# Scheme of work

Combined Science: Trilogy

## Biology – Organisation

This resource provides guidance for teaching the Organisation topic from our new GCSE in Combined Science; Trilogy (Biology). It has been updated from the draft version to reflect the changes made in the accredited specification.

There have been small changes in the wording to the required practicals in section 4.1.1.2 and 4.2.2.1. In addition some minor changes have been made to the specification in sections 4.2.1 Principles of organisation, 4.2.2.1.The human digestive system, 4.2.2.3 Blood, 4.2.2.4 Coronary heart disease, 4.2.2.5 Health issues, 4.2.2.6 The effect of lifestyle, 4.2.3.1 Plant Tissues and 4.2.3.2 Plant organ system. These alterations have not required changes to the scheme of work.

The scheme of work is designed to be a flexible medium term plan for teaching content and development of the skills that will be assessed.

It is provided in Word format to help you create your own teaching plan – you can edit and customise it according to your needs. This scheme of work is not exhaustive; it only suggests activities and resources you could find useful in your teaching.

**4.2 Organisation**

**4.2.1 Principles of organisation**

This section is covered at KS3, so could be omitted, depending on your students, or taught as an introduction to 4.1 Cell biology.

Organ systems associated with the specification are the Digestive, Circulatory, Respiratory, Nervous, Endocrine, Reproductive and Excretory Systems.

| **Spec ref.** | **Summary of the specification content** | **Learning outcomes**  *What most candidates should be able to do* | **Suggested timing (hours)** | **Opportunities to develop Scientific Communication skills** | **Opportunities to apply practical and enquiry skills** | **Self/peer assessment opportunities and resources**  *Reference to past questions that indicate success* |
| --- | --- | --- | --- | --- | --- | --- |
| 4.2.1 | Principles of organisation  Cells are the building blocks of living organisms.  A tissue is a group of cells with a similar structure and function.  Organs are groups of tissues working together.  Organs are organised into organ systems.  An organism is made up of several organ systems. | Explain the terms cell, tissue, organ, organ system and organism, and be able to give examples of each.  Have an understanding of the size and scale of cells, tissues, organs, organ systems and organisms.  Describe the main systems in the human body and their functions. | 0.5 | Recap KS3 work on organisation using models and images of the human body and organs.  Prepare a set of cards with images of different body organs and ask pupils to arrange the cards into organ systems. What is the function of each organ within its system?  Produce a flow diagram showing organisation in large organisms and relate to size. | Using models.  Critically evaluating models to identify those features which are effectively represented and those which are not. | Torso, models or images of systems, models or images of organs showing different tissues |

**4.2.2 Animal tissues, organs and organ systems**

Students should know the organs in the digestive system from KS3, so 4.2.2.1 could be covered as a revision exercise for homework.

The structure and function of the gas exchange system was covered at KS3. For KS4 the focus is on the relationship between the circulatory and gas exchange systems.

4.2.2.2 Heart and blood vessels has links with 4.4.2 Respiration. Some teachers may wish to move on to teach parts of 4.4.2.2 Response to exercise immediately after the heart and blood in 4.2.2.2 and 4.2.2.3.

4.2.2.3 Blood, also links with 4.3.1.6 Human defence systems and 4.3.1.7 Vaccination.

4.2.2.4 Coronary heart disease could be taught with the heart, or later following on from Health issues in 4.2.2.5.

There are links with 4.1.1.3 (Cell specialisation), 4.1.3.1 (Diffusion) and 4.1.3.3 (Active transport).

