GCSE Science – Schemes of Work

Biology

Unit 3: Biology 3

We need to understand how biological and environmental systems operate when they are working well in order to be able to intervene when things go wrong. Modern developments in biomedical and technological research allow us to do so.

* The suggested timings relate to the learning outcomes rather than to the activities.

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
B3.1 Movement of molecules in and out of cells The cells, tissues and organs in plants and animals are adapted to take up and get rid of dissolved substances. Different conditions can affect the rate of transfer. Sometimes energy is needed for transfer to take place. Students should use their skills, knowledge and understanding to: • evaluate the development and use of artificial aids to breathing, including the use of artificial ventilators • evaluate the claims of manufacturers about sports drinks • analyse and evaluate the conditions that affect water loss in plants						
B3.1.1 Dissolved substances						
a b	Dissolved substances move by diffusion and active transport. Water moves across boundaries by osmosis; from a dilute to a more concentrated solution through a partially permeable membrane.	Define the term 'diffusion'. Define the term 'osmosis' and explain what a partially permeable membrane is. (use of terms 'turgor' and 'plasmolysis' not required') Plot and interpret a graph of change in mass vs concentration of solution.	2	**Define** diffusion and associated experiments covered in B2.1.2 – could show computer simulation. **Developing explanations using ideas and models** **Explain** movement of water molecules as a special type of diffusion through a partially permeable membrane. • Set up a simple osmometer at the start of the lesson and	**Obtaining and presenting primary evidence** Fill cellulose tubing 'sausages' with concentrated sugar solution or water and place in beakers of concentrated sugar solution or water. Students explain in terms of movement of molecules	PPT B3.1.1 Dissolved substances **Note:** Use of the terms turgor and plasmolysis is **not** required. **Demo:** Cellulose tubing filled with conc sugar solution attached to capillary

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
c	Differences in concentrations inside and outside a cell cause water to move into or out of the cell by osmosis.	Explain in terms of movement of water molecules, the outcomes of osmosis experiments.		measure how far the liquid in the capillary tube rises during the lesson. • **Model** to show osmosis or get students to make a model. • Watch a computer simulation of osmosis or video on osmosis in living cells – **describe and explain** interactive concepts in biochemistry and cellular transport. • **Use evidence** from a video clip of osmosis in blood cells to **apply** understanding.	**Planning an approach; selecting and managing variables** • Investigate the effect of different concentrations of solution on potato cylinders – mass and size. • Find the concentration of salt or sucrose inside potato cells. • Investigate the effect of different concentrations of solution on beetroot or rhubarb cells. • Investigate the effect of different concentrations of	tube held in clamp, beaker of water. **Demo:** Four beakers (two of water and two of sugar solution); four cellulose sausages (two of water and two of sugar solution). **Potato experiment:** Potatoes, cork borers, knives, rulers, balance, test tubes, range of different concentrations of salt or sucrose solutions. Clear plastic box, plasticine for membrane and different sized balls for water and solute.

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
					solution on shelled eggs.	Refer to McGraw-Hill website at http://highered.mcgraw-hill.com/sites/0072495855/student_view0 select 'Chapter 2' and 'How Osmosis works' **Living cells:** Beetroot slices or rhubarb epidermis, slides, coverslips, pipettes, water, concentrate, solution and blotting paper. Useful information on Osmosis in chicken eggs can be found at http://practicalbiology.org by searching for 'Investigating

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
						osmosis in chickens' eggs'.
d e f	Most soft drinks contain water, sugar and ions. Sports drinks contain sugar to replace that used in energy release, and water and ions to replace those lost in sweat. If water and ions are not replaced cells do not work as efficiently.	Evaluate the claims of manufacturers about sports drinks. Explain why sports drinks contain sugar, water and ions. Describe some effects on the body if water and ions are not replaced.	1	**Communication for audience and purpose.** Are sports drinks all they are claimed to be? Divide class in to groups with different **bias** 1. Sports drinks company. Present a marketing presentation in media of student choice about a drink containing sugar, water and ions 2. Medical journalists Produce an article for a medical journal about the same drink 3. Diabetic nurse Produce presentation for local doctor's surgery about increase use of same drink 4. Tabloid newspaper reporter	**Applications and implications of scientific claims** Compare the ingredients in sports drinks and other soft drinks. Present data in appropriate tables and graphs and draw conclusions. Research claims made for the sports drinks and decide if they are valid.	

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
				Produce a headline and 50 word article about the same drink **Applications implications and cultural understanding** **Evaluate** the use of rehydration and electrolyte replacement during severe vomiting and diarrhoea such as cholera and nor virus infections		
g	Active transport – substances are sometimes absorbed against a concentration gradient. This uses energy.	Define the term active transport. Describe and label diagrams to show where active transport occurs in humans and plants in terms of molecules transported Explain why active transport requires energy. Explain how active transport enables cells to absorb ions from very dilute solutions Explain the relationship between active transport and oxygen supply and numbers of mitochondria in cells.	1	**Compare** diffusion and osmosis and **explain** the similarities and differences to active transport **Using models** Introduce active transport as absorption against the concentration gradient – why might this be useful? **Research:** Research where active transport occurs in plants and humans and label these on diagrams with notes. Why must soil and hydroponics solutions be kept aerated? **Discuss:** Discuss in terms of energy used and show images of kidney and root hair	**Selecting and managing variables** Students research and as a class set up an aquarium of brine shrimps. **Explain** how the concentration of the liquid is critical to shrimp survival Describe how this be **applied** to other organisms?	Useful information can be found on BBC GCSE Bitesize at www.bbc.co.uk/schools/gcsebitesize/science by searching for 'active transport'. For interactive animations search for 'interactive biochemistry' in your chosen search engine, then choose the Wiley website.

