know some of this I don't know this.
a	Explain how substances are transported into and out of cells through diffusion, osmosis and active transport	
b	Describe the process of mitosis in growth, including the cell cycle	
c	Explain the importance of cell differentiation	
d	Recall that stem cells are present in embryonic and adult animals and meristems in plants	
e	Describe the functions of stem cells	
f	Describe the difference between embryonic and adult stem cells in animals	

B2.2 The challenges of size

B2.2	To know how to:	I know this I know some of this I don't know this.
a	Explain the need for exchange surfaces and a transport system in multicellular organisms in terms of surface area:volume ratio	
b	Describe some of the substances transported into and out of a range of organisms in terms of the requirements of those organisms	
c	Describe the human circulatory system	
d	Explain how the structure of the heart and the blood vessels are adapted to their functions	
e	Explain how red blood cells and plasma are adapted to their transport functions in the blood	
f	Explain how water and mineral ions are taken up by plants, relating the structure of the root hair cells to their function	
g	Describe the processes of transpiration and translocation	
h	Explain how the structure of the xylem and phloem are adapted to their functions in the plant	
i	Explain the effect of a variety of environmental factors on the rate of water uptake by a plant	
j	Describe how a simple photometer can be Used to investigate factors that affect the rate of water uptake	

Topic B3: Organism level systems

B3.1 Coordination and control – the nervous system

B3.1	To know how to:	I know this I know some of this I don't know this.
a	Describe the structure of the nervous system	
b	Explain how the components of the nervous system can produce a coordinated response	
c	Explain how the structure of a reflex arc is Related to its function	

B3.2 Coordination and control – the endocrine system

B3.2	To know how to:	I know this I know some of this I don't know this.
a	Describe the principles of hormonal coordination and control by the human endocrine system	
b	Explain the roles of thyroxine and adrenaline in the body (higher)	
c	Describe the role of hormones in human reproduction including the control of the menstrual cycle	
d	Explain the interactions of FSH, LH, oestrogen and progesterone in the control of the menstrual cycle (higher)	
e	Explain the Use of hormones in contraception and evaluate hormonal and non-hormonal methods of contraception	
f	Explain the Use of hormones in modern reproductive technologies to treat infertility (higher)	

B3.3 Maintaining internal environments

B3.3	To know how to:	I know this I know some of this I don't know this.
a	Explain the importance of maintaining a constant internal environment in response to internal and external change	
b	Explain how insulin controls blood sugar levels in the body	
c	Explain how glucagon interacts with insulin to control blood sugar levels in the body (higher)	
d	Compare type 1 and type 2 diabetes and Explain how they can be treated	

Topic Chemistry 1: Particles

C1.1 The particle model

C1.1	To know how to:	I know this I know some of this I don't know this.
a	Describe the main features of the particle model in terms of states of matter and change of state	
b	Explain in terms of the particle model the distinction between physical changes and chemical changes	
c	Explain the limitations of the particle model in relation to changes of state when particles are Represented by inelastic spheres (e.g. like bowling balls) (higher)	

C1.2 Atomic Structure

C1.2	To know how to:	I know this I know some of this I don't know this.
a	Describe how and why the atomic model has changed over time	
b	Describe the atom as a positively charged nucleus surrounded by negatively charged electrons, with the nuclear radius much smaller than that of the atom and with most of the mass in the nucleus	
c	Recall the typical size (order of magnitude) of atoms and small molecules	
d	Recall relative charges and approximate relative masses of protons, neutrons and electrons	
e	Calculate numbers of protons, neutrons and electrons in atoms and ions, given atomic number and mass number of isotopes	

Topic C2: Elements, compounds and mixtures

C2.1 Purity and separating mixtures

C2.1	To know how to:	I know this I know some of this I don't know this.
a	Explain what is meant by the purity of a substance, distinguishing between the scientific and everyday Use of the term 'pure'	
b	Use melting point data to distinguish pure from impure substances	
c	Calculate relative formula masses of species separately and in a balanced chemical equation	
d	Deduce the empirical formula of a compound from the relative numbers of atoms present or from a model or diagram and vice versa	
e	Explain that many Useful materials are formulations of mixtures	
f	Describe, Explain and exemplify the processes of filtration,	

	crystallisation, simple distillation, and fractional distillation	
g	Describe the techniques of paper and thin layer chromatography	
h	Recall that chromatography involves a stationary and a mobile phase and that separation depends on the distribution between the phases	
l	interpret chromatograms, including measuring R_f values	
j	suggest suitable purification techniques given information about the substances involved	
k	suggest chromatographic methods for distinguishing pure from impure substances	

