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**Knowledge Rich Curriculum Plan**

SCIENCE- Biology Year 10

B1 Cell Biology

| **Lesson/Learning Sequence**  | **Intended Knowledge:***Students will know that…* | **Prior Knowledge:***In order to know this, students need to already know that…* | **Working Scientifically** | **Tiered Vocabulary and Reading Activity** | **Support** |
| --- | --- | --- | --- | --- | --- |
| **Lesson 1:****Eukaryotes & Prokaryotes Review** | Students will learn that animal and plant cells are examples of eukaryotic cells as they have DNA inside a nucleus.Students will learn that bacterial cells are examples of prokaryotic cells which are much smaller and an electron microscope is required to view bacterial cells. Students will learn that prokaryotic cells have cytoplasm, cell membrane, cell wall, flagella and loops of DNA called plasmids. DNA is not inside a nucleus, it is just present as strands or loops in the cytoplasm. Students will learn that the cell wall of algal cells and plant cells is made from a sugar called cellulose. | *Students will know that all living things are made from tiny units called cells.* *Students should be able to recognise an animal and plant cell in a diagram.* *Students should be able to label the nucleus, cell membrane, mitochondria, ribosomes and cytoplasm in animal cells and these parts in addition to chloroplasts, vacuole and cell wall in plant cells.* *Students should know the main function of each of these parts. Students will know that cells are incredibly small and a light microscope is required to view cells.* |  | *Eukaryote**Prokaryote**Organelles**Ribosomes**Mitochondria**Plasmid**Components* *characteristics**Differences between animal and plant cells* | [*https://www.bbc.co.uk/bitesize/guides/z84jtv4/revision/11*](https://www.bbc.co.uk/bitesize/guides/z84jtv4/revision/11)*Knowledge Organiser B1*[*https://www.youtube.com/watch?v=M-1S9NmH9O0*](https://www.youtube.com/watch?v=M-1S9NmH9O0) |
| **Lesson 2&3:** **Using a light microscope REQUIRED PRACTICAL** | Students will learn that a light microscope is used in school. Electron microscopes are more expensive, require specialist training, observe dead specimen, has a much higher magnification and resolution. The specimen takes a long time to prepare and a vacuum is needed.Students will learn how to use a light microscope correctly and make observations of biological specimens and produce labelled scientific drawings. They should include subcellular structures (Structures within the cells). Students will learn how calculate the range of possible magnifications of the microscope they are using by using the equation Eyepiece x Objective lens. Students will follow a method to prepare a slide and will state that a stain is used to make the sub cellular structures more visible and give iodine as a common example. Students will be able to state the magnification of their image. Students will learn how to calculate magnification in given examples using the equation Magnification = Image/Actual | *Students will be able to name several parts of the light microscope including the stage, eyepiece lens, Objective lens, light, fine focus wheel and course focus wheel**Students will already know the parts of plant cells including the cell wall**Students will know that iodine is an example of a stain used to see parts of cells* | *Use of apparatus to record length and area**Make observations of biological specimens and produce labelled scientific drawings**Calculating Magnification* | *Magnification**Resolution**Objective Lens**Intimidating**Attributes**Aperture* *Perceive**Vacuum**Reading- Light microscope and electron microscopes* | *Knowledge Organiser B1*[*https://www.bbc.co.uk/bitesize/guides/z84jtv4/revision/5*](https://www.bbc.co.uk/bitesize/guides/z84jtv4/revision/5)[*https://www.youtube.com/watch?v=7t2bISXFl6c*](https://www.youtube.com/watch?v=7t2bISXFl6c)[*https://www.youtube.com/watch?v=Lk1Mb1U11EY*](https://www.youtube.com/watch?v=Lk1Mb1U11EY) |
| **Lesson 4:****Specialised Cells in Animals** | Students will know that Specialised cells are those which are adapted to carry out a particular functionStudents will know how sperm cells are adapted to swim to the egg cell (ovum)- tail, Acrosome (produces an enzyme to help the sperm to penetrate the egg, many mitochondria for respirationStudents will know how nerve cells are adapted to carry electrical impulses around the body- Long, thing, dendrites to branch to other nerve cells and myelin sheath to insulate and prevent messages getting mixed up. Students will know how muscle cells are adapted to contract and relax to allow movement- Many mitochondria for energyStudents will know that red blood cells have no nucleus so more space for oxygen and a biconcave shape gives a large surface area | *Students need to already know that there are different types of cells that have different jobs in the body.* *Students should already know that sperm cells are the male reproductive cells (gametes) which are made in the testes of males and move to fertilize the egg cell of the female.* *Students will already know that the nervous system carries 'messages' around the body very quickly and that nerve cells belong to this system. Students will already know that muscles contract and relax to allow movement and that energy is needed for movement.* *Students should recall from previous lessons that respiration is a chemical reaction that occurs in the mitochondria that releases energy.* |  | Electrical impulseBiconcave*Specialised* *Penetrate**Stem Cell* *Differentiate* *Acrosome*Reading – Extract from ‘Sciencing’ | *Knowledge Organiser B1*<https://www.youtube.com/watch?v=LNLz7mswPkQ> |
