

Secondary Science Texts

Subject: Biology

Year group: Secondary 1

Unit 2: The cell

- 1** Cut a slice of onion. Peel off a thin layer of cells and hold it up to the light. Explain why it would be better to look at the cells with a microscope.
- 2** Draw plant and animal cells. Label these structures and give their functions: membrane, cell wall, chloroplast, cytoplasm, mitochondrion, nucleus, vacuole.
- 3** Draw diagrams of these specialised cells: root hair cell, guard cell, palisade cell, red blood cell, nerve cell. Explain how each is adapted to its function.
- 4** Define each of these levels of organisation: organism, organ, cell, tissue, organ system. Now list them in order of increasing complexity, starting with cell.
- 5** Work with friends to create a play to explain what cells are and how they work together in an organism of your choice. Show the audience how amazing cells are!

Subject: Biology

Year group: Secondary 1

Unit 3: Movement of substances into and out of cells

- 1** A cell membrane encloses its cell and separates it from the surroundings. It is made from a double layer of lipid with embedded protein molecules. Find out the answers to these questions about a cell membrane: (a) Why does it have small pores? (b) What does 'semi-permeable' mean? (c) Why is it sensitive to pH and temperature? (d) What property of a cell membrane enables it to control the movement of ions into and out of the cell?
- 2** Substances move into and out of cells by diffusion, osmosis and active transport. Diffusion is the movement of particles from a region of their high concentration to a region of their low concentration. Several factors affect rate of diffusion. In a group of four students, allocate one factor to each student: temperature, surface area, concentration, the distance particles must travel. Each student researches how and why their factor affects diffusion rate. They then teach their group what they found out.
- 3** Water gets into and out of cells by osmosis. Osmosis is the movement of water molecules from a dilute solution to a concentrated solution through a semi-permeable membrane. Do an experiment to study osmosis in potatoes. Cut three cuboids of potato of the same size, and measure their length. Put each in a different test tube: A – water; B – dilute sugar solution; C – concentrated sugar solution. In 30 minutes, measure the lengths again. Research information to explain your results.
- 4** Active transport is the movement of molecules or ions from an area of low concentration to an area of high concentration. Carrier protein molecules pick up particles on one side of the membrane and carry them across. Several factors affect active transport. In a group of five students, allocate one factor to each student: oxygen concentration, glucose concentration, temperature, pH and enzyme inhibitors. Each student researches how their factor affects active transport. They then teach their group what they found out.
- 5** In your group, decide whether each of these uses diffusion, osmosis or active transport. (a) Glucose moving from the small intestine into the blood (b) Water moving from cell to cell in tissues (c) Root hair cells absorbing mineral salts from the soil when the concentration of mineral salts is higher in the cells than in the soil (d) Unicellular organisms getting rid of waste (e) The exchange of gases in the stomata of leaves and the lungs of animals.

Subject: chemistry

Year group: secondary 1

Unit 3: acids, bases, indicators and salts

- 1** Tut has solutions of pH 1, 5, 7, 8, 13. Which could be pure water? Which is most acidic? Which two are alkaline? Which has the highest H^+ ion concentration?
- 2** Acids dissociate in water to give H^+ ions. Explain the differences between: a strong and a weak acid; concentrated and dilute solutions of the same acid.
- 3** Mary wants to grow coffee. The soil pH on Mary's farm is 8.5, but coffee grows best in pH 6. Suggest what Mary could add to her soil. Explain why.
- 4** An acid + base react to make a salt + water. Write equations for reactions of: $HCl + NaOH$; nitric acid + calcium hydroxide, sulfuric acid + sodium hydroxide.
- 5** Research the uses of these acids and bases, and write about your findings: sulfuric acid, ethanoic acid, nitric acid, sodium hydroxide, calcium hydroxide.