C2.2 Bonding

C2.2	To know how to:	I know this I know some of this I don't know this.
a	Describe metals and non-metals and Explain the differences between them on the basis of their characteristic physical and chemical properties	
b	Explain how the atomic structure of metals and non-metals Relates to their position in the Periodic Table	
c	Explain how the position of an element in the Periodic Table is Related to the arrangement of electrons in its atoms and hence to its atomic number	
d	Explain how the reactions of elements are Related to the arrangement of electrons in their atoms and hence to their atomic number	
e	Explain in terms of atomic number how Mendeleev's arrangement was refined into the modern Periodic Table	
f	Describe and Compare the nature and arrangement of chemical bonds in: <ul style="list-style-type: none"> i. ionic compounds ii. simple molecules iii. giant covalent structures iv. polymers v. metals 	
g	Explain chemical bonding in terms of electrostatic forces and the transfer or sharing of electrons	
h	Construct dot and cross diagrams for simple covalent and binary ionic substances	
l	Describe the limitations of particular representations and models	

C2.3 Properties of materials

C2.3	To know how to:	I know this I know some of this I don't know this.
a	Recall that carbon can form four covalent bonds	
b	Explain that the vast array of natural and synthetic organic compounds occur due to the ability of carbon to form families of similar compounds, chains and rings	

c	Explain the properties of diamond, graphite, fullerenes and graphene in terms of their structures and bonding	
d	Use ideas about energy transfers and the relative strength of chemical bonds and intermolecular forces to Explain the different temperatures at which changes of state occur	
e	Use data to predict states of substances under given conditions	
f	Explain how the bulk properties of materials (ionic compounds; simple molecules; giant covalent structures; polymers and metals) are Related to the different types of bonds they contain, their bond strengths in relation to intermolecular forces and the ways in which their bonds are arranged	

Topic C3: Chemical reactions

C3.1 Introducing chemical reactions

C3.1	To know how to:	I know this I know some of this I don't know this.
a	Use chemical symbols to write the formulae of elements and simple covalent and ionic compounds	
b	Use the names and symbols of common elements and compounds and the principle of conservation of mass to write formulae and balanced chemical equations and half equations (higher)	
c	Use the names and symbols of common elements from a supplied Periodic Table to write formulae and balanced chemical equations where appropriate	
d	Use the formula of common ions to Deduce the formula of a compound	
e	Construct balanced ionic equations (higher)	
f	Describe the physical states of products and reactants using state symbols (s, l, g and aq)	
g	Describe tests to identify selected gases	
h	Recall and Use the definitions of the Avogadro constant (in standard form) and of the mole (higher)	
i	Explain how the mass of a given substance is Related to the amount of that substance in moles and vice versa	
j	Explain how the mass of a solute and the volume of the solution is Related to the concentration of the solution (higher)	
k	Recall and Use the law of conservation of mass	
l	Explain any observed changes in mass in non-enclosed systems during a chemical reaction and Explain them using the particle model	
m	Deduce the stoichiometry of an equation from the masses of reactants and products and Explain the effect of a limiting quantity of a reactant (higher)	
n	Use a balanced equation to Calculate masses of reactants or products (higher)	

C3.2 Energetics

C3.2	To know how to:	I know this I know some of this I don't know this.
a	distinguish between endothermic and exothermic reactions on the basis of the temperature change of the surroundings	
b	draw and label a reaction profile for an exothermic and an endothermic reaction	
c	Explain activation energy as the energy needed for a reaction to occur	
d	Calculate energy changes in a chemical reaction by considering bond making and bond breaking energies (higher)	

C3.3 Types of chemical reactions

C3.3	To know how to:	I know this I know some of this I don't know this.
a	Explain reduction and oxidation in terms of loss or gain of oxygen, identifying which species are oxidised and which are reduced	
b	Explain reduction and oxidation in terms of gain or loss of electrons, identifying which species are oxidised and which are reduced (higher)	
c	Recall that acids form hydrogen ions when they dissolve in water and solutions of alkalis contain hydroxide ions	
d	Describe neutralisation as acid reacting with alkali or a base to form a salt plus water	
e	recognise that aqueous neutralisation reactions can be generalised to hydrogen ions reacting with hydroxide ions to form water	
f	Recall that carbonates and some metals react with acids and write balanced equations predicting products from given reactants	
g	Use and Explain the terms dilute and concentrated (amount of substance) and weak and strong (degree of ionisation) in relation to acids (higher)	
h	Recall that relative acidity and alkalinity are measured by pH	
i	Describe neutrality and relative acidity and alkalinity in terms of the effect of the concentration of hydrogen ions on the numerical value of pH (whole numbers only) (higher)	
j	Recall that as hydrogen ion concentration increases by a factor of ten the pH value of a solution decreases by a factor of one (higher)	
k	Describe techniques and apparatus Used to measure pH	