| **Lesson 5:****Specialised Cells in plants** | Students will now that palisade cells are found in leaves and contain lots of chloroplasts to absorb sunlight for photosynthesis (the job of chloroplasts is to absorb sunlight and NOT to make the leaves look green. Students will know that root hair cells are found underground and are adapted to absorb (take in) water by having a large surface area. Students will recognise root hair cells as having a large protrusion (bit that sticks out) which provides this extra surface area. Students will also know that there are no chloroplasts in the root hair cells as they are underground so would not be able to absorb sunlight for photosynthesis. Students will also learn that active transport is a method in which nutrients move from the soil and into the roots and for this to happen energy is needed. Lots of mitochondria are found in root hair cells to release the energy neededStudents will know that root hair cells are found underground and are adapted to absorb (take in) water by having a large surface area. Students will recognise root hair cells as having a large protrusion (bit that sticks out) which provides this extra surface area. Students will also know that there are no chloroplasts in the root hair cells as they are underground so would not be able to absorb sunlight for photosynthesis. Students will also learn that active transport is a method in which nutrients move from the soil and into the roots and for this to happen energy is needed. Lots of mitochondria are found in root hair cells to release the energy neededStudents will learn that the stem of a plant contains vessels called Xylem which carry water and Phloem which carry minerals for the plant. Xylem cells are specialised as they are made of dead cells, they are stacked with no end walls so the flow of water is continuous and in one direction. Xylem cells are supported by lignin (an organic polymer) which gives support to the plant. Phloem carries minerals in both directions (up and down the stem) and has perforations (tiny holes) in the end walls to allow movement of minerals. | *Students need to already know that the roots anchor the plant into the ground and take water and nutrients from the soil so the plant can grow. Students will know that the stem holds the plant upright and carries water and minerals. Students will already know that a process called photosynthesis takes place in the leaves and that chloroplasts absorb sunlight for photosynthesis* |  | PoresAbsorbProtrusion*Perforations* | *Knowledge Organiser B1*[*https://www.youtube.com/watch?v=LNLz7mswPkQ*](https://www.youtube.com/watch?v=LNLz7mswPkQ) |

| **Lesson/Learning Sequence**  | **Intended Knowledge:***Students will know that…* | **Prior Knowledge:***In order to know this, students need to already know that…* | **Working Scientifically** | **Tiered Vocabulary and Reading Activity** | **Support** |
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| **Lesson 6:****Cell differentiation** | Students will know that a stem cell is an undifferentiated cell (A cell that has not yet become specialised to do a certain job). As an organism develops, cells carry out the process called differentiation to become different types of cells and therefore specialised. Students will know that bone marrow and early animal embryos contain stem cells. Animal stem cells can only differentiate at an early stageStudents will know that regions of stem cells in plants are called meristems and are found in the tips of the roots and shoots. The advantage of plant stem cells is they can differentiate at any stage in their life, not just at an early stage like animal stem cellsStudents will know that cell division occurs so living things can grow and so damaged cells can be repaired and replaced. Students will know that the advantage of plant stem cells can differentiate into any type of plant cell at any time during the life of the plant. | *Students need to already know that bone marrow is found inside bones and embryos are unborn babies in the early stage of development (up to 9 weeks after fertilization and then it becomes a foetus)* | Analysing statistical dataPie Chart interpretation | Cell DifferentiationMeristemsCloningDiscardedCriticallyReading- Plant meristems | *Knowledge Organiser B1*<https://www.bbc.co.uk/bitesize/guides/z2kmk2p/revision/3> |
| **Lesson 9:****Stem Cells and Ethics** | * Students will learn that stem cells can be used in the medical industry as a possible treatment for diabetes and paralysis.
* Students will learn that stem cells can be used to replace damaged cells.
* Students will learn that embryonic stem cells can differentiate into a wider range of cell types, but are difficult to obtain and their use raises ethical challenges. The best source is the five-day-old embryo but some people see this as killing 'babies'. Adult stem cells will differentiate into a narrower range of cell types. Bone marrow transplants are an example of adult stem cell transplant. Bone marrow cells will differentiate into different types of blood cell.