| **Spec ref.** | **Summary of the specification content** | **Learning outcomes**  *What most candidates should be able to do* | **Suggested timing (hours)** | **Opportunities to develop Scientific Communication skills** | **Opportunities to apply practical and enquiry skills** | **Self/peer assessment opportunities and resources**  *Reference to past questions that indicate success* |
| --- | --- | --- | --- | --- | --- | --- |
| 4.2.2.1 | The human digestive system  The structure and functions of the digestive system. | Describe the functions of the digestive system to digest and absorb foods.  Identify the positions of the main organs on a diagram of the digestive system.  Know that food molecules must be small and soluble in order to be absorbed into the blood.  Describe the functions of the organs in the system  Explain how the small intestine is adapted for its function. | 0.5 | Recap the functions of the digestive system, and organs in the system from KS3.  Label a diagram of the digestive system and colour areas where digestion, digestion and absorption of food and absorption of water occur.  Watch the video of digestion of an egg sandwich (see resources).  Describe the pathway of an egg sandwich from mouth to anus. Tell it as a story. | Demonstrate the digestion show:   * mouth is potato masher in a bowl (add food and mash). Squirt in saliva. * transfer into a sandwich bag (stomach) and squeeze with ‘enzymes’. * transfer into another bowl via a sieve (small intestine). * what is left in the sieve must be soaked up with a sponge (large intestine) then emptied into a small sandwich bag (rectum). * cut a hole in corner of bag for anus and show egestion.   View sections of the small intestine under a microscope  Make a model to show how the villi increase the surface area of the small intestine. | Model of the digestive system and organs.  [BBC Bitesize: Digestive system](http://www.bbc.co.uk/education/guides/zwqycdm/revision)   * Two bowls * Masher * Food * Bottle of ‘saliva’ and ‘enzymes’ * Sieve * Two sandwich bags * Scissors * Microscopes * Slides of small intestine.   [Digestion of egg sandwich video](https://www.youtube.com/watch?v=P5lyQUtq1KQ) |
| 4.2.2.1 | Properties of enzymes  Enzymes are biological catalysts.  The properties of enzymes.  The lock and key theory and collision theory can be used to explain enzyme action. | Define the terms ‘catalyst’ and ‘enzyme’.  Describe the properties of enzymes.  Explain why enzymes are specific and are denatured by high temperatures and extremes of pH.  Use the lock and key theory and collision theory to explain enzyme action. | 1 | Recap KS3 work on enzymes.  Demo: the action of an inorganic catalyst and catalase, using living and dead tissues, on the breakdown of hydrogen peroxide. Use the observations to lead into the properties of enzymes.  Watch a video clip to help to describe the action of catalase.  Watch computer simulations to help make notes and explain the properties of enzymes.  Make models or cut-outs to demonstrate the shape of the active site of an enzyme and the shape of the substrate(s).  Demo: how the rate of the catalase reaction can be measured using a gas syringe or inverted cylinder of water and timer to prepare for the Required practical next lesson. | Interpret observations of the action of a catalyst and of catalase from celery, potato, fresh liver and boiled liver on hydrogen peroxide.  Explore how the rate of a reaction can be measured by measuring the volume of gas given off in a given time.  Calculate the rate using data obtained.  Discuss how the equipment could be adapted to investigate the effect of a factor on the rate of the reaction.  Make predictions and identify variables. | Demo: Manganese dioxide, liver, boiled liver, celery, apple or potato, hydrogen peroxide, test tubes or small beakers and goggles.  [BBC Bitesize: Enzymes and active sites](http://www.bbc.co.uk/education/clips/zpk9wmn)  [Properties of enzymes](http://inteleducationresources.intel.co.uk/content/keystage4/biology/pc/modules/digestion/digestion_part_3/index.html)  Demo: living tissue, hydrogen peroxide, flask, delivery tube, gas syringe, cylinder and trough, timer. |
| 4.2.2.1 | Required practical:  Investigate the effect of pH on the rate of reaction of amylase enzyme.  Students should use a continuous sampling technique to determine the time taken to completely digest a starch solution at a range of pH values. Iodine reagent is to be used to test for starch every 30 seconds.  Temperature must be controlled by use of a water bath or electric heater. | Carry out a safe, controlled investigation to measure the rate of the catalase under different conditions.  Draw a diagram of the apparatus and write a method. Identify variables. Present and analyse the results: calculate rates of reaction using raw data and graphs. Draw conclusions and give explanations for the results. | 1.5 | Required practical. | Required practical:Carry out a safe, controlled investigation to measure the rate of the catalase reaction under different conditions. Draw a diagram of the apparatus and write a method. Identify variables. Present and analyse the results: calculate rates of reaction using raw data and graphs. Draw conclusions and give explanations for the results. |  |