C3.4 Electrolysis

C3.4	To know how to:	I know this I know some of this I don't know this.
a	Recall that metals (or hydrogen) are formed at the cathode and non-metals are formed at the anode in electrolysis using inert electrodes	
b	predict the products of electrolysis of binary ionic compounds in the molten state	
c	Describe competing reactions in the electrolysis of aqueous solutions of ionic compounds in terms of the different species present	
d	Describe electrolysis in terms of the ions present and reactions at the electrodes	
e	Describe the technique of electrolysis using inert and non-inert electrodes	

Topic Physics 1: Matter

P1.1 The particle model

P1.1	To know how to:	I know this I know some of this I don't know this.
a	Describe how and why the atomic model has changed over time	
b	Describe the atom as a positively charged nucleus surrounded by negatively charged electrons, with the nuclear radius much smaller than that of the atom and with almost all of the mass in the nucleus	
c	Recall the typical size (order of magnitude) of atoms and small molecules	
d	Define density	
e	Explain the differences in density between the different states of matter in terms of the arrangements of the atoms and molecules	
f	Apply the relationship between density, mass and volume to changes where mass is conserved (M1a, M1b, M1c, M3c)	

P1.2 Changes of state

P1.2	To know how to:	I know this I know some of this I don't know this.
a	Describe how mass is conserved when substances melt, freeze, evaporate, condense or sublimate	
b	Describe that these physical changes differ from chemical changes because the material recovers its original properties if the change is reversed	
c	Describe how heating a system will change the energy stored within the system and raise its temperature or produce changes of state	
d	Define the term specific heat capacity and distinguish between it and the term specific latent heat	
e	Apply the relationship between change in internal energy of a material and its mass, specific heat capacity and temperature change to Calculate the energy change involved (M1a, M3c, M3d)	
f	Apply the relationship between specific latent heat and mass to Calculate the energy change involved in a change of state (M1a, M3c, M3d)	
g	Explain how the motion of the molecules in a gas is Related both to its temperature and its pressure	
h	Explain the relationship between the temperature of a gas and its pressure at constant volume (qualitative only)	

Topic P2: Forces

P2.1 Motion

P2.1	To know how to:	I know this I know some of this I don't know this.
a	Describe how to measure distance and time in a range of scenarios	
b	Describe how to measure distance and time and Use these to Calculate speed	
c	make calculations using ratios and proportional reasoning to convert units and to compute rates (M1c, M3c)	
d	Explain the vector-scalar distinction as it applies to displacement and distance, velocity and speed	
e	Relate changes and differences in motion to appropriate distance-time, and velocity-time graphs; interpret lines and slopes (M4a, M4b, M4c, M4d)	
f	Interpret enclosed areas in velocity-time graphs (M4a, M4b, M4c, M4d, M4f) (higher)	
g	Calculate average speed for non-uniform motion (M1a, M1c, M2b, M3c)	
h	Apply formulae relating distance, time and speed, for uniform motion, and for motion with uniform acceleration (M1a, M1c, M2b, M3c)	

P2.2 Newton's laws

P2.2	To know how to:	I know this I know some of this I don't know this.
a	Recall examples of ways in which objects interact	
b	Describe how such examples involve interactions between pairs of objects which produce a force on each object	
c	Represent such forces as vectors	
d	Apply Newton's First Law to Explain the motion of an object moving with uniform velocity and also an object where the speed and/or direction change	
e	Use vector diagrams to illustrate resolution of forces, a net force (resultant force), and equilibrium situations (M4a, M5a, M5b) (higher)	
f	Describe examples of the forces acting on an isolated solid object or system (higher)	
g	Describe, using free body diagrams, examples where two or more forces lead to a resultant force on an object (higher)	
h	Describe using free body force diagrams the special case of balanced forces when the resultant force is zero (qualitative only)	
i	Apply Newton's Second Law in calculations relating forces, masses and accelerations	

j	Explain that inertia is a measure of how difficult it is to change the velocity of an object and that the mass is Defined as the ratio of force over acceleration (higher)	
k	Define momentum and Describe examples of momentum in collisions (higher)	
l	Use the relationship between work done, force, and distance moved along the line of action of the force and Describe the energy transfer involved	
m	Calculate relevant values of stored energy and energy transfers; convert between newton-metres and joules (M1c, M3c)	
n	Explain, with reference to examples, the definition of power as the rate at which energy is transferred	
o	Recall and Apply Newton's Third Law	
p	Explain why an object moving in a circle with a constant speed has a changing velocity (qualitative only)	