Students will learn how to EVALUATE the use of stems cells in the medical industry | *Students will already need to know that diabetes is a disease where blood sugar levels cannot be controlled effectively.* *Students will know that when someone is paralysed means they have lost the ability to move part of the body.* | Evaluating evidence | ParalysisDiabetesReading task: Stem cell decision making | *Knowledge Organiser B1*<https://www.bbc.co.uk/bitesize/guides/z2kmk2p/revision/3> |
| **Lesson 7:****Cell division/Cell Cycle** | Students will know that the nucleus of a cell contains chromosomes which are made of DNA molecules. Genes are sections on the chromosomes which carry genetic information. Chromosomes are found in pairs in the nucleus of cells because we inherit half from each parent. Human body cells contain 46 chromosomes or 23 pairs. Students will know that the cell cycle is a series of stages a cell goes through when it is growing and dividing to allow growth and repair of an organism. During the first stage of the cell cycle, the cell grows and the DNA replicates (makes a copy of itself) to for 2 copies of each chromosome. A process called mitosis then occurs (DETAILS OF STAGES NOT NEEDED BUT ANIMATION MAY HELP STUDENTS TO VISUALISE) where one set of chromosomes is pulled to each end of the cell and the nucleus divides. Finally, the cytoplasm and cell membrane divides to for 2 genetical identical cells called daughter cells. Students will be able to recognise and describe situations where mitosis is occurring. | *Students need to already know that DNA is found in the nucleus of cells and that we inherit genes from our parents.* *Students will label where the nucleus, cell membrane and cytoplasm are in a diagram.**Students will know that multicellular organisms are made up of more than 1 cell (unicellular) and that cells don't just grow in size when we grow, cells divide to make more which results in growth.* |  | Cell cycleMitosis MeiosisChromosomesCytokinesisContinuallyReplicate | *Knowledge Organiser B1*<https://www.bbc.co.uk/bitesize/guides/z3qjcj6/revision/2#:~:text=A%20growing%20and%20dividing%20cell,of%20cell%20division%20called%20mitosis%20>. |
| **Lesson 11:****DIffusion** | Students will know how to calculate and compare surface area: volumeStudents will know why exchange surfaces in transport systems of multicellular organisms are importantStudents will learn that the small intestine has a specialised exchange surface to absorb nutrients into the bloodstream. The small intestine is 7m long so the nutrients have plenty of opportunity to be absorbed into the blood. The surface of the small intestine is folded and covered in villi (projections) DO NOT REFER TO THEM AS HAIRS which increase the surface area. In addition, the villi are covered in microvilli which further increase the surface area. The membrane is thin to provide a short diffusion pathway which means the nutrients don't have far to move from the lumen (hole running through a tubular organ) of the small intestine to the blood. There is a good blood supply to ensure the nutrients can easily pass to the blood. Students will learn that gas exchange occurs in the lungs in the alveoli. The alveoli are air sacs which provide a large surface area to allow oxygen to diffuse into the blood and carbon dioxide to diffuse from the blood into the alveoli to be exhaled. The alveoli are surrounded by a network of capillaries to provide a good blood supply and walls of the alveoli are thin to provide a short diffusion pathway. Student will know that gas exchange in fish occurs in the gills which have a large surface area and good blood supply again to allow for efficient gas exchange (Structure of gills is not required for combined science but is for triple). Students will learn that roots have root hair cells which increase the surface area for mineral and water uptake. Students will learn that leaves have a large surface are and holes in the underside if the leaf which allow gases into and out of the leaf for respiration and photosynthesis. | *Student will have heard the term diffusion in KS3 and should know that this is the method by which particles spread out. They will already know that is someone sprays an aerosol, the particles spread throughout the room and this is an example for diffusion.*Students will know that the air we breathe in contains Nitrogen, Oxygen and Carbon dioxide. We need the oxygen and we breathe out carbon dioxide*Students need to already know that the small intestine is where absorption of nutrients takes place. This means the nutrients move from a high concentration in the small intestine to a low concentration in the blood. Students will know that gas exchange occurs in the lungs and that oxygen is useful and carbon dioxide is a waste product which we breathe out.* *Students need to already know that fish have gills not lungs. Students will know that plants use carbon dioxide from the air and this enters the plant through the leaves and plants take in water through the roots which are underground* |  | DiffusionSurface areaMaintainsReading taskLung diffusion testing | <https://www.bbc.co.uk/bitesize/guides/zs63tv4/revision/1><https://www.bbc.co.uk/bitesize/guides/zyptv9q/revision/4><https://www.bbc.co.uk/bitesize/guides/zwqycdm/revision/6>*Knowledge Organiser B1* |

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| **Lesson 13:** **Osmosis** | Students will learn that Osmosis is the movement of water. Osmosis is defined as the movement of water from a dilute solution to a more concentrated solution across a partially permeable membrane. - A membrane that only lets certain substances pass through.Students will learn that a hypertonic solution is one that contains a higher concentration of solutes than inside the cell. When placed in a hypertonic solution, a cell will lose mass by osmosis- the water will move from a dilute area inside the cell to a more concentrated area outside the cell across the cell membrane. An isotonic solution is one that has the same concentration is the same inside and outside of the cell. This results in no net movement of water so there will be no change in mass. Students will learn that a hypotonic solution is one that contains a lower concentration of solutes than inside the cell and so water will move into the cell by osmosis and the cell will gain mass. Students will be able to plot data and identify the isotonic point of the cell. | *Students will know that cell membranes control what goes into and out of the cell.* *Students will know that when we have a certain volume of a solution; a dilute solution contains a lot of water but few solutes and a concentrated solution contains lots of solutes but only a little water. They will relate this to drinking cordial.* *Students will be able to calculate Mean when given a set of data and use %. Students will be able to draw a suitable scale to plot data and know that the independent variable (the one you change) goes on the X axis and the dependent variable (the one you measure) goes on the Y axis* | Translate mass data into graphical formUse % and calculate % changePlot and interpret graphs | OsmosisRegionPartiallyPermeableReading Task: Reading to follow a method | *Knowledge Organiser B1*<https://www.bbc.co.uk/bitesize/guides/zs63tv4/revision/4> |