| 4.2.2.1 | Human digestive enzymes  Enzymes in the digestive system chemically digest food into small, soluble molecules that can be absorbed.  Names of enzymes with substrates, products and sites of production.  Bile is made by the liver and stored in the gall bladder. It helps in the digestion of fats by neutralising acid from the stomach and emulsifying fats.  Different enzymes work best at different temperatures and pH values.  Required practical: Food tests  Use qualitative reagents to test for a range of carbohydrates, lipids and proteins. To include: Benedict’s test for sugars; iodine test for starch; and Biuret reagent for protein. | Explain why foods need to be digested into small, soluble molecules.  Describe the three types of enzymes involved in digestion, including the names of the substrates, products and where the enzymes are produced.  Explain how bile helps in the digestion of fats.  Interpret graphs to determine the optimum temperature or pH for an enzyme.  Carry out other enzyme controlled investigations as appropriate.  Calculate the rate of enzyme controlled reactions.  Interpret the results from enzyme controlled reactions. | 2 | Observe a model for digestion using popper beads to illustrate large molecules being broken into smaller ones.  Introduce the names of the three groups of digestive enzymes, what they digest and the products formed. Present the information in a table.  Discuss the role of bile and demonstrate the action of washing up liquid on fats.  Demonstrate the effect of bile salts on the rate of digestion of milk using a pH indicator.  Using a model or large poster of the digestive system identify where each type of enzyme and bile is produced.  Add labels to the digestive system diagram to show where the different enzymes and bile are produced.  Optional investigations or use computer simulations and interpret and explain the results:   * Investigate the optimum pH values for pepsin and trypsin. * Investigate the effect of temperature on amylase activity.   Use the BBC activity about the digestive system.  Make a life size model of the digestive system.  Role play – What happens to food as it moves along the digestive system? | Use bead model.  Investigate the action of amylase on starch using a model gut or interpret the results using the computer simulation.  Watch the demos and discuss the outcomes. Explain why pH is measured to indicate the rate of fat digestion.  Investigate the optimum pH values for pepsin and trypsin enzymes.  Relate the results to their sites of action in the digestive system.  Investigate the effect of temperature on amylase activity – measure time taken for starch to disappear. Plot results and find optimum temperature for amylase.  Plot and interpret graphs about enzyme activity; determine optimal temperatures and pH values. | Model: Strings of popper beads.  Model gut: amylase solution, starch solution, cellulose tubing, beaker, iodine solution, Benedict’s solution, test tubes, spotting tile, waterbath.  [Digestion experiments](http://inteleducationresources.intel.co.uk/content/keystage4/biology/pc/modules/digestion/digestion_experiments/index.html)  Demo: large trough of water, greasy frying pan, washing up liquid, tube of water and olive oil  Demo: two tubes full cream milk, sodium carbonate solution, phenolphthalein or UI solution, lipase solution, +/- washing up liquid and timer.  pH: Pepsin solution, trypsin solution, buffer solutions at different pH values, UI strips, egg white suspension, test tubes, timers and goggles.  Amylase: amylase solution, starch solution, test tubes, water baths at different temperatures, thermometers, glass rods, spotting tiles, iodine solution, timers, goggles.  [BBC Bitesize; Digestive system](http://www.bbc.co.uk/education/guides/zwqycdm/activity) |