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
				cells with mitochondria. Model by showing a computer simulation of active transport.		
j i h k	The size and complexity of an organism increases the difficulty in exchanging materials. Gas and solute exchange surfaces in organisms are adapted to maximise effectiveness. Many organ systems are specialised to exchange materials, eg by having a large surface area, being thin, having an efficient blood supply and being well ventilated.	Explain why the size and complexity of an organism increases the difficulty in exchanging materials. Describe and explain the features of a good exchange surface. Explain how the structure of some organs are adapted to exchange materials efficiently eg lung alveolus and list how it is adapted for gas exchange.	1-2	**Presenting and writing descriptions and explanations** Why do larger organisms need specialised systems? Describe exchange of materials in paramecium in hay infusion or describe image of unicellular organism, eg amoeba and discuss how it obtains food and oxygen and removes wastes; Show image of root hair cell and ask students to **explain** how it is adapted to absorb lots of water (could be covered with B3.1.3). **Describe** and label a diagram of an alveolus showing exchange of gases and **evaluate** how it is adapted for its function (probably best covered with B3.1.2).	**Planning an approach** Students use various sizes of visking tubing or cubes of agar to show how diffusion rate increases with surface area. **Working with** • **primary evidence** Observe prepared slides showing alveoli and relate structure to function. • **secondary evidence** Research how other organisms exchange gases and relate structure of exchange surfaces to function eg fish,	Useful information unicellular organism, Amoeba, can be found at www.biology-resources.com by searching for 'biological drawing amoeba / paramecium feeding'. Hay infusion –warm water and fresh hay in beaker for 3 days. Decant infusion, look for paramecium Bioviewers or microscopes, cavity slides and amoeba.

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
l	In humans surface area is increased by alveoli in the lungs and villi in the small intestine. Villi have a large surface area and a good blood supply to absorb the products of digestion by diffusion and active transport.	Explain why foods have to be digested from large to small molecules. Explain why some food molecules are absorbed by diffusion and others by active transport. Describe a diagram of a villus and list how it is adapted for absorption of food molecules.		Draw a concept map to describe types of molecules absorbed and explain why food has to be digested and where digestion happens. **Discuss:** Discuss where absorption of food occurs and show images of villi. **Explain** how villi create a large surface area for absorption of food **Using models** • Observe slides of villi. • Label a diagram of a villus and list adaptations of the small intestine and a villus for absorption of food. • Students make a model of the lining of small intestine, eg use pipe cleaners highly folded to show increase in exchange surface area or marshmallows		Microscopes, prepared slides of alveoli and villi.

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
				stuck into a surface(could be covered with B2.2.1).		
B3.1.2 Gaseous exchange						
a b	The lungs are in the upper part of the body (thorax),protected by the ribcage and separated from the lower part of the body (abdomen) by the diaphragm The breathing system takes air into the body so oxygen and carbon dioxide can be exchanged between the air and the bloodstream.	Describe and label a diagram of the breathing system. Explain the function of the breathing system.	1	**Using models** **Identify** the main organs of the breathing system and discuss the function of the system. **Describe** and label a diagram showing the position of the lungs, ribcage, rib muscles, diaphragm, abdomen, thorax, trachea, bronchi, bronchioles and alveoli (could cover B3.1.1 h, i and k here). **Use evidence from** a video clip showing structure of the breathing system to describe the structure of this system. Produce a flow diagram to illustrate the sequence of action of each part in gas exchange.	**Assessing risk and working safely/ obtaining and presenting primary evidence** Demo: Pigs lungs, trachea, diaphragm. Show air sacs as spongy features	Ppt B3.1.2 Gaseous exchange **Note:** Consider all members of the class before carrying out the lung dissection. Torso or model of the breathing system. **Dissection:** Lungs with heart and trachea, board, tube, foot pump, large plastic bag and knife. A video clip on Anatomy and physiology of the lungs can be found

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
						on the BBC website at www.bbc.co.uk/learningzone/clips by searching for clip '5373'.
c	Mechanism of ventilation of the lungs.	Explain the changes that occur to bring about ventilation of the lungs in terms of relaxation and contraction of muscles, movement of the ribcage and diaphragm, changes in volume and pressure in the thorax. Calculate mean, median, mode and range of lung volumes. Interpret spirometer traces.	2	**Writing explanations** Think about the changes that occur when breathing in and out. Try to **explain** what is moving. **Using models** Model lungs – relate the model to the structure of the breathing system. **Evaluate** how good a model it is. Use a computer simulation to show the changes that occur during breathing in and out. **Describe** what happens to the diaphragm, ribcage and thorax during breathing in and breathing out. **Explain the relationship between** the associated changes in volume and pressure. Produce a table of differences.	**Working critically with primary and secondary evidence** Investigate variation of each candidates of lung volume. Interpret spirometer traces from practical measurement or from past exam papers (see B2.6.1).	Remember that breathing is a result of pressure changes in the thorax. Model lungs - balloons in bell jar with moveable rubber sheet. See human lungs article at http://science.nationalgeographic.com/science/health-and-human-body/human-body/lungs-article.html or search 'lungs article

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
		Evaluate the development and use of artificial aids for breathing, including the use of artificial ventilators.		**Discuss** situations that would require the use of artificial aids for breathing. **Models:** Discuss what machines have been used to aid breathing – show pictures or actual aids and work out how they work. **Presenting argument** Produce a poster or PowerPoint presentation to weigh up the pros and cons of the development of artificial aids for breathing.		National Geographic' in your search engine. **Lung volume:** 5 litre plastic bottle marked every 0.5 ltrs, tube, large trough with water, mouth pieces or Dettol solution or spirometer.

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
B3.1.3 Exchange systems in plants (best taught alongside B3.2.3 Transport systems in plants)						
a b c e	In plants carbon dioxide enters leaves by diffusion; most water and ions are absorbed by roots. The surface area of the roots is increased by root hairs and of leaves by the flattened shape and internal air spaces. Plants have stomata to obtain carbon dioxide and remove oxygen produced in photosynthesis. The size of stomata is controlled by guard cells which surround them.	Explain why and how the flattened, thin structure of a leaf is useful for photosynthesis and gas exchange. Describe root hair cells and explain how they are adapted for their function. Describe the structure and location of stomata and guard cells and explain their function. Explain why plants sometimes wilt.	1	**Using models** Show images of stomata open and closed on different types of leaves and root hair cells. Evaluate effectiveness **Produce a model**: How the guard cells control the size of the stomata. Evaluate strengths and weaknesses of other models in the class **Discuss:** Discuss role of guard cells in reducing wilting.	If not already covered in B2.3.1 – **Obtaining and presenting primary evidence** Investigate how the leaf is adapted for photosynthesis and describe some special adaptation. **Explain** the distribution of guard cells and stomata using nail varnish prints. **Demo guard cells:** Two long balloons with sellotape stuck on one side of each. **Observe** root hair cells of germinating cress seeds if not previously covered	Ppt B3.1.3 Exchange systems in plants Be able to suggest how having more stomata on the lower surface of the leaf helps the plant to survive better. **Leaf structure:** Bioviewers or prepared slides, microscopes. **Stomata**: Leaves from privet and spider plants, kettle, beakers, nail varnish, slides and coverslips, microscope.

