

# Year 9 Science Learning Outcomes

## Biology Unit 1: Cell Biology

### Unit 1.1: Cell Structure and Transport

- Understand how microscopy techniques have developed over time and how we use microscopes.
- Explain how the main subcellular structures relate to their function in animal and plant cells.
- Demonstrate an understanding of the scale and size of cells.
- Make order of magnitude calculations, including the use of standard form.
- Explain how the structure of different types of cell relate to their function in a tissue, an organ or organ system, or the whole organism.
- carry out calculations involving magnification, real size and image size using the formula:  $\text{magnification} = \frac{\text{size of image}}{\text{size of real object}}$
- Define diffusion and explain how different factors affect the rate of diffusion.
- Explain how osmosis happens and how it is different to diffusion.
- Investigate the effect of a range of concentrations of salt or sugar solutions on the mass of plant tissue.
- Explain how active transport occurs in both plants and animals.
- Explain how the small intestine and lungs in mammals, gills in fish, and the roots and leaves in plants, are adapted for exchanging materials.

### Unit 1.2: Cell Division

- Explain why chromosomes in body cells are normally found in pairs, state how many are found in human cells.
- Understand the stages of the cell cycle and recognise given contexts where mitosis is occurring.
- Describe the functions of stem cells in embryos and in adult bone marrow and explain the ethical considerations of both types.
- Explain why plant clone cells are produced in the agriculture industry.

## Biology Unit 2: Tissues, Organs & Organ Systems

### Biology Unit 2.1: Organisation and Digestive System

- Describe what is meant by a cell, tissue, organ and organ system giving key examples.
- Understand the process by which food passes through the digestive system.
- Use qualitative reagents to test for a range of carbohydrates, lipids and proteins.
- Explain the role of digestive enzymes including specific enzymes produced within different organs and their roles.

- Explain why enzymes are specific and are denatured by high temperatures and extremes of pH.
- Investigate the effect of pH on the rate of reaction of amylase enzyme.

### **Biology Unit 2.2: Organising Animals and Plants**

- Describe the functions of each of the blood components.
- Explain how the structure relates to the functions of blood vessels.
- Evaluate the advantages and disadvantages of treating cardiovascular diseases by drugs, mechanical devices or transplant.
- Describe the structure and function of the human lungs, including how lungs are adapted for gaseous exchange.
- Explain how the structures of plant tissues are related to their functions.
- Understand factors that can affect the rate of transpiration.
- Describe the process of transpiration and translocation, including the structure and function of the stomata.

## Biology Unit 3: Infection & Response

### **Biology Unit 3.1: Communicable Diseases**

- Describe the relationship between different factors that affect health.
- Explain how pathogens are spread.
- Explain how the spread of diseases can be reduced or prevented.
- Explain how measles, HIV, tobacco mosaic virus, Gonorrhoea and salmonella infect an organism and how they affect the infected organism.
- Explain how Malarial protists and Rose black spot fungus affects organisms and how the spread of these can be reduced.
- Describe the non-specific defence systems of the human body against pathogens and explain the role of the immune system in the defence against disease.

### **Biology Unit 3.2: Preventing and Treating Disease**

- Explain how vaccination will prevent illness in an individual, and how the spread of pathogens can be reduced by immunising a large proportion of the population.
- Explain the use of antibiotics and other medicines including painkillers in treating disease.
- Describe the process of discovery and development of potential new medicines, including preclinical and clinical testing.

### **Biology Unit 3.3: Non-Communicable Diseases**

- Describe the relationship between health and disease and the interactions between different types of disease.
- Explain the effect of smoking on heart disease, lung disease and on unborn babies.
- Explain the effect of alcohol on liver and brain function and on unborn babies.
- Describe what cancer is and explain lifestyle and genetic risk factors.

## Physics Unit 2: Electricity

### **Physics Unit 2.1: Electrical Circuits**

- Identify circuit components from their symbols.

- Perform a range of calculations, including rearrangement of the equation  $Q=It$ .
- Explain how resistance, current and potential difference are linked.
- Calculate the resistance of a component by using the relationship  $R = V/I$ .
- Compare the characteristics of a variety of electrical components, describing how the components can be used.
- Explain how we can use series circuits and how they are different to parallel.
- Analyse a variety of series circuits to determine the current through, p.d. across, and resistance of combinations of components.
- Explain how we can use parallel circuits and how they are different to series.
- State that the p.d. across parallel sections of a circuit is the same.

### Physics Unit 2.2: Electricity in the Home

- Explain the difference between AC and DC.
- Explain why transformers are used in the national grid.
- Identify parts of a plug and wire a plug correctly.
- Calculate power for a range of situations.
- Calculate the flow of electric charge when you know the current and time.
- Describe what energy transfers happen when electrical charge flows through a resistor.
- Calculate efficiency for a variety of appliances.