| 4.2.2.2  4.2.2.2 | The heart and blood vessels  The heart is a double pump.  How the heart is adapted for its function.  The names of the blood vessels associated with the heart.  Pacemaker cells regulate the beating of the heart.  Artificial pacemakers correct irregularities in heart rate.  How the lungs are adapted for efficient gas exchange. | Describe the functions of the heart and circulatory system  Describe and label a diagram of the heart showing four 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.  Explain how the heart is adapted for its function.  Describe the heart as a double pump and explain why this is efficient.  Describe the function of the pacemaker cells and coronary arteries.  Label the main structures in the gas exchange system – trachea, bronchi, alveoli and capillary network around alveoli.  Explain how the alveoli are adapted for efficient gas exchange. | 1.5 | Describe the functions of the heart and circulatory system.  Show pictures of a single and a double circulatory system. Pupils write down similarities and differences. Discuss the reasons why.  Use 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.  Describe the flow of blood by sorting cards with names of blood vessels, chambers, lungs and body to show direction of blood flow.  Research the work of Galen and William Harvey and produce a report.  Recap KS3 work on the structure and function of the gas exchange system. Use a model and identify the main organs in the gas exchange system.  Label a diagram of the gas exchange system.  Label a diagram of the alveoli and explain how they are adapted for efficient gas exchange. | 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. Allow students to feel the vessels. Show students how to dissect their pig hearts and identify the vessels.  Dissect a pig’s heart. See Nuffield Foundation Practical Science suggestions.  Show lungs and trachea of a sheep from a local butcher. Identify the main structures and discuss the roles.  Inflate the lungs with a bicycle pump. | Model heart  Demo: Heart and lungs of pig with vessels attached, board, scissors, mounted needle, gloves.  Dissection: hearts with vessels attached, boards, scissors, mounted needles, gloves.  [Practical Biology: Looking at a heart](http://www.nuffieldfoundation.org/practical-biology/looking-heart)  [BBC Bitesize; The human heart](http://www.bbc.co.uk/education/clips/zx7qn39) (video clip showing heart and pacemaker cells).  [Activity: Cards to sort](http://www.klbict.co.uk/interactive/science/heart.htm)  [The structure of the heart](http://inteleducationresources.intel.co.uk/content/keystage3/biology/pc/learningsteps/heart_structure/launch.html)  Torso or model of gas exchange system.  Sheep lungs and trachea (PLUCK), bicycle pump |
| 4.2.2.2 | Structure and function of arteries, veins and capillaries | Explain how the blood vessels are adapted for their function. | 1 | Use computer simulation or video clip showing the three types of blood vessels and comparing their functions. Extract information to explain the structure of the blood vessels.  Label diagrams of the three types of blood vessel.  Produce a table to compare the structure of the vessels and relate to their function.  Demo: how valves in veins prevent backflow of blood using someone with prominent veins. Students explain the principles of valve action. | Observe prepared slides of the different vessels, or use bio-viewers. Compare their size and structure.  Measure pulse rate and blood pressure – lying down, sitting and standing. | Microscopes, prepared slides, bio-viewers.  [The blood vessels](http://www.abpischools.org.uk/page/modules/heartandcirculation/heart5.cfm?coSiteNavigation_allTopic=1)  Pulse and blood pressure: timers or pulse rate sensor, blood pressure monitor. |
| 4.2.2.4 | Coronary heart disease  Fatty material builds up in coronary arteries reducing blood flow to the heart muscle.  Stents can be used to keep the coronary arteries open.  Statins reduce cholesterol levels, so fatty material is deposited more slowly.  Faulty heart valves can be replaced with biological or mechanical ones.  Heart failure can be treated with a heart and lung transplant.  Artificial hearts can be used whilst waiting for a transplant, or to allow the heart to rest and recover. | Describe problems associated with the heart and explain how they can be treated.  Evaluate the use of drugs, mechanical devices and transplants to treat heart problems, including religious and ethical issues. | 1 | Watch video clip about coronary heart disease.  Discuss the different types of heart problems that can occur and how they are treated –blocked coronary arteries, heart attack, faulty valves, hole in the heart, drugs, transplants, artificial hearts and replacement valves. Produce a report or PowerPoint presentation.  Observe illustrations of artificial hearts and replacement valves.  Demonstrate effect of blockage in tube on rate of water flow.  Observe video of heart and lung transplant.  BBC animation and quiz about heart disease.  Research the first heart transplant. | Demo: Calculate the rate of water flow through tubing.  Evaluate the use of models to represent blocked arteries. | [BBC Bitesize: Coronary heart disease](http://www.bbc.co.uk/education/clips/zqsq6sg)  Artificial heart and valves if available otherwise show illustrations.  Demo: Rigid, transparent tubing – one left open and the other partially blocked with wax, funnel, measured volumes of water, timer.  [BBC Bitesize: Heart and lungs transplant](http://www.bbc.co.uk/education/clips/z6sjxnb)  [BBC Bitesize: The circulatory system](http://www.bbc.co.uk/education/guides/zhnk7ty/activity) |