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
d	If plants lose water faster than it is replaced the stomata can close to prevent wilting.	Describe the changes that occur in a plant to prevent wilting.				**Root hair cells:** Microscopes, coverclips, slides and germinating cress seeds.
d	Plants mainly lose water through their leaves, most loss is through stomata. Evaporation is faster in hot, dry and windy conditions. If plants lose water faster than it is replaced the stomata can close to prevent wilting.	Define the term transpiration. Explain how a potometer can be used to measure the rate of water uptake by a shoot. Design and carry out an investigation about factors that affect the rate of transpiration. Interpret graphs of water loss from plants over time.	1-2	**Explain** the term 'transpiration' and ask for factors that might increase the rate of transpiration. .	**Obtaining and working critically with primary evidence** **Explain and Demonstrate** • Plants lose water through their leaves using cobalt chloride paper. . • How to set up and use a potometer. **Estimate** the water loss from a plant –explain that water uptake is an indicator of water loss but not exactly the same – why not? **Obtaining and presenting primary evidence**	Know why windy conditions increase water loss. **emo:** Plant with plastic bag sealed around the leaves and cobalt chloride paper. **Demo:** Plant with plastic bag sealed around the pot placed on a balance and connect to datalogger. **Demo:** Potometer, Vaseline, leafy shoot cut under water.

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
					Investigate the effect of Vaseline on the upper and lower surfaces of a leaf – relate results to work done on leaf structure **Interpret** graphs showing rate of transpiration	**Transpiration:** Potometer, leafy shoot, Vaseline, timer, fan, lamp and hairdryer. **Vaseline:** Four privet leaves, Vaseline, washing line, paper clips and balance. Transpiration experiments can be found at www.skoool.co.uk

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
B3.2 Transport systems in plants and animals Substances are transported around the body by the circulatory system (the heart, the blood vessels and the blood). They are transported from where they are taken into the body to the cells, or from the cells to where they are removed from the body. Modern developments in biomedical and technological research enable us to help when the circulatory system is not working well. Plants have separate transport systems for water and nutrients. Students should use their skills, knowledge and understanding to: • evaluate data on the production and use of artificial blood products • evaluate the use of artificial hearts and heart valves • evaluate the use of stents.						
B3.2.1 The blood system						
a b c	The circulatory system transports substances around the body. The heart is an organ and pumps blood around the body, much of its wall is made from muscle tissue. There are four main chambers to the heart, right and left atria and ventricles.	Explain the functions of the circulatory system Describe and label a diagram of the heart showing 4 chambers, vena cava, pulmonary artery, pulmonary vein and aorta. Describe the flow of blood from the body, through the heart and lungs and back to the body.	1-2	**Presenting and writing descriptions and explanations** **Describe** the functions of the heart and circulatory system. **Using models** • Computer simulation to show the flow of blood around the heart, lungs and body. • Label a diagram of the heart and colour to show oxygenated and deoxygenated blood.	**Demo:** Show a model heart and identify the chambers, main blood vessels and valves **Demo:** Heart and lungs of a pig to show the associated vessels. Get candidates to feel the vessels. Show candidates how to go about dissecting their pig hearts and identify the vessels.	Ppt B3.2.1 The blood system Information on heart and circulation found at www.nationalstemcentre.org.uk

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
d	The direction of blood flow from the body, through the heart and lungs and out to the body. Valves ensure blood flows in the correct direction. Blood flows from the heart to organs through arteries and returns through veins. There are two separate circulation systems – to the lungs and to the other organs of the body.	Describe problems associated with the heart and explain how they can be treated. Evaluate the use of artificial hearts and heart valves.		**Describe** flow of blood by sorting cards with names of blood vessels, heart chambers, lungs and body to show direction of blood flow. **Discuss:** Discuss the different types of heart problems that can occur and how they are treated – heart attack, leaky valves, hole in the heart, blocked coronary arteries, heart transplants, artificial hearts and replacement valves. Illustrate with pictures. Produce a report or PowerPoint presentation to present to the class **Reaching agreement on scientific explanation** Research the first heart transplant and report on the conflicting views of different individuals eg medical, religious,	**Dissect** a pig's heart. See Nuffield Foundation Practical Science suggestions	http://www.nuffieldfoundation.org/practical-biology/looking-heart Useful information can be found at www.klbict.co.uk/interactive/science/heart.htm Heart animations and interactives can be found at www.smm.org/heart/heart/top.html Video clips on the heart can be found on the BBC website at www.bbc.co.uk/learningzone/clips by

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
						searching for clips '5367' and '2270'. **Demo:** Heart and lungs of pig, board, scissors, mounted needle and gloves. **Dissection:** Pig hearts, boards, scissors, gloves and mounted needles. Useful information can be found at http://kent.skoool.co.uk go to Key stage 4 → Biology → Blood and Circulation. **Note:** Consider **all** members of the class before carrying out the demonstrations.