| **Lesson 14:****Osmosis** **Required Practical** | Students will have 5 different concentrations of sucrose solution of different concentrations including distilled water. Students will learn that the units for concentration are moldm-3. Students will label boiling tubes with each different concentration and use a measuring cylinder to measure a certain volume of each concentration of solution and put into the corresponding boiling tube. Students will use a borer to bore cylinder from potatoes and then use a ruler to measure each cylinder to certain length with a ruler and cut it with a knife. Students will learn that using the borer to make cylinders ensures the surface area of the potatoes is the same for each one. Student will use a balance to find the starting mass of each cylinder and record the results in a table. Students will place one cylinder in each boiling tube and start a stopwatch. After a set amount of time, the student will remove the potatoes, pat with a paper towel to remove excess water that could add mass and use the balance to find the end mass of each. These results will be recorded in the table. Students will learn how to calculate change in mass and then % change in mass (because the starting masses were all different) and then plot a graph of their results. Students will form a conclusion and be able to explain the conclusion using the science of osmosis and then use the graph to identify the isotonic point of the potato. | *Students will know that a balance is used to measure the mass (grams) (don't let them use the word weigh), a stop watch measures length of time (seconds), a thermometer measures temperature (oC) and a ruler measures length (mm)**Students will know that the independent variable in a practical is the one we change, dependent is the one we measure and the controls we keep the same to ensure results are valid.* *Students will already know that to improve reliability of results we would do the test 3 times, identify any anomalies (don't include these) then calculate the mean change in mass. Students will know that potatoes are made up of plant cells and be able to label the plant cell* | Use appropriate apparatus to record mass and timeUse appropriate apparatus and techniques to observe and measure the process of osmosisMeasure the rate of osmosis uptakePlan an experiment to test a hypothesisRisk assessment and health and safetyTranslate mass data into graphical formForm a conclusion from the dataFind the isotonic point from a graph.Using scientific theories to explain findings | Reading- Method | *Knowledge Organiser B1*<https://www.youtube.com/watch?v=itp1Dpz0EnY> |
| **Lesson15:****Active Transport** | Students will learn that active transport is the movement of substances from a low concentration to a high concentration and this is referred to as 'against a concentration gradient. To do this energy is required from the process of respiration and this is why root hair cells contain lots of mitochondriaStudents will learn that mineral ions are absorbed into the plant root hair cells by active transport from dilute concentrations in the soil. Students will learn that plants need Nitrate, Phosphates, Potassium Ions and Magnesium ions for healthy growth. Students will learn that sugar molecules are absorbed from lower concentrations in the small intestine to a higher concentration in the blood by active transport. Glucose is a reactant of respiration. Students will create a Venn diagram or table comparing Osmosis, diffusion and active transport and summarise the differences between these 3 processes. | *Students will know that respiration is a chemical reaction that occurs in the mitochondria of cells and releases energy to allow living thing to move, grow, keep warm, build compounds**Students will know that roots take up water for the plant and root hair cells are specialised cells with a large surface area and lots of mitochondria. Students will already know the reactants and products of photosynthesis and be able to write this as a word equation.* |  | Reading Activity Active TransportCarrier ProteinATP | <https://www.youtube.com/watch?v=AxXN-j6UzOY>*Knowledge Organiser B1*<https://www.bbc.co.uk/bitesize/guides/zc7k2nb/revision/8> |
| **TRIPLE ONLY****Culturing Microorganisms** | Students will learn that bacteria multiply by binary fission once every 20 minutes if they have nutrients and the correct temperature Agar plates are used to crow bacterial cultures. Agar jelly is a nutrient broth that contains nutrients for the bacteria to grow.Students will learn that petri dishes are sterilized before use, inoculating loops transfer the microorganisms and these should be sterilized by passing the loop through a Bunsen flame, The lid of the dish should never be completely lifted off and it should be taped and stored upside down (so water from respiration doesn’t affect the results)Plates are incubated at 25oC as this is the optimum temperature for bacterial growth. Students will measure the area of inhibition and use this to form a conclusion about the most and least effective antibiotic/antimicrobial. | *Students will already know that the 4 pathogens are bacteria, virus, fungi, protist.**Students will know that disinfectants are cleaning products**Students will know that antibiotics are used to treat bacterial infections. Students will know that not all microorganisms are harmful (eg yogurt yeast)**Students will know how to use* πr2 *to calculate area of a circle* | Use appropriate apparatus to measure and record length and areaUse appropriate apparatus and techniques to observe and measure the process of bacterial growth. Safe and ethical use of bacteria to measure physiological function and response to antibiotics/antisepticsProblem solving Planning experimentMaking observationsHealth and safety when working with bacterial culturesUsing πr2 to calculate are of clear zoneSTANDARD FORM ANSWERS | PathogenAntimicrobial ResistanceDescendantsColonyZone of inhibitionReading- Antimicrobial practical background info and method |  |

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**Knowledge Rich Curriculum Plan**

SCIENCE- Biology Year 10

B2 Organisation

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| **Lesson 1:****Review of relevant KS3 Knowledge** | * Students will know that cells are the basic building blocks of all living things. A tissue is a group of cells with similar structure and function. Organs are aggregations of different tissues performing specific functions. Organs are organised into organ systems which work together to form organisms.