Subject: Physics

Year group: Secondary 1

Unit 2: Force types and their measurement

- 1** A force is a push or pull. Decide which of these are pushes and which are pulls: kicking a football, a donkey making a cart move, lifting a pan from a stove. Forces can change the speed of an object, its direction or its shape. Roll a pencil on the desk. Use your thumb to apply forces to change its speed and direction. Get some plasticine and apply forces to make its shape change. Now plan a speech to tell your family about forces.
- 2** Forces explain why things move (or not). You cannot see forces but you can see what they do. Think about your journey to school. Did you see the effects of forces making something change speed, like a foot pushing a bicycle pedal? Did you see the effects of forces changing the shape of something, like a bicycle tyre? Did you see the effects of forces making something change direction? Draw pictures or write descriptions of the force effects you saw.
- 3** There are different types of forces. Friction is the force between two surfaces that are sliding over each other. Push a table along the floor. If your friend sits on the table, a greater force is needed to move the table. Can you suggest why? Friction can be useful, for example, friction between your foot and the ground stops you slipping. Write a list of when friction is useful. When is friction not useful?
- 4** Friction acts between things that are touching, so it is a contact force. Gravity is another type of force, but it is a non-contact force. Gravity pulls objects towards the centre of the Earth. The weight of an object is a measure of the gravitational pull on the object. List these animals in increasing order of weight: mouse, dog, elephant. Which is pulled most strongly towards the Earth? Write some sentences to compare the forces of friction and gravity.
- 5** Mass measures the amount of matter in a substance. If you went to Mars, your mass would not change. However, your weight on Mars is less than on Earth. This is because the mass of Mars is smaller, so its gravitational pull is less. Weight is equal to mass (in kg) x gravitational field strength, g (in N/kg). On Earth, g is 10 N/kg. Calculate the weights of objects with these masses: 5 kg, 10 kg, 0.2 kg. Give your answers in newtons, N.

Subject: biology

Year group: Secondary 2

Unit 2: Nutrition in animals

- 1** Holozoic nutrition breaks down complex insoluble food to simple soluble compounds. Explain these steps and list in order: ingest, absorb, assimilate, digest.
- 2** Parasites get nutrients from other live organisms. Research these parasites and their impacts on animal and human health: tape worm, liver fluke, headlice, ticks.
- 3** Saprophytes live on dead or decaying matter. Name two saprophytes and explain how they obtain nutrients. Make a table comparing parasites and saprophytes.
- 4** Look at someone's teeth. Identify and draw incisors, canines, pre-molars and molars. Which tooth type: pierces food; cuts food; crushes and grinds; grinds?
- 5** Look at the teeth of a dog and a cow or goat. Write and draw how they are similar and different. Explain how the teeth of each animal is adapted to its diet.

Subject: chemistry

Year group: Secondary 2

Unit 1: The atmosphere and properties of common gases

- 1** The air is a mixture of these gases: oxygen (20.9%), nitrogen (78.1%), carbon dioxide (0.04%) and other gases, including argon (0.96%). (a) Draw a pie chart to show this information. (b) Add uses for each gas to the pie chart, including: oxygen – making steel and helping people to breathe in hospital; nitrogen – making fertilisers and preserving food; carbon dioxide – fizzy drinks and helping plants grow in greenhouses.
- 2** Gases are identified in laboratory tests. For example: oxygen relights a glowing splint; water vapour makes white anhydrous copper sulfate become blue; limewater makes colourless limewater become cloudy. (a) Write instructions to describe how to do the tests safely. (b) Make a table to summarise the observations in the tests.
- 3** Majok wanted to find the percentage of oxygen in air. He put some copper in a glass tube and connected one gas syringe to each end. The syringes contained 80 cm³ of air. Majok heated the copper and passed air over it. The syringes then contained 70 cm³ of air. (a) Draw a diagram of the apparatus. (b) Calculate the percentage of oxygen. (c) Compare the calculated percentage to the expected value and suggest why it is different.
- 4** The substances in air are separated by filtering, followed by cooling to –200 °C and then allowing the remaining gases to warm up. The boiling points of the substances are: helium –272 °C; neon –249 °C; nitrogen –196 °C; oxygen –183 °C; water 100 °C. Carbon dioxide gas solidifies at –79 °C. (a) Why is the air filtered? (b) As the air cools, which gas condenses first? (c) As it gets colder, which solid substance is removed next?
- 5** To do this question, you need information from text 4. In the procedure to separate the gases of the air, the cooled mixture at –200 °C contains four substances – helium, neon, nitrogen and oxygen. (a) At this temperature, which two substances are in the gas state? (b) The two substances that are liquid at –200 °C slowly warm up. Which substance becomes a gas first?