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
e f g	Arteries have thick walls containing muscle and elastic fibres. Veins have thinner walls and often have valves to prevent back-flow of blood. Use of stents to keep arteries open. Structure and function of capillaries.	Explain the structure and function of arteries, veins and capillaries. Compare the structure and function of arteries, veins and capillaries. Describe what a stent is and what it is used for, particularly with reference to coronary arteries. Evaluate the use of stents. Explain how blood flows through capillary walls into and back from body tissue	1-2	**Developing explanations** Watch a computer simulation or video clip showing the three types of blood vessels and comparing their functions and extract information to **explain** structures of blood vessels. Produce a table **to compare** the structure of the vessels and relate to their function. Demonstrate how valves in veins prevent backflow of blood using someone with prominent veins. Students **explain** the principles of valve action **Applications and cultural understanding** Watch a video clip to gather evidence about the use of a stent. Students produce a flier for doctor's surgery to **explain** what they are, why they are used and explain how they save lives. Research the work of Galen and William Harvey and produce a presentation using medium of choice –powerpoint, animation, poster etc- to explain the implications of their work.	**Using models** **Obtaining primary evidence** **Applications and implications** Model effect of Aspirin on blood flow through vessels Use 3 straws – 1 unblocked, 1 blocked with margarine;1 with cotton wool Time coloured water flow through each. The one with margarine eventually breaks down and flow rate increases(models Aspirin effect) Students evaluate strengths and weaknesses of the model **Assessing risk and working safely** **Compare** elasticity of blood vessels	Be able to recognise veins and arteries from diagrams of blood vessels. Modelling effect of aspirin on blood Sets of 3 straws containing: • no blockage • a 5 mm plug of cotton wool – pushed near one end of the straw • a 5 mm plug of margarine – pushed near one end as above. Measuring cylinders Beaker, Water, dyed red with food colouring, at about 40 °C, Stopclock or stopwatch

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
					http://www.nuffieldfoundation.org/practical-biology/elastic-recoil-arteries-and-veins **Planning and approach and assessing risk** Students plan investigation to measure pulse rate and blood pressure – eg lying down, sitting and standing.	Useful information on blood vessels and the vascular system can be found at www.ivy-rose.co.uk by searching 'Blood Vessels - Vascular System'.

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
B3.2.2 The blood						
a b c d	Blood is a tissue consisting of plasma, white blood cells, red blood cells and platelets. Plasma transports carbon dioxide to the lungs, soluble products of digestion from the small intestine and urea from the liver to the kidneys. Function and structure of red blood cells; oxygen attaches to haemoglobin	Describe the constituents of blood. Explain the structure and function of red blood cells, white blood cells and platelets. Describe some substances transported in the blood plasma. Explain the reversible reaction between oxygen and haemoglobin and its importance in different organs	1	**Developing explanations, using models** Produce model or animation of red blood cells, white blood cells and platelets. Draw and label diagrams of red blood cells, white blood cells and platelets. Use concept map to explain the composition of blood and describe the functions of plasma, red blood cells, white blood cells and platelets. Write a word equation for the reaction of oxygen with haemoglobin. How safe is artificial blood? Do we need a blood transfusion service? **Discuss/Research:** The need for blood and explain who can/can't give blood; why is artificial blood useful?	**Working with primary evidence** Observe prepared blood smears.	Be able to name the blood part which carries most oxygen. **Blood smears:** microscopes, prepared slides or bioviewers Useful information can be found at http://kent.skoool.co.uk go to Key stage 4 > Biology > Blood and Circulation

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
e	Function and structure of white blood cells. Function and structure of platelets.	Explain the part played by white blood cells in the body's defence system against microorganisms Describe the structure of platelets and explain how they help to clot blood at the site of a wound Apply understanding of blood to explain what artificial blood is. Describe differences between real and artificial blood. Evaluate data on the production and use of artificial blood products.	1	Watch a video on Biopure Hemopure. Find evidence on the National Blood Service site to help. **Research:** Research products other than whole blood used in transfusions and produce a report evaluating them. List the differences between real and artificial blood and give the advantages and disadvantages of each.		Useful information can be found at www.blood.co.uk A magazine style video report about the use of artificial blood can be found on www.youtube.com by searching 'Medicine on the Bleeding Edge'. Information on artificial blood can be found at www.pharmainfo.net by searching for 'artificial blood'

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
B3.2.3 Transport systems in plants						
a	Flowering plants have separate transport systems: ▪ xylem transports water and mineral ions from roots to stem and leaves ▪ movement of water from roots to leaves is the transpiration stream ▪ phloem carries dissolved sugars from	Explain the structure and function of xylem and phloem and their position in roots stems and leaves. Describe what the transpiration stream is. Describe the flow rate in xylem. Interpret results of ringing experiments and radioactive isotopes.	1	**Presenting and writing arguments** Observe tree rings and work out the age of a tree trunk (also see B3.1.3 for transpiration investigations). **Explain** the similarities and differences between movement through a plant and circulation in humans	**Obtaining and presenting evidence** **Investigate** the flow of water in xylem using celery stalks with leaves and cut sections to observe position of xylem vessels. **Calculate** the flow rate of water through a celery stalk **Observe** prepared slides showing xylem and phloem in roots, stem and leaves **Using models eg** computer simulation or video clip	Ppt B3.1.3 Exchange systems in plants **Demo 1:** Celery stalk with leaves, beaker of dyed water, microscopes, slides, coverslips, scalpels and tiles. **Demo 2:** Leaves, bright light. **Flow rate:** Celery stalks with leaves, dyed water, beaker, ruler and timer.

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
	leaves to the rest of the plant.				showing ringing experiments, use of radioisotopes and aphid experiment to show transport of sugars in phloem. Students use data provided interpret the results.	**Slides:** Microscopes, prepared slides or bioviewers. See lessons on plant transport at www.skoool.co.uk
B3.3 Homeostasis Humans need to remove waste products from their bodies to keep their internal environment relatively constant. People whose kidneys do not function properly may die because toxic substances accumulate in their blood. Their lives can be saved by using dialysis machines or having a healthy kidney transplanted. Water and ion content, body temperature and blood glucose levels must be kept within very narrow ranges. Students should use their skills, knowledge and understanding to: • evaluate the advantages and disadvantages of treating kidney failure by dialysis or kidney transplant • evaluate modern methods of treating diabetes						
B3.3.1 Removal of waste and water control						
a	Waste products that have to be removed from the body include: ▪ carbon dioxide, produced by respiration and removed via the	Define the term 'homeostasis' Explain where named waste products are excreted from the body. Explain why waste products have to be excreted from the body.	1	Recap inputs and outputs of the body covered in B1.2.2. Introduce the term 'homeostasis' and describe a list of conditions that have to be controlled in the body. **Discuss:** Discuss how urea and carbon dioxide are produced in the body and	**Using models** Demonstrate effect of acid, alkali and exhaled air on hydrogen carbonate indicator	**Ppt B3.3.1 Removal of waste and water control** **Demo:** Acid and alkali, pipettes, tubes of hydrogen