* Students will know how to relate cells, tissues and organs based on size and scale.
 | * ***Students need to already know that...THIS LESSON IS ALL PRIOR KNOWLEDGE***
* ***Students need to already know how to sequence large and small numbers. They will need to use conversions ie 1mm = 1000 micrometres; 1 micrometre = 1000 nm***
 |  | OrganelleMitochondriaCytoplasmRibosomeGenetic materialCelluloseTissueOrganOrgan systemsMicrometerMillimetrescale | Knowledge Organiser B2<https://www.bbc.co.uk/bitesize/topics/z2mttv4> |
| **Lesson 2:****The Digestive System** | * Students will know that food travels through the digestive system passing through the following organs in sequence: mouth, oesophagus, stomach, small intestine, large intestine and leaves via the anus. They will know that enzymes are added to food from the salivary gland (amylase), the stomach(protease) and the pancreas (carbohydrase, protease and lipase). They will know that the stomach secretes HCl and the liver produces bile which is stored in the gall bladder. Students will know that digestion involves the chemical breakdown of large insoluble molecules that cannot be absorbed into small soluble molecules that can be absorbed. Absorption occurs in the small intestine. The small intestine has structures known as villi that increase the surface area that facilitates passage of the products of digestion into the blood.
* Students will know how the small intestine is adapted for absorption of soluble products of digestion.
 | * ***Students need to already know that the body makes chemicals called enzymes. In Y7 they will have covered the names of the organs involved in the digestive system.***
* ***Students need to already know how small intestines are adapted for optimum exchange of substances (Y10, topic 1)***
 |  | OesophagusPancreasEnzymeSalivaGastric juiceAmylaseCarbohydraseProteaseLipaseSubstrateProductsInsolubleVilliSecreteabsorb | Knowledge Organiser B2<https://www.bbc.co.uk/bitesize/guides/z89mk2p/revision/1> |
| **Lesson/Learning Sequence**  | **Intended Knowledge:***Students will know that…* | **Prior Knowledge:***In order to know this, students need to already know that…* | **Working Scientifically** | **Support** |
| **Lesson 3 & 4:****Required Practical 3:****Food tests** | * Students will know that Benedict’s reagent is used to test for glucose: if present it will change from clear blue to brick red precipitate. Biuret solution is the reagent to demonstrate the presence of protein; the positive test result is a lilac solution. Ethanol is the reagent used to show the presence of fats; a positive result is observed if there will be a cloudy white precipitate.
* Students will know how to prepare samples of food to be tested with the reagents listed above. They will use a pestle and mortar to grind the food to a paste. They will filter the mixture to remove insoluble material. They will use the filtrate test with individual reagents using a fresh sample for each reagent. They will work safely with the chemicals by referring to hazard symbols and CLEAPPS wallets on display in laboratories. They will record all observations in a suitable results table.
 | * ***Students need to already know that there are three main nutrients in food: carbohydrates, proteins and fats. These are the basic molecules needed by humans.***
* ***Students need to already know how to use a pestle and mortar; how to use a filter paper with a funnel; how to work safely with apparatus and chemicals in a laboratory. They will be able to design a suitable results table with clear column headings (name of reagent) and labels for rows (name of food being tested.)***
 | Using ApparatusWorking safelyMaking and recording observations | ReagentPrecipitatePestle and mortar | Knowledge Organiser B2<https://www.bbc.co.uk/bitesize/guides/zs9krwx/revision/2> |
| **Lesson 5:****Enzymes** | * Students will know that enzymes are biological catalysts. They speed up the chemical digestion of nutrients in food. There are 3 groups of enzymes: carbohydrates, proteases, and lipases. They will state that amylase (a carbohydrase) digest starch into glucose; protease digests protein into amino acids; lipase breaks down fats into fatty acids and glycerol. They will know that enzyme models involve a shape in the structure known as the active site. They will know that the active site can change shape in different PHz or at different temperatures. This change may affect how well the enzyme can breakdown substrates. We say the enzyme of denatured.