| 4.2.2.3 | Blood  Blood is a tissue consisting of plasma, red blood cells, white blood cells and platelets.  Plasma transports dissolved chemicals and proteins around the body.  Red blood cells transport oxygen attached to haemoglobin.  White blood cells help to protect the body against infection.  Platelets are fragments of cells involved in blood clotting. | Describe the four main components of blood.  Explain how each component is adapted for its function.  Identify pictures of the different blood cells. | 1 | Discuss the functions of blood and describe the four main components of blood.  Draw and label diagrams of red blood cells, white blood cells and platelets.  Watch BBC lesson about blood with animations (see resources).  Produce models of red blood cells, white blood cells and platelets.  Produce a Mind 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. | Observe prepared blood smears, or use bio-viewers. Compare the size and number of red and white blood cells. | Microscopes, prepared slides or bio-viewers.  [BBC Bitesize: Blood](http://www.bbc.co.uk/education/guides/ztp9q6f/revision/4) |
| 4.2.2.5  4.2.2.6 | Health issues and Effect of lifestyle on non-communicable diseases  Health is the state of physical and mental well-being.  Factors such as diet, stress and life situations can have a serious effect on physical and mental health.  Diseases are major causes of ill health.  Different diseases may interact: defects in the immune system increase the chance of catching an infectious disease.  Viral infections can trigger cancers.  Immune reactions can trigger allergies.  Physical ill-health can lead to depression and mental illness.  Various risk factors are linked to some non-communicable disease. | Explain how diet, stress and life situations can affect physical and mental health.  Give examples of communicable and non-communicable diseases.  Describe examples of how diseases may interact.  Describe the effects of diet, smoking, alcohol and exercise on health.  Explain how and why the Government encourages people to lead a healthy lifestyle.  Give risk factors associated with cardiovascular disease, Type 2 diabetes, lung diseases and cancers. | 1 | Discuss factors that can affect health and how to lead a healthy lifestyle.  Carry out research using textbooks and the internet and write a report on the effects of diet, stress, smoking, alcohol and exercise on health, to include risk factors for specific diseases.  Analyse data about health risks and diseases.  Carry out a survey of lifestyle habits.  Watch the adverts about smoking, alcohol and diet. Analyse the message they are sending and suggest why. Ask what advice do they give and how effective they are and why.  Brainstorm the human and financial cost of these non-communicable diseases on individuals, communities, nations and globally.  Role-play a doctor and patient discussing the benefits and difficulties of one lifestyle change, eg smoking, alcohol, diet or exercise. | Carry out research.  Collect, present and analyse data about health risks and diseases, looking for correlations.  Measure height and weight to calculate BMI.  Calculate BMI and evaluate the use of this type of measurement. | [Human physiology and health](http://abpischools.org.uk/page/resource/age/subject/topic.cfm?age=Age%20range%2014-16&subject=Human%20physiology%20and%20health)  Adverts:  [Change4Life: Be Food Smart TV ad 2013](http://www.youtube.com/watch?v=KMiT-tdNKTY)  [Public Health England ant-smoking campaign video](http://www.theguardian.com/media/video/2013/dec/30/public-health-england-anti-smoking-campaign-video)  [Change4Life: Alcohol](http://www.tellyads.com/play_advert/?filename=TA14445&advertiser=Change%204%20Life&type=recent) |
| 4.2.2.7 | Cancers (malignant tumours) result from uncontrolled cell division.  Cancer cells may invade neighbouring tissues, or break off and spread to other parts of the body in the blood, where they form secondary tumours. | Describe some causes of cancer, eg viruses, smoking, alcohol, carcinogens and ionising radiation.  Describe the difference between benign and malignant tumours.  Explain how cancer may spread from one site in the body to form a secondary tumour in another part of the body. | 1 | Watch animation about cancer on ABPI site (see resources).  Research the causes of cancer and cancer treatment.  Explore activities and information on cancer research site. | Analyse data about cancer from cancer research site. | [Cell division and cancer](http://www.abpischools.org.uk/page/modules/celldiv_cancer/.cfm?coSiteNavigation_allTopic=1)  [Cancer Research UK Lesson plans](http://www.cancerresearchuk.org/cancer-info/youthandschools/teachersresources/#wichttp://www.abpischools.org.uk/page/modules/celldiv_cancer/.cfm?age=Age range 14-16&subject=Science) |