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
	lungs when we breathe out ▪ urea, produced in the liver by breaking down amino acids and removed by the kidneys in urine which is stored in the bladder.			why they must be excreted from the body. **Using models** Use an outline of the body with lungs, liver, kidney and skin labelled. Cut out labels to stick on showing substances produced/excreted by these organs.		carbonate indicator solution and straw.
b c	If the water or ion content of the body is wrong, too much water may move into or out of cells; water and ions enter the body when we eat and drink. A kidney produces urine by filtering the blood, reabsorbing all the sugar and dissolved ions needed by the body and	Describe and label a diagram of the excretory system and state the functions of the kidneys and bladder. Use a model eg a flow diagram to explain how urine is made. Interpret data relating to the composition of blood, kidney fluid and urine. *NB knowledge of other parts of the urinary system, the structure*	1	**Using models:** • Locate the positions of the liver, kidneys and bladder in the human body after seeing them in a torso. **Explain** the need to excrete urea. • **Video:** Watch a video clip or computer simulation to show how urine is produced by the kidney.	**Presenting descriptions and explanations** Describe the external features of a. Dissect a pig's kidney and describe the main features. Use a podcast or digital photostory to create a presentation about the procedure and evidence collected. **Working with secondary data**	Be able to name the organ which stores urine. Be able to name two substances which will pass through the filter from blood plasma into the filtrate. Model of human body torso.

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
	as much water as the body needs. Urea, excess ions and water are excreted in urine.	*of the kidney and the structure of a nephron is **not** required*		• Use cards to sequence how urine is made and produce a flow diagram. **Explain** why protein is not found in the urine of a healthy person. Why does drinking alcohol make you dehydrated?	Interpret data about concentration of water, ions, glucose etc in blood, kidneys and urine (link active transport of sugar and ions to B3.1.1).	**Dissection:** Kidneys, boards, scalpels and gloves.
d e f	Kidney failure can be treated by a using a dialysis machine or having a kidney transplant. Treatment by dialysis restores substances in the blood to normal levels and has to be carried out at regular intervals. How a dialysis machine works.	Explain how a kidney machine works in terms of the partially permeable membrane and composition of the dialysis fluid. Explain why dialysis fluid contains sugar and ions at the same concentration as normal blood, but no urea. Describe the flow of blood between person and dialysis machine and explain the composition of dialysis fluid	1-2	Should dialysis be available to everyone? **Video:** Watch a video clip showing dialysis treatment. **Discuss:** Discuss the advantages and disadvantages of dialysis treatment. Research how a dialysis machine works and produce a script for a new nurse in the dialysis clinic to **explain** the procedure Label a diagram of a kidney dialysis machine and add notes to explain the constituents of the fluid and how the machine restores the concentration of dissolved substances in the blood to normal.	**Obtaining primary evidence** Set up mock dialysis using visking tubing. Make sure students are aware of analysis tests	**Dialysis:** Cellulose tubing, pipettes, fake urine, boiling tubes, test tubes, Benedict's solution **or** glucose test sticks, biuret reagent, **or** albustix,nitric acid and silver nitrate solution, dialysis fluid, water and goggles.

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
g h i	Kidneys transplants and precautions to avoid rejection. The recipient's antibodies may attack antigens on the donor organ. To prevent rejection the donor kidney has a similar 'tissue-type' and immunosuppressant drugs are given.	State the advantages and disadvantages of kidney transplants. Describe what antigens and antibodies are and explain how they interact. Explain why a donor kidney may be rejected and describe the precautions taken to prevent rejection. *NB Knowledge of ABO blood grouping and compatibility tables is **not** required* Describe the economic, ethical and medical considerations regarding treatment of kidney failure.	3	**Developing argument** **Video:** Watch a video clip explaining the process of kidney transplants Are kidney transplants part of a lottery? **Discuss:** Debate current discussions about organ donation – opt in or opt out cards. Show a donor card. Students prepare for a debate about the supply of kidneys for transplant and the criteria for selection Watch a computer simulation showing antibodies attacking antigens on a transplanted kidney. Describe and draw labelled diagrams to explain tissue rejection. Research the process of kidney transplants, including tissue typing and use of immunosuppressant drugs. Produce a leaflet to give to patients awaiting a kidney transplant to explain the process.	Use observations and tests to identify samples of urine from different people. After teaching B3.3.3 carry out an experiment to identify urine samples from a diabetic, someone with kidney disease, normal urine, healthy person who had drunk one and a half litres of water half an hour earlier and urine from healthy person produced on a hot day.	Be able give two advantages of a kidney transplant rather than dialysis treatment. Be able to give one disadvantage of having a kidney transplant. **Note:** Knowledge of ABO blood grouping and compatibility is **not** required. A video clip on human kidney transplants can be found on the BBC website at www.bbc.co.uk/learningzone/clips by

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
				Design a poster to explain and encourage people to carry organ donor cards. **Discuss:** Moral dilemma – research cost of dialysis and transplants. Discuss considerations in terms of cost as to how kidney patients should be treated – lifetime dialysis, transplant, shortage of kidneys, buying kidneys from healthy people and prioritising lists for surgery. Produce arguments for and against the options.		searching for clip '4186'. **Urine:** artificial urine samples made with tea – sugar added, protein added, normal colour, dilute, concentrated, biuret reagent or albustix, Benedict's solution **or** glucose test sticks, test tubes, water bath, goggles.