* Students will know how enzymes are affected by changes in the pH or temperature. They will know that some enzymes work best in high pH whilst others work better in low ph. They will know that all enzymes work best at an optimum temperature. In humans, the optimum is 37oC. They will know that when temperatures exceed the optimum, the enzyme becomes denatured.
 | * ***Students need to already know that food has key nutrients known as carbohydrates, proteins and fats (lipids). They will know the products of digestion: amino acids, fatty acids and glycerol and glucose.***
* ***Students need to already know how to interpret graphs by reading the labels on the x and y axis to deduce what the changes on the graph represent.***
 | WS 1.2 Students should be able to use other models to explain enzyme action. | EnzymeCatalystFatty acidGlycerolActive siteDenaturedOptimum | Knowledge Organiser B2<https://www.bbc.co.uk/bitesize/guides/z88hcj6/revision/1> |
| **Lesson 6:****Visking Tubing as a model for digestion using enzymes** | * Students will know that visking tubing is used to model the function of small intestines in absorbing soluble products of digestion. They will know that the contents of the visking tubing are enzyme plus a large, insoluble substrate. They will predict that when the solution outside the tubing is tested with benedict’s solution, there will be a positive result. They will relate this observation to the idea that the enzyme within the tubing must have digested the large insoluble substrate rendering it small enough to pass through the poured in the tubing.
* Students will know how the model works. They will state that the visking tubing is a suitable model because it is slightly porous. They will describe that small molecules can pass through the pores whilst large molecules cannot pass through. They will recognise that the visking tubing is not a perfect model and then state that the pores may not be the same size; the surface does not have villi, the water surrounding the visking tubing is not blood and therefore will have a different concentration. This makes the model imperfect.
 | * ***Students need to already know that digestion involves enzymes. Enzymes are biological catalysts. Enzymes speed up the breakdown of large insoluble molecules. They need to know that soluble means that particles are small enough to disperse between water particles; that diffusion involves movement of particles from a region of high concentration to a region of low concentration across a selectively permeable membrane until equilibrium has been reached. They will need to recall that a positive test for glucose produces a brick-red precipitate and that a positive test for starch involves a blue-black colour.***
* ***Students need to already know how interpret food test results (see previous box)***
 | Using ApparatusWorking safelyInterpreting dataDescribing & explaining findings using high level scientific terminologyForming a conclusion | Visking tubingSolubleProductsSubstrateEnzymeParticleprec | Knowledge organiser B2 |
| **Lesson 7:****Required Practical - effect of pH on enzyme activity** | * Students will know that we can simulate digestion in a test tube using enzyme and substrate solution. We can use the model to investigate optimum conditions for amylase. They will know that a spotting tile and a pipette are used to when testing samples because only small quantities are required. They will evaluate what a suitable time interval would be between taking samples in order to ensure that suitable data is collated.
* Students will know how to use iodine solution to demonstrate that starch is or is not present in a solution. They will know how to use the hazard symbols and CLEAPSS cards to ensure safe practical work. They will know how to use a spotting tile to track the colour changes over time. They will know how to interpret qualitative data in their results in order to infer the optimum pH for amylase activity.
 | * ***Students will know the 3 types of variable (Independent + the factor that is being investigated, dependent = the factor that can be measured to allow us to see the effect and control = factors that must stay the same throughout the investigation.) They will recall that the enzyme called amylase controls the breakdown of starch into glucose. They will know that iodine can be used to identify the presence of starch and that a positive result involves the orange colour changing to blue-black. They will recall that room temperature is not the optimum temperature for enzymes and link this to the need to conduct the main parts of the activity in a water bath (apart from the sampling in the spotting tile).***
* ***Students will know how to use CLEAPSS safety cards to carry out risk assessments. Students will know how to use AIDCAR to identify the apparatus, variables (independent, dependent and control): pH, time for the reaction to be complete and then control concentration, temperature, volumes.***
 | AID CARForming a conclusion and explaining results using high level scientific terminologyPresenting results in graphical formFurther investigations | SimulationModelSubstrateEnzymePipetteInterval | Knowledge organiser B2 |
| **Lesson 8:** **Blood and Circulation** | * Students will know that blood is a mixture of a watery solution called plasma, red blood cells, white blood cells and platelets. They will know that the function of plasma is to dissolve substances e.g., products of digestion and waste products e.g., urea and carbon dioxide and also to carry hormones. The function of red blood cells is to carry oxygen because the red blood cells have haemoglobin. White blood cells have the function of fighting disease (see topic B3). They will know that there are three types of blood vessel: capillaries, arteries and veins. Capillaries are narrow aperture and have walls that are one cell thick; this makes them suitable vessels for exchange of substances. Arteries have muscular walls that assist with blood flow (emphasis is NOT to be 'pump blood') Veins are wider lumen but have valves that prevent backflow of blood and therefore maintain circulation in one direction.