Subject: chemistry

Year group: Secondary 2

Unit 2: Atomic structure, the Periodic Table and bonding

- 1** Deduce the numbers of protons, neutrons and electrons in these ions: K^+ ($Z=19$, $A=39$); Br^- ($Z=35$, $A=80$); Al^{3+} ($Z=13$, $A=27$); Se^{2-} ($Z=34$, $A=79$); P^{3-} ($Z=15$, $A=31$).
- 2** Explain what isotopes are. Give the numbers of protons and neutrons in Ne-20 and Ne-22. Calculate the R.A.M. of a sample containing 90.5% Ne-20 and 9.5% Ne-22.
- 3** An atom has the electronic configuration 2.8.8.1. Deduce its Periodic Table group and period. Give the electronic configurations of atoms with 7, 9 and 20 electrons.
- 4** With a friend, plan and teach a revision lesson to explain how ionic, covalent, coordinate and metallic bonds are formed. Include examples. Teach your lesson.
- 5** Make a table to compare melting point, solubility & electrical conduction of substances with these structures: giant ionic, metallic, simple covalent (e.g. wax).

Subject: Physics
Year group: Secondary 2
Unit 2: Forces and turning effects

- 1** A force may change the speed of an object. Can you remember two more effects of forces? Forces can change the direction of an object, or its shape. A force may also produce a turning effect. Place a ruler or stick across your finger so that it balances. Gently press one end and watch it turn. What happens if you press the other end? Now use a door handle or bottle-opener. Can you identify the pivot point that each object turns around?
- 2** The turning effect of a force about a point is the moment of the force about that point. To calculate the moment of a force, multiply the force by the perpendicular distance from the point to the line of action of the force. $\text{Moment} = F \text{ (in newtons)} \times d \text{ (in metres)}$. Calculate the moment of the force when 5 N is applied to a bottle-opener at a distance of 0.09 metre from the bottle lid. Make up five similar questions for a friend.
- 3** You will investigate two moments at the same turning point (fulcrum). Tear some paper to make 15 one-cm² pieces. Balance a ruler on a pencil (fulcrum) so that the ruler does not touch the table. Place 5 paper squares at one end of the ruler. It will overbalance. Now add paper squares half way between the fulcrum and the other end of the ruler. How many squares do you need to balance the ruler again? Write down your results. Can you explain them?
- 4** In activity 4, the paper squares exerted turning forces on each end of the ruler. When the ruler was balanced the clockwise moment about the fulcrum was equal to the anticlockwise moment. This illustrates the principle of moments. Using your results from activity 4, do calculations to show that your experiment obeyed the principle of moments. Test the principle again, putting paper squares at different distances from the fulcrum. Now copy out a full statement of the principle of moments.
- 5** A student places a 100 cm ruler on a fulcrum at its centre. She hangs these weights on the left of the fulcrum: 12 N at 20 cm from the fulcrum and 8 N at 40 cm from the fulcrum. On the right of the fulcrum, she hangs a 16 N weight that is 10 cm from the fulcrum. She hangs a fourth weight 50 cm to the right of the fulcrum. What size should this weight be to balance the ruler?