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
B3.3.2 Temperature control						
b c a	Body temperature is monitored and controlled by the thermoregulatory centre in the brain. It has receptors sensitive to the temperature of the blood. Temperature receptors in the skin send impulses to the thermoregulatory centre.	Describe normal body temperature of humans and different methods to measure it Calculate a mean and describethe range of body temperatures for the class. Compare the changes that occur when body temperature is too high or too low. Explain that body temperature is monitored and controlled by the thermoregulatory centre in the	1	**Describe** changes that occur when body temperature is too high and too low and write notes in the form of a table or a flow chart. **Discuss:** Discuss how the body detects and controls core body temperature. **Video:** Watch a video clip or computer animation showing changes that occur when body temperature is too high or too low and make notes. **Models**	**Obtaining primary evidence** Investigate the range of normal body temperature in the class and calculate the mean. Monitor skin temperature in different conditions using surface temperature sensors. **Working with secondary evidence** Use data from tables to **calculate** the volume of urine	Ppt B3.3.2 and 3 Temperature and sugar control **Note:** The name of the hypothalamus is **not** required. **Body temperature:** Clinical thermometers, forehead thermometers.

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
	Sweating cools the body; water balance in hot weather.	brain, using information about blood and skin temperature. Explain why we drink more fluid during hot weather.		Show a model of the structure of the skin. **Discuss:** Discuss the effects of sweating on urine formation and why we drink more fluids in hot weather (links with B1.2.2 and B3.3.1).	lost by the body/ the proportion of water gained by the body from food eaten.	Skin temperature sensors and dataloggers.
d e	Changes in terms of blood flow to the skin and sweating if core body temperature is too high. Changes in terms of blood flow to the skin and shivering if core body temperature is too low.	Explain why the skin looks red when you are hot and pale when you are cold. HT only **Explain how sweating cools the body as it evaporates.** **Explain the changes in blood vessels supplying skin capillaries when the body is too hot or too cold.** **Explain how shivering helps to warm the body by releasing more energy from respiration.** Plot cooling curves.	1	HT only **Task: Draw diagrams to explain the changes in blood vessels supplying skin capillaries when the body temperature is too high or too low.** Why don't kangaroo rats sweat? HT only **Recap respiration and energy release to explain the effect of shivering (links with B2.6.1).**	Demonstrate the effect of cooling by ethanol on the skin. Discuss the effect of evaporation – **explain** in relation to kinetic theory. Investigate the effect of sweating on the rate of cooling using tubes of hot water wrapped in wet and dry paper towels. Plot cooling curves and make conclusions.	Explain why this could be dangerous for the animal. **Sweating:** Boiling tubes, paper towels, elastic bands, thermometers **or** temperature sensors, pipettes and timers.

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
B3.3.3 Sugar control						
a b	Blood glucose concentration is monitored and controlled by the pancreas by producing insulin, which allows glucose from the blood to enter cells **HT only** **Glucagon is also produced by the pancreas to convert stored glycogen back**	Recognise that insulin is produced by the pancreas and explain its effect on blood glucose levels. **HT only** **Recognise that glucagon is also produced by the pancreas and**	1-2	Is diabetes always treatable? Can we avoid diabetes? **Use a model** to show the position of the pancreas in the body. If possible get someone who has type 1 diabetes to explain the initial symptoms, how they were diagnosed, what they have to do to control the disease – blood testing, injections, diet, exercise, demonstrate blood testing and show the vials of insulin and pens used today.	**Applications of science** Demonstrate how doctors used to diagnose diabetes by tasting fake urine, then test with Benedict's solution and glucose test strips. Which gives the most accurate results?	**Demo:** weak tea samples with and without glucose, glucose test strips, Benedict's solution and water bath. Model of human body torso. Blood testing meters and test strips.

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
c d	**into glucose when blood glucose levels fall.** In Type 1 diabetes glucose levels may rise too high because the pancreas does not produce enough insulin. Type 1 diabetes can be controlled by diet, exercise and injecting insulin.	**explain its effect on blood glucose levels.** Explain the cause, effects, treatment and problems associated with the disease. Interpret glucose tolerance test. Evaluate modern methods of treating diabetes.		Why is extreme thirst an indication of diabetes? **Video:** Watch a video about type 1 diabetes. Research and produce a report to **explain** the cause, effects, treatment and problems associated with the disease. **Interpret data** on glucose tolerance tests in healthy people and diabetics. **Research:** Research the work of Banting and Best. **Research:** Research how treatment of diabetes has developed including use of human insulin produced by bacteria, current research into pancreas cell transplants and stem cell research (links with B1.7.2). Create opportunities for pupils to develop their own models and analogies to explain how feedback mechanisms regulate systems in the body.		Video clips on blood sugar levels and diabetes can be found on the BBC website at www.bbc.co.uk/learningzone/clips by searching for clips '7314' and '5371'. Further information on diabetes can be found at www.diabetes.org.uk

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
B3.4 Humans and their environment Humans often upset the balance of different populations in natural ecosystems, or change the environment so that some species find it difficult to survive. With so many people in the world, there is a serious danger of causing permanent damage not just to the local environments but also to the global environment unless our overall effect is managed carefully. Humans rely on ecosystems for food, water and shelter. Students should use their skills, knowledge and understanding to • analyse and interpret scientific data concerning environmental issues • evaluate methods used to collect environmental data and consider their validity and reliability as evidence for environmental changes • evaluate the methods being used to feed and provide water to an increasing human population, both in terms of short term and long term effects						
B3.4.1 Waste from human activity						
a	Rapid growth in the human population means more waste,	Describe the problems associated with an increasing human population.	1-2		**Working with secondary data**	Ppt B3.4.1 Waste from human activity