* Students will know how to relate structure of blood vessel to the role played by the vessel e.g., size of lumen, type of wall.
 | * ***Students will recall that blood carrying oxygen is called oxygenated blood. Blood without oxygen is known as deoxygenated blood. Students will recall that red blood cells and white blood cells are specialised cells. They will describe that red blood cells have no nucleus and are packed with haemoglobin; white blood cells have enlarged nuclei and this allows them to fight infections.***
 |  | PlasmaPlateletsUreaHormoneHaemoglobinCapillariesApertureLumenOxygenatedenlarged | Knowledge Organiser B2 |
| **Lesson 9:** **The structure and function of the Heart** | * Students will know that the heart has 4 chambers known as right & left atria and right & left ventricles. They will know that the main vein enters the heart at the right atrium. The main artery enters the heart at the left atrium. The blood leaving the right ventricle follows the pulmonary artery and the blood returning from the lungs travels in the pulmonary vein. They will know that the heart is a muscle. The walls of the heart on the left side are thicker because they need to use more force to push blood to the furthest parts of the body. The muscle is supplied with oxygen and nutrients by its own blood vessels. The main vessel supplying the heart muscle (cardiac muscle) is called the coronary artery. CRITICAL that students learn the exceptions that the pulmonary artery carries deoxygenated blood and the pulmonary vein carries oxygenated blood.
* Students will know how to describe the path that blood takes as it travels around the body. They will state that blood leaves the heart in the aorta and then travels around the network of blood vessels towards respiring cells in vessels called arteries. Blood in the arteries is loaded with oxygen and glucose that respiring cells need. To reach the cells, blood passes from arteries into capillaries where exchange of substances occurs because the walls of capillaries are very thin. Oxygen and glucose leave the blood and enter the respiring cells. Meanwhile, carbon dioxide passes from the cells into the blood to be carried away. The blood that leaves the capillaries is now called deoxygenated blood. This travels back towards the heart in vessels called veins eventually entering the heart in a main vein called the vena cava. Once in the heart, deoxygenated blood moves from the right atrium to the right ventricle and then leaves the heart to travel to the lungs in a new vessel known as the pulmonary artery. From the lungs, blood returns to the heart in a vessel known as the pulmonary vein. Students will learn that a typical heart beats approximately 60 - 80 times per minute at rest and that during exercise this can increase to approximately 140 beats per minute. The reason for the increase is to provide MORE oxygen and glucose to respiring cells.
 | * ***Students need to know the terms oxygenated and deoxygenated blood. They need to recall that all muscles need oxygen and glucose the function. Blood delivers oxygen and glucose and blood removes waste e.g., carbon dioxide to prevent toxins building up that could damage cells. They must know that arteries travel away from the heart and veins travel towards the heart together with the idea that arteries are carrying oxygenated blood and veins carry deoxygenated blood. (\* exceptions introduced in this lesson)***
 | Making Observations of biological specimens and produce labelled scientific drawingsUsing apparatus correctlyWorking Safely in the labMaking & Recording observations | ChamberVentricleAtriumPulmonaryCoronaryCardiacToxinsVena cavaAortaPace-maker | Knowledge Organiser B2<https://www.bbc.co.uk/bitesize/guides/zhnk7ty/revision/4> |
| **Lesson 10:****Cardio-vascular Disease** | * Students will know that coronary heart disease is an example of a non-communicable disease (it cannot be caught or spread to other people) It is a condition that affects the heart and the heart's blood vessels and it results from blocked coronary arteries. Blockages mean that blood carrying vital oxygen and glucose cannot reach the cardiac muscle. Blockages result from persistent poor diet and other lifestyle choices eg., high cholesterol, smoking, high salt intake, high blood pressure, low exercise levels, obesity AND in families where there is a history of CHD. The term 'risk factor' means things that increase your chance of developing a condition'. Cardio-vascular disease (CVD) includes CHD but also refers to strokes, aortic disease and arterial disease.
* Students will know how CHD can be treated with mechanical devices called stents or with chemical intervention known as statins. The stent is a wire mesh that supports the walls of the artery and maintain a thoroughfare for red blood cells, etc. Statins are drugs that reduce the formation of blockages in blood vessels and lower cholesterol levels. Students will know how to evaluate both alternatives.
 | ***Recall the names of parts of the heart.******Know that the heart has its own blood supply: coronary arteries******Recall that all muscles need a supply of oxygen and glucose to function via respiration.******Recall from KS3 that a healthy diet maintains optimum body conditions/function. Poor diets affect how our bodies form and perform.******Some diseases can be spread (communicable) and others cannot be transmitted (non communicable)*** | WS 1.4 WS 1.3 Evaluate methods of treatment bearing in mind the benefits and risks associated with the treatment. | CoronaryArteryCholesterolObesityPressureRisk factorCardio-vascularStentStatin | Knowledge Organiser B2<https://www.bbc.co.uk/bitesize/guides/zhnk7ty/revision/6#:~:text=The%20coronary%20arteries%20supply%20blood,heart%20muscle%20is%20cut%20off>. |
| **Lesson 11:****Lungs** | * Students will be able to name each part of the human breathing system: trachea, bronchus, bronchioles, alveoli, diaphragm, intercostal muscles. Students will know the role of each part: the muscles are involved in changing the volume of the lung capacity i.e. breathing in and out; the ribs protect the delicate lungs by encasing them; the trachea, bronchus, bronchioles and alveoli are the passageways that air travels through to eventually get into our blood. Gas exchange occurs in the tiny alveoli. The alveoli increase the surface area of our lungs to ensure lots of oxygen can pass through into the blood. Inhalation is when air is breathed in. Exhalation is when gas is breathed out.