Subject: Physics

Year Group: S3

Syllabus unit title and number: **Unit 2: The Nature of Electrostatics**

- Text 1 Current electricity flows. Static electricity does not. Why does electrical charge remain on e.g. a plastic comb, a balloon, someone's hair, a piece of fabric?
25 159
- Text 2 Use what you know about the structure of an atom to explain why electrons, not protons, can move from or onto insulators so they become charged?
26 144
- Text 3 Electrostatic charge can be measured with a gold leaf electroscope. Draw diagrams to show why the gold leaf diverges when it is charged & how you discharge it.
28 159
- Text 4 Draw diagrams to show how an electroscope can be charged by contact with a charged object or by induction. Explain why induction gives a temporary charge.
26 154
- Text 5 Coulomb's Law: The electrostatic force between 2 charged points is directly proportional to the product of the charges & inversely proportional to the square of the distance between them.
Two charged objects either attract or repel each other. Explain the circumstances that will cause them to attract and to repel. Use Coulomb's Law to write down the formula for working out the force between 2 charged points. Research to find out if you were right.
46 263 (if there is no need to provide Coulomb's Law)
75 451 (if the whole text is needed)

Subject: Biology

Year Group: S3

Syllabus unit title and number: **Unit 2: Pathogens and Diseases**

- Text 1 In 2020 we faced a global pandemic caused by a pathogen called a coronavirus. The strain of virus was Covid-19. What's a pathogen & what other types are there?
29 160
- Text 2 Diseases may be caused by 4 types of pathogen: viruses, bacteria, fungi & protozoa. Research different diseases & find out about causes, symptoms & transmission.
24 160

- Text 3 Pathogens may be obligate, opportunistic or accidental. Find out & explain what these words mean in relation to pathogens. Find out about useful microorganisms.
24 160
- Text 4 Malaria is caused by a protozoan called plasmodium that is carried by mosquitoes. Explain plasmodium's life cycle & how we can avoid and treat malaria.
25 151
- Text 5 Explain why scientists must be able to culture & identify pathogens quickly. Explain what people can do to minimize the risk of catching & passing on diseases.
27 159

Subject: Chemistry

Year Group: S3

Syllabus unit title and number: **Unit 2: Mole Concept, Application of Gas Laws and Balance Equations**

- Text 1 Think about what you know about atomic structure. Explain why atoms of a) the same element have the same mass b) different elements have different masses.
26 155
- Text 2 A **mole** of any chemical substance contains 6.022×10^{23} particles. Explain & write how many atoms / molecules in 0.5, 1, 2 & 3 moles of carbon, H₂O and CO₂.
31 155
- Text 3 Relative atomic mass is the average mass of an atom compared to 1/12 of the mass of an atom of ¹²C. Why do we use relative rather than actual masses of atoms?
32 158
- Text 4 If we know the formula of a compound we can use the relative atomic masses of its atoms to work out its molecular mass. Do this for CO₂ & H₂O (C=12, O=16, H=1)
33 159
- Text 5 Use the formula: Number of Moles = Mass in grams / Molar mass to work out how many moles are present in 54g of water and 49g of H₂SO₄ (RAMs: H=1, S=32, O=16)
33 158

Subject: Physics

Year Group: S3

Syllabus unit title and number: **Unit 3: Current Electricity**

- Text 1 Current flows when there is an electromotive force that overcomes the resistance of a conductor. What does this mean & how would you measure current and emf?
27 157
- Text 2 Resistance, emf, electrical charge, current. Match each of these to its unit & add the right abbreviation for the unit. Units: coulombs, volts, ohms, amperes.
24 158
- Text 3 Ohm's Law is often summarised as $V=IR$. Explain this in words. Rewrite the formula making I and then R the subject of the formula. Explain the VIR triangle.
29 156
- Text 4 Explain a) the meaning of series & parallel circuits b) why domestic electricity supplies are connected in parallel c) how the 2 are shown in circuit diagrams.
27 159
- Text 5 What is a semiconductor and what types are there? Explain some applications of semiconductors and why they have become so important in today's world.
24 149