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
c	which could lead to more pollution. Humans reduce the amount of land available for other plants and animals by building, quarrying, farming and dumping waste.	Interpret graphs showing human population growth.		**Describe** the effects of an increasing population and write a list. **Communication for audience and purpose** Discuss what water may become polluted with. Show images of sewage, industries, eutrophication and effects on water life.	Show how fast the world human population is increasing using the counter on the Worldometers' website. **Interpret** graphs showing human population growth and extrapolate.	Current world population can be found on the Worldometers' website at www.worldometers.info/population Websites or past exam questions.
b	Waste may pollute **water** with sewage, fertilisers or toxic chemicals. Waste may pollute **air** with smoke and gases such as sulfur dioxide, which contributes to acid rain.	Describe how water can be polluted with sewage, fertiliser or toxic chemicals. Analyse and interpret data about water pollution Describe examples of air pollutants and where they come from.	3	Do factories cause more pollution than farmers? **Discuss:** Discuss what air may be polluted with and where the pollutants come from. **Models:** Show images illustrating the effects of acid rain on buildings, trees, lakes and images of smog. **Discuss:** Discuss the Clean Air Act and explain the significance to industrial pollution. Compare now to 100 years ago	**Planning an approach** Plan to investigate the effect of fertiliser on growth of duckweed and oxygen levels to be monitored and results explained later. Evaluate results **Interpret data** about water pollutants **Selecting and managing variables**	Demo: Beakers containing different concentrations of fertiliser, duckweed plants, oxygen sensors and dataloggers. **Sulfur dioxide:** Petri dishes, cotton wool,

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
	Waste may pollute **land** with toxic chemicals such as pesticides and herbicides, which may be washed from the land into the waterways.	Describe the effects of smoke on buildings, humans and plant photosynthesis. Explain how carbon dioxide contributes to global warming. Describe how acid rain is formed. Describe the effects of acid rain on living organisms. Investigate the effect of sulfur dioxide on seed germination. Analyse and interpret data about air pollution. Evaluate the use of fertiliser on plant growth and oxygen levels. Describe what herbicides and pesticides are used for. Describe the uses of DichloroDiphenylTrichloroethane (DDT) and explain why it was banned.		Produce poster(s) or diagrams to describe the causes and effects of sulfur dioxide, carbon dioxide and smoke pollution to complete for homework. Show images of how land is used or damaged by man and the effects of pollution – describe the impact on environment. **Discuss:** Discuss the sources and effects of toxic chemicals; what pesticides and herbicides are used for. How might these affect life in rivers and streams? **Research:** Research the use of DDT and why it was banned – produce a report or presentation. **Explain** the recent increase in bed bugs and discuss the advantages and disadvantages of using pesticides to kill them.	Investigate the effect of sulfur dioxide on the germination of cress seeds. Measure the pH of rain water samples Interpret data about air pollution (links with B3.4.3).	water, small pots of sodium metabisulfite solution, cress seeds, plastic bags with ties and goggles. Examples of toxic chemicals with hazard symbols and some pesticides and herbicides.

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
B3.4.2 Deforestation and the destruction of areas of peat						
a b	Large scale deforestation has increased the release of carbon dioxide and reduced the rate at which carbon dioxide is removed from the atmosphere and 'locked up' in wood.	Define the term 'deforestation'. Explain why vast tropical areas have been cleared of trees. Explain how deforestation increases the amount of carbon dioxide in the atmosphere and leads to a reduction in biodiversity.	1-2	Why use peat free compost? **Describe** using evidence from images or video clips of deforestation taking place – clearing, burning, rotting and destruction of habitats. **Discuss:** Discuss what effects this has on the environment – carbon dioxide, methane and reduction in biodiversity. Do beef-burgers affect the environment?	**Investigate** the growth of plants in 'peat free' and peat based composts (links with B3.4.3).	Ppt B3.4.2 Deforestation and the destruction of areas of peat Video clips on rainforest destruction and changing ecosystems can be found on the

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
c d	Deforestation leads to reduction in biodiversity. Deforestation has occurred so biofuel crops can be grown and more land can be used to rear cattle and grow crops for food. Cattle and rice fields release methane The destruction of peat bogs releases carbon dioxide into the atmosphere	Explain how deforestation could lead to an increase in methane in the atmosphere. Explain what peat is and why it is important to preserve areas of peat.		**Explain** why areas of tropical rain forest are being cleared with images or video clips – timber, land for biofuel crops, cattle and rice – and how this can lead to global warming. **Writing for audience and purpose** Prepare a newspaper article for either • a scientific journal • tabloid newspaper • Environmental News • Burger chain Present a bias of choice to suit the article Show a block of peat and peat compost. Ask what it is and what it is used for. **Explain** why is destruction of peat bogs harmful to the environment? **Activity:** Produce a worksheet to help students research and prepare a PowerPoint presentation, with images, explaining all the main points listed above. Candidates could work in groups		BBC website at www.bbc.co.uk/learningzone/clips by searching for clips '3096' and '3234'. **Composts:** 'Peat free' compost, peat based compost, plant pots and seedlings.

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
				to divide up the areas of research and give a joint presentation.		
B3.4.3 Biofuels						
a	Levels of carbon dioxide and methane in the atmosphere are increasing and contribute to 'global warming'. An increase of only a few degrees Celsius may cause changes in	Explain the terms 'greenhouse effect' and 'global warming'. Explain with the aid of a diagram how levels of carbon dioxide and methane contribute to global warming. Describe the possible effects of global warming.	1	**Is the Earth really in danger?** **Obtain evidence** about the causes and effects of global warming.eh video, internet If not already done in B3.4.1, produce a poster to **explain** the greenhouse effect including sources of carbon dioxide and methane.	**Obtaining primary and secondary data** Measure the temperature inside and outside a greenhouse over 24 hours. Use to **explain** the greenhouse effect using the words or phrases "absorb" and "re-radiate heat".	Ppt B3.4.3 Biofuels A useful PowerPoint presentation can be found at http://www.schoolscience.co.uk by searching 'powerpoint presentations' and

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
	the Earth's climate, a rise in sea level, a reduction in biodiversity, changes in migration patterns and result in changes in the distribution of species.			**Describe** the possible effects of global warming. **Model** Show a computer simulation of the greenhouse effect. Is 'alternative' energy the same across the world? Should developing countries restrict their development? Are carbon footprints bad? **Evaluate** a variety of sources to present an argument for or against decisions taken to manage sustainability, e.g. biofuels versus food crops	Demonstrate how a black object absorbs and re-radiates heat using sensors or hold near the skin	selecting 'Practical Action Climate Change Powerpoint Presentations'. **Video:** The truth about climate change with David Attenborough. **Video:** An inconvenient truth with Al Gore. **Greenhouse:** temperature sensors and dataloggers. **Demo:** black object, infra red lamp, temperature sensors
b	Carbon dioxide can be sequestered in oceans, lakes and ponds and this is important in removing carbon dioxide from the atmosphere.	State that much carbon dioxide is stored in oceans. Evaluate methods used to collect environmental data and consider their validity and reliability as	1	**Discuss: Looking at bias in scientific research** Find out about the recent 'climategate' – alleged distortion of facts by scientists. **Research:** Research new ideas about tackling climate change, and produce a	**Working with secondary data** Interpret data on carbon dioxide and methane levels in the atmosphere and temperature.	Useful information on climate change can be found at www.wwf.org.uk by searching 'tackling climate change' **or** at