**4.2.3 Plant tissues, organs and systems**

Some useful resources and information can be found at [saps.org.uk](http://www.saps.org.uk)

This section closely ties in with 4.4.1 Photosynthesis.

The structure of a leaf in 4.2.3.1 should be linked to the process of photosynthesis.

Plant transport systems in 4.2.3.2 should be related to the transport of water to the leaf for photosynthesis, and the transport of sugars away from the leaf to other parts of the plant.

4.1.3.3 Active transport is included here in relation to 4.2.3.2 Plant organ system.

Meristem tissue can be covered with 4.1.1.4 Cell differentiation or 4.1.2.3 Stem cells.

There are links with 4.1.1.3 Cell specialisation, 4.1.1.5 Microscopy, 4.1.3.1 Diffusion and 4.1.3.3 Active transport.

| **Spec ref.** | **Summary of the specification content** | **Learning outcomes**  *What most candidates should be able to do* | **Suggested timing (hours)** | **Opportunities to develop Scientific Communication skills** | **Opportunities to apply practical and enquiry skills** | **Self/peer assessment opportunities and resources**  *Reference to past questions that indicate success* |
| --- | --- | --- | --- | --- | --- | --- |
| 4.2.3.1  4.2.3.2  4.2.3.1 | Plant organs and Plant tissues.  The leaf  Plant organs include stems, roots and leaves.  Organs are made up of different tissues, eg meristem tissue at growing tips.  The leaf is the organ of photosynthesis.  Examples of tissues in a leaf: epidermis, palisade and spongy mesophyll, xylem, phloem, guard cells and stomata. How these tissues are adapted for their function. | Label the main organs of a plant and describe their functions.  Identify the tissues in a leaf and describe their functions. Relate the structure of each tissue to its function in photosynthesis.  Explain why there are more stomata on the lower surface of a leaf.  Describe the role of stomata and guard cells to control water loss and gas exchange.  Calculate stomatal density. | 1.5 | Label a diagram of a plant with names and functions of organs.  Observeacross section of a leaf and identify the tissues. Compare prepared slides with their own cross sections and evaluate the methods used to produce them. Relate to use of the microscope.  Label a diagram of a cross section through a leaf.  Describe how the tissues are adapted for their role in photosynthesis.  Investigate the arrangement of stomata and suggest reasons for this distribution.  Calculate stomatal density using data provided or from direct observations.  Demonstrate how guard cells open and close the stomata.  Observe the video clip showing stomata.  Explain how the guard cells and stomata control water loss and gas exchange.  Listen to the rap about photosynthesis and leaf structure. | Make sections of a leaf and observe under the microscope, or use bio- viewers.  Draw the tissue arrangement observed.  Dip leaves into hot water and make nail varnish imprints of stomata and observe under the microscope. Suggest reasons why there are more stomata on the lower surface.  Draw the arrangement of stomata and guard cells observed. | Using a flowering plant make and examine leaf sections: microscopes, slides, coverslips, stain, scalpels, tiles, prepared slides and bio-viewers.  Stomata: Leaves from privet and spider plants, kettle, beakers, nail varnish, slides, coverslips and microscopes.  Demo: 2 cylindrical balloons, sellotape.  [Measuring stomatal density](http://www.nuffieldfoundation.org/practical-biology/window-past-measuring-stomatal-density)  [Stomata: Leaf structure, stomata and carbon dioxide video clip](http://www.saps.org.uk/secondary/teaching-resources/799-video-clip-leaf-structure)  Rap:  [BBC Bitesize: Photosynthesis rap](http://www.bbc.co.uk/education/clips/z6f7tfr) |