Subject: Biology

Year Group: S4

Syllabus unit title and number: **Unit 2: Reproduction and Growth in Plants and Animals**

- Text 1 What do the terms asexual and sexual reproduction mean? Think of or find out about and list examples of plants and animals that use each method of reproduction.
28 160
- Text 2 Research & discuss methods of asexual reproduction: bulbs, corms, rhizomes, tubers, suckers/runners, binary fission, spore formation and budding. Give examples.
20 160
- Text 3 DNA in chromosomes determines an organism's genetic characteristics. Most cells are diploid (2n) whereas gametes are haploid (n). Draw a diagram to explain why.
24 160
- Text 4 Find a simple flower and remove some petals to expose its reproductive parts. Draw the flower, labeling each part and adding notes to explain its function.
26 155

Text 5 Research and discuss the many ways that seeds of different plants are dispersed. Draw examples and add notes to explain how the seeds are adapted for dispersal.
27 160

Subject: Chemistry

Year Group: S4

Syllabus unit title and number: **Unit 2: Energy Changes in Chemical Reactions**

Text 1 Chemical reactions result in chemical changes but energy or enthalpy changes also take place. Research & explain why, referring to energy in chemical bonds.
25 156

Text 2 What do we mean by exothermic (ΔH negative) and endothermic (ΔH positive) reactions? Explain, again referring to bond energies. Give examples of each type.
24 156

Text 3 Research & explain how you could calculate the heat of reaction (ΔH) using the bond energies of the reactants and of the products. Give a theoretical example.
27 158

Text 4 Hess's Law: The enthalpy change in a chemical reaction is the same whatever the route taken as long as initial and final conditions are kept constant. Explain.
27 159

Text 5 Activation energy is the minimum energy needed to start a reaction. A catalyst reduces the activation energy but not the overall heat of reaction. Explain.
25 155

Subject: Physics

Year Group: S4

Syllabus unit title and number: **Unit 2: Newton's Law of Gravitation**

Text 1 Express Coulomb's Law formula $F = kQ_1Q_2/r^2$ in words. To work out the gravitational force between objects we use $F = Gm_1m_2/r^2$. How they are similar & how different.
25 160

Text 2 Work out the force of gravity between a person weighing 90kg and the Earth. (Radius of Earth = 6.4×10^6 m, mass of earth = 5.98×10^{24} kg, $G = 6.67 \times 10^{-11}$ Nm²/kg²)

24 153

Text 3 What are Kepler's three laws of planetary motion. Explain why planets orbit around the sun and the moon orbits the earth. What forces are involved?
25 147

Text 4 Explain the meaning of the terms orbital velocity and escape velocity. The thrust of the first stage of a Falcon 9 Full Thrust rocket is 7,607 kN. Why so high?
30 160

Text 5 What is a geostationary satellite? Explain why these are important for communications, why we have launched so many & why there are concerns about this.
25 152

Subject: Biology

Year Group: S4

Syllabus unit title and number: **Unit 3: Co-ordination in Plants and Animals**

Text 1 The growth responses (tropisms) of the shoots & roots of seedlings to gravity & light are caused by hormones called auxins. Explain their effect on cell growth.
27 160

Text 2 Ethylene & abscisic acid are also plant hormones. Explain the effect these can have on plants. How have we made /could we make commercial use of phytohormones?
27 159

Text 3 What do we mean by a) the central and the peripheral nervous system? b) voluntary and involuntary actions? c) sensory, motor and relay or inter neurons?
26 153

Text 4 Some actions you think about but others are reflexes. What does this mean and what are the characteristics of reflex actions? Give examples & draw a reflex arc.
28 160

Text 5 The glands of our endocrine system release hormones, chemicals that have an important role in coordination. Explain functions of some key hormones in humans.
24 157