P2.3 Forces in action

P2.3	To know how to:	I know this I know some of this I don't know this.
a	Explain, that to stretch, bend or compress an object, more than one force has to be applied	
b	Describe the difference between elastic and plastic deformation (distortions) caused by stretching forces	
c	Describe the relationship between force and extension for a spring and other simple systems	
d	Describe the difference between linear and non-linear relationships between force and extension	
e	Calculate a spring constant in linear cases	
f	Calculate the work done in stretching	
g	Describe that all matter has a gravitational field that causes attraction, and the field strength is much greater for massive objects	
h	Define weight, Describe how it is measured and Describe the relationship between the weight of an object and the gravitational field strength (g)	
i	Recall the acceleration in free fall	

Topic P3: Electricity and magnetism

P3.1 Static and charge

P3.1	To know how to:	I know this I know some of this I don't know this.
a	Describe that charge is a property of all matter and that there are positive and negative charges	
b	Describe the production of static electricity, and sparking, by rubbing surfaces, and evidence that charged objects exert forces of attraction or repulsion on one another when not in contact	
c	Explain how transfer of electrons between objects can Explain the phenomena of static electricity	
d	Recall that current is a rate of flow of charge (electrons) and the conditions needed for charge to flow	
e	Recall that current has the same value at any point in a single closed loop	
f	Recall and Use the relationship between quantity of charge, current and time	

P3.2 Simple circuits

P3.2	To know how to:	I know this I know some of this I don't know this.
a	Describe the differences between series and parallel circuits	
b	Represent d.c. circuits with the conventions of positive and negative terminals, and the symbols that Represent common circuit elements	
c	Recall that current (I) depends on both resistance (R) and potential difference (V) and the units in which these are measured	
d	Recall and Apply the relationship between I, R and V	
e	Explain that for some resistors the value of R remains constant but that in others it can change as the current changes	
f	Explain the design and Use of circuits to explore such effects	
g	Use graphs to explore whether circuit elements are linear or non-linear (M4c, M4d)	
h	Use graphs and Relate the curves produced to the function and properties of circuit elements (M4c, M4d)	
i	Explain, why, if two resistors are in series the net resistance is increased, whereas with two in parallel the net resistance is decreased (qualitative explanation only)	
j	Calculate the currents, potential differences and resistances in d.c. series and parallel circuits	
k	Explain the design and Use of such circuits for measurement and testing purposes	
l	Explain how the power transfer in any circuit device is Related to the potential difference across it and the current, and to the energy changes over a given time	

m	Apply the equations relating potential difference, current, quantity of charge, resistance, power, energy, and time, and solve problems for circuits which include resistors in series, using the concept of equivalent resistance (M1c, M3b, M3c, M3d)	
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P3.3 Magnets and magnetic fields

P3.3	To know how to:	I know this I know some of this I don't know this.
a	Describe the attraction and repulsion between unlike and like poles for permanent magnets	
b	Describe the difference between permanent and induced magnets	
c	Describe the characteristics of the magnetic field of a magnet, Showing how strength and direction, change from one point to another	
d	Explain how the behaviour of a magnetic (dipping) compass is Related to evidence that the core of the Earth must be magnetic	
e	Describe how to Show that a current can create a magnetic effect and Describe the directions of the magnetic field around a conducting wire	
f	Recall that the strength of the field depends on the current and the distance from the conductor	
g	Explain how solenoid arrangements can enhance the magnetic effect	
h	Describe how a magnet and a current-carrying conductor exert a force on one another (higher)	
i	Show that Fleming's left-hand rule Represents the relative orientations of the force, the current and the magnetic field (higher)	
j	Apply the equation that links the force on a conductor to the magnetic flux density, the current and the length of conductor to Calculate the forces involved (higher)	
k	Explain how the force exerted from a magnet and a current-carrying conductor is Used to cause rotation in electric motors (higher)	