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
		evidence for environmental change.		report or plan a campaign to get people to take action to combat climate change.	**Evaluate** how the data was collected – is it valid and reliable?	www.UPD8.org.uk by searching 'climate change – what will you do?'.
c	Biofuels can be made from natural products by fermentation.	Define the term 'biofuel'. Write the equation for the production of ethanol using yeast. Explain the advantages and disadvantages pf growing crops for biofuels.	1	Exhibition of different fuels and discuss where they come from. What is a biofuel? **Using models:** • Show image of sugar cane and get candidates to produce a flow diagram to explain how it can be used to produce ethanol. • Show images of 'Gasohol' used in Brazil to power cars. • Show images of other crops used for fuels. • Watch a video clip about biofuel crops and environmental and ethical issues.	Demonstrate production of ethanol from yeast and burn the fuel.	A video clip on Biofuels can be found on the BBC website at www.bbc.co.uk/learningzone/clips by searching for clip '476'.

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
				Draw a table **explaining** the advantages and disadvantages of growing crops for biofuels.		
c	Biogas can be produced by anaerobic fermentation of plant products or waste materials containing carbohydrates.	Define the term 'biogas'. State that biogas is produced by anaerobic respiration of plant products or animal wastes. Evaluate the use of biogas generators.	1-2	**Explain** how methane can be produced from plant materials and animal wastes containing carbohydrates. **Compare and evaluate** biogas generators Watch a video showing different biogas generators. Discuss the advantages and disadvantages of each design. Design and build a simple gas generator. Evaluate the designs and select the best and demonstrate how the methane can be burned as a fuel. Model for pupils how to question the validity and reliability of data so that they can evaluate evidence relating to biofuels for bias, manipulation or misrepresentation.	**Demo:** burning methane using a Bunsen burner. **Secondary data** Use data from a table to calculate the yearly profit from a biogas generator.	Be able to explain how the output from a biogas generator is affected by climatic conditions.

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
B3.4.4 Food production						
a b	Energy and biomass losses in food chains; shorter food chains are more efficient for food production. Efficiency of food production can be improved by restricting	Explain how energy is lost at each level in a food chain and calculate percentage energy losses. Explain why shorter food chains are more efficient for food production.	1-2	Explain food chains and pyramids of biomass covered in B1.5.1. **Models:** Interpret data on energy transfer in food chains and list energy losses at each level. **Calculate** the percentage of energy transferred at each stage.	**Primary evidence** Carry out a survey to find out what sort of eggs people buy and why. Display data appropriately	Ppt B3.4.4 Food production

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
	energy losses from food animals.	State how energy losses from food animals can be reduced. Evaluate the positive and negative effects of managing food production. Explain why people buy foods that have travelled a long way and the effect of this on the environment. Recognise that practical solutions for human needs may require compromise between competing priorities.		Is locally produced food best? Is local recycling energy efficient? Who is responsible for the Earth's resources? **Using primary data** Students describe what they had for lunch and write food chains for them. Consider different food chains relating to food production and evaluate how efficient each is in terms of energy produced for consumption per unit of land. Watch video clips showing battery hens, animals reared indoors and free range animals. **Explain** how energy losses are reduced when animals are reared indoors. List the advantages and disadvantages of factory farming animals. **How great are your food miles?**		

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
				Consider the pros and cons of eating foods that have travelled a long way.		
c	Fish stocks are declining and need to be maintained at levels where breeding continues or some species may disappear. Net size and fishing quotas play an important role in conservation of fish stocks.	Explain why some fish stocks are declining and why this is a problem. Describe ways that fish stocks can be conserved. Give an example of sustainable food production.	1	Who can catch the most fish? **Discuss:** The problems of catching both large and small fish and relate to the fishing industry. How can we maintain fish stocks? **Research:** Research fishing quotas for different types of fish and display the information. **Research:** Research what has happened to Blue Fin Tuna and what we could do to increase fish stocks.		Be able to give examples of sustainable food production. **Fishing:** Different sized nets, different sized fish or objects to represent fish
d	Fusarium is useful for producing mycoprotein, a protein rich food suitable for vegetarians. The fungus is grown on glucose syrup in aerobic conditions, and the biomass is harvested and purified.	State that the fungus Fusarium can be used to produce mycoprotein which is a protein rich food. Describe how Fusarium is grown to produce mycoprotein that can be eaten.	1	**Is there an answer to world food shortage?** Do a taste comparison of a mycoprotein based food and its 'real' counterpart. Can you tell the difference? Which tasted the best? **Developing argument**	**Applications and implications of scientific evidence** Grow the fungus on glucose agar and allow candidates to observe under a microscope.	**Demo:** Fusarium grown on agar plate, forceps, slides, coverslips, microscopes OR prepared slides of Fusarium.

Spec Reference	Summary of the Specification Content	Learning Outcomes *What most candidates should be able to do*	Suggested timing (lessons)	*Opportunities to develop Scientific Communication skills*	Opportunities to develop and apply Practical and Enquiry skills	Self/Peer assessment Opportunities & resources *reference to past questions that indicate success*
		Evaluate the use of mycoprotein as a food. Summarise all the areas regarding the growing human population – energy, food, water, space, pollution, resources.		Compare values for protein, fat and fibre found in beef and mycoprotein. Produce a marketing strategy to sell more mycoprotein **Models:** Research how foods such as Quorn are produced and produce a flow diagram. **Explain** the advantages and disadvantages of using mycoprotein as a food and produce a poster. Produce a mind map to summarise all the issues related to the growing human population.		