## Chemistry Unit 1: Atomic Structure & Periodic Table

### Chemistry Unit 1.1: Atomic Structure

- Demonstrate and apply knowledge of word equations, symbol equations and balanced symbol equations.
- Explain, including diagrams, the difference between a pure element, a mixture, and a compound.
- Explain in detail how multi-step separation techniques work – filtration, distillation, fractional distillation, chromatography and crystallisation.
- Suggest an appropriate separation or purification technique for an unfamiliar mixture.
- Explain the main processes occurring in paper chromatography.
- Use the Periodic table to find atomic number and mass number data and use it to determine the number of each sub-atomic particle in any given form.
- Demonstrate and apply knowledge and understanding of how the atom was discovered and its structural development.
- Define atom, ion and isotope.
- Demonstrate and apply knowledge and understanding of electronic structure of atoms.
- Explain why elements in the same group react in a similar way.

### Chemistry Unit 1.2: The Periodic Table

- Describe how the Periodic Table was developed over time.
- Explain how the Periodic Table can be used to make predictions about the electronic structure and reactions of the elements.
- Explain how Group 1 elements behave when added to water, including word and balanced symbol equations.
- Describe the trend in size, melting point, boiling point and state of the Group 7 elements.

- Explain why the reactivity of group 1 and 7 changes down the group.

## Chemistry Unit 2: Bonding

- Identify the three states of matter, their state symbols and particle diagrams.
- Describe the process of melting, freezing, boiling and condensing.
- Determine if atoms will form positive or negative ions based on their position in the Periodic Table.
- Describe, with an example, how a Group 1 metal atom becomes a positive ion. Describe, with an example, how a Group 7 non-metal atom becomes a negative ion.
- Describe how and why ionic compounds are held together.
- Describe the properties of ionic compounds.
- Describe how covalent bonds are formed.
- Explain why simple molecules have low melting and boiling points.
- Describe the general properties of substances with giant covalent structures.
- Explain some properties of fullerenes, nanotubes and graphene and how they can be applied in the real-world.
- Describe the structure and bonding in a metal.
- Explain why metals have high melting and boiling points.
- Describe what an alloy is.
- Explain why metals can be bent and shaped without breaking.
- State some uses of nanoparticles.
- Evaluate the use of nanoparticles in their applications, including sun cream.

## Physics Unit 1: Energy

### Physics Unit 1.1: Conservation and Dissipation of Energy

- Name the different energy stores and how we can use them.
- Describe changes in energy stores in terms of the process that causes the change.
- Apply the law of conservation of energy in straightforward situations.
- Calculate work done.
- Use the equation for work done to calculate distances or size of forces.
- Calculate the gravitational potential energy store of a system using the mass, gravitational field strength, and height.
- State the factors that affect the change in the gravitational potential energy store of a system.
- Calculate the kinetic energy store of an object and the elastic potential energy store of a stretched spring.
- Describe energy changes involving elastic potential energy and kinetic energy stores.
- Identify useful and wasted energy in simple scenarios.
- Describe energy dissipation and how this reduces the capacity of a system to do work.
- Calculate efficiency of a range of energy transfers.
- Describe a range of energy transfers.
- Describe the energy transfers carried out by electrical devices.
- Calculate power and rank power ratings of electrical appliances.

### Physics Unit 1.2: Energy Transfer by Heating

- Describe the changes in the behaviour of the particles in a material as the temperature of the material increases.
- Describe materials as good or poor thermal conductors.
- Compare the cooling and heating of different coloured surfaces.
- State that an object cools by emitting IR radiation and heats by absorbing IR radiation.
- Evaluate materials used for transferring energy in terms of their specific heat capacity.
- Calculate the energy required to change the temperature of an object.
- State some design features used to prevent energy transfer to the surroundings in the home.
- Compare home improvement features in terms of payback time.

### Physics Unit 1.3: Energy Resources

- Compare fossil fuels and nuclear fuels in terms of energy provided, waste and pollution.
- Discuss some of the problems associated with biofuel use and production.
- State some simple advantages or disadvantages of renewable energy systems.
- Describe the operation of a wind farm and a hydroelectric system.
- Compare and contrast the operation of solar cells (photovoltaic cells) with solar heating panels.
- Describe the effects of acid rain and climate change.
- Evaluate methods of reducing damage caused by waste products of nuclear fuels and fossil fuels.
- Form persuasive arguments for and against a variety of energy resources.

### Physics Unit 3: Molecules and Matter

- Explain why some materials will float on water.
- Use the density equation in a wide variety of calculations.
- Explain in detail why the density of a material changes during a change of state, using a particle model.
- Explain the factors that lead to things changing state.
- Describe the term 'latent heat'.
- Explain what happens to internal energy as something changes state.
- Perform a variety of calculations based on the latent heat equation.
- Explain how gas pressure and temperature are related.
- Explain Brownian motion in terms of particle behaviour and collisions.