| 4.2.3.1  4.2.3.2 | Plant transport systems  The roots, stem and leaves form a plant transport system.  Root hair cells absorb water by osmosis and mineral ions by diffusion and active transport. (See next lesson).  Xylem tissue transports water and dissolved ions. The flow of water from the roots to leaves is called the transpiration stream.  Xylem tissue is composed of hollow tubes strengthened with lignin.  Phloem tissue transports dissolved sugars from the leaves to other parts of the plant. The movement of food through phloem is called translocation.  Phloem cells have pores in their end walls for movement of cell sap. | Describe the organs that make up the plant transport system.  Describe the role of xylem, phloem and root hair cells and explain how they are adapted for their functions.  Define the terms ‘transpiration’ and ‘translocation’. | 1 | Demonstrate capillary action using in a long capillary tube and coloured dye.  Demonstrate transport of coloured dye in celery or a plant stem then allow students to take sections and observe the dye in the xylem vessels under the microscope.  Observe and draw xylem, phloem and root hair cells. Estimate the size of the cells. Describe how they are adapted for their functions.  Label a diagram of a plant to show that water enters via the roots and travels in the xylem to the leaves; carbon dioxide enters leaves via stomata; light is absorbed by chlorophyll in leaves; dissolved sugars are transported from the leaves in the phloem to other parts of the plant. | Evaluate the use of a model to show water transport in a plant stem.  Prepare sections of celery or plant stem and observe under a microscope.  Observe prepared slides or bioviewers of xylem and phloem cells; draw them and estimate their size. | Demonstrate long piece of capillary tubing supported in clamp, beaker of coloured water.  Plant stalks: celery of plant stalk in beaker of coloured water, scalpels, tiles, slides and coverslips, microscopes.  Prepared slides: of xylem, phloem and root hair cells, microscopes, bioviewers.  [BBC Bitesize: The need for transport](http://www.bbc.co.uk/education/guides/zwsdmp3/revision/1) |
| 4.1.3.3  4.1.3.3 | Active transport  Active transport involves the movement of a substance against a concentration gradient and requires energy from respiration.  Mineral ions can be absorbed by active transport into plant root hairs from very dilute solutions in the soil.  Sugar can be absorbed by active transport from the gut into the blood. | Define the term ‘active transport’.  Describe where active transport occurs in humans and plants and what is 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. | 0.5 | Recap diffusion and osmosis. Compare them with active transport. Produce a comparison table.  Introduce active transport as absorption against the concentration gradient. Discuss when this might be useful.  Research where active transport occurs in plants and humans and label these on diagrams with notes.  Observe a video or pictures of plants growing in soil and in hydroponic solutions. Suggest why farmers and gardeners turn the soil and hydroponic solutions must be kept aerated.  Use the Nuffield activity.  Students can carry out a similar investigation to demonstrate the need for oxygen.  Observe images of the mitochondria in root hair cells and cells lining the small intestine. Relate to active transport.  Observe a computer simulation of active transport. | Investigate the effect of oxygen availability on the growth of plants. Observe results in later lessons.  Use of a model. | [BBC Bitesize: Movement across cell membranes](http://www.bbc.co.uk/education/guides/zc9tyrd/revision/5)  [Tracking active uptake of minerals by plant roots](http://www.nuffieldfoundation.org/practical-biology/tracking-active-uptake-minerals-plant-roots)  Oxygen: gas jars with lids, glass tubes, fresh and boiled water to make mineral ion solution(s), black paper. |