* Students will know how the composition of gas changes between breathing in and then breathing out (more oxygen before gas exchange. More carbon dioxide after gas exchange; nitrogen is not absorbed into the blood. They will know how the rate of breathing changes during exercise and why this is necessary. They will describe how the alveoli are adapted for gas exchange (Topic B1)
 | * ***Students will know the composition of air: 78% nitrogen, 20%oxygen and less than 1% carbon dioxide.***
* ***They will know how alveoli are adapted for gas exchange: moist membranes, increased surface area, thin epithelium***
 |  | TracheaAlveoliDiaphragmIntercostalInhaleExhaleComposition | Knowledge Organiser B2<https://www.bbc.co.uk/bitesize/guides/zpd4wxs/revision/1> |
| **Lesson 12:****Health Issues** | * Students will know what the terms 'health' and 'disease' mean in science. (Health = the state of physical and mental wellbeing', Disease = ill health is caused by communicable and non-communicable disease) Communicable diseases are infections and can be passed on; non-communicable diseases are not infectious and cannot be passed on. The factors that affect our health include diet, stress, physical activity, lifestyle choices, smoking and alcohol. Students will analyse graphs to interpret information about the impact of lifestyle choices on health e.g., how does smoking impact on health.
* Students will analyse graphs to interpret information about the impact of lifestyle choices on health e.g., how does smoking impact on health.
 | * ***They will recall that the independent variable is on the x axis and the dependent variable is on the y axis. They will know that the relationship between the variables is described in terms of ' as x increase, y ....'***
* ***Students will know how to use the labels on axes of graphs to infer what the curves/lines represent. They will break a graph into smaller sections to make good descriptions of trends or patterns.***
 |  | HealthDiseasePhysicalInfectious |  |
| **Lesson 13:****Non-communicable diseases** | * Students will know that there is a link between certain lifestyle choices and non-communicable disease: some factors interact to cause disease. The two main groups of factors are lifestyle choice and things that are taken into the body e.g., tobacco smoke or drugs including alcohol. They will know what COPD (chronic obstructive pulmonary disease) and cancer are together with possible factors that result in these diseases.eg., carcinogens result in cancers. Students will know the difference between a benign and a malignant tumour in terms of the behaviour of tumour cells.
* Students will know how to describe the risk factors and occurrence of non-communicable disease.
 | * ***Students will recall the meaning of the term non-communicable and know some examples (previous lesson) They will know what the term 'risk factor' means and give some examples.***
 |  | InteractCOPDObstructChronicPulmonaryCarcinogenBenignMalignanttumour |  |
| **Lesson 14:****Plant tissues and organs** | * Students will know that the leaf is a plant organ along with roots, stem and flowers. They will know that it is made of distinct and observable tissues known as upper epidermis, palisade mesophyll, sponge mesophyll, lower epidermis (including guard cell pairs surrounding the spaces known as stomata). They will know that the upper surface is often protected by a waxy cuticle. They will know the role of guard cells in supporting gas exchange and preventing unnecessary water loss. They will know the role of root hair cells in facilitating water uptake.
* Students will know how water is moved(transpiration) from the soil through the roots, up the stem and into the leaves to support cells that are carrying out photosynthesis. They will know how the phloem is involved in movement of glucose (translocation) to all parts of the plant to support life processes. Students will learn how various factors affect the rate of these transport processes e.g., humidity, air movement, air temperature.
 | * ***They will know that a plant is a multicellular organism with 4 main organs: leaf, roots, stem and flower. They will know that specialised cells known as phloem and xylem are located in the stems of plants. They will recall from B1 that plant cells have organelles that are associated with photosynthesis. They will recall the adaptation of root hair cells to support water and mineral uptake.***
 |  | PhloemXylemEpidermisMesophyllStomataTranspirationTranslocationHumidity | Knowledge organiser B2 |
| **Lesson 15:****Transpiration** | * Students will know that water is moved through the xylem in a plant by a physical process known as transpiration.
* Students will know how leaves are adapted to prevent water loss: they have a waxy upper cuticle and they have stomata on the lower surface that are controlled by pairs of guard cells. Transpiration is regulated by these features to prevent excessive loss of water if factors are likely to cause this effect e.g., high temperature or wind. A model called a potometer will be used to outline how transpiration rate can be measured. The movement of the air bubble represents the rate of water loss from the system. Students will evaluate the model and interpret graphs to represent the relationship between the various factors and the rate of transpiration.
 | * ***Students will recognise stomata cells, xylem cells, phloem cells, vascular bundles. They will know where these structures are located within a plant (see previous lesson)***
* ***Recall the structure of root hair cells and how they are adapted for uptake of water.***
* ***Students will know how to interpret graphs and how to state the relationship between variables written as labels on the graph in the form of 'as x increases, y ...'***
 | Naming the equipmentTaking measurementsVariablesInterpreting dataUsing secondary data (graphs)Explaining resultsFurther investigations | CuticleGuard cellsTranspirationExcessivePotometer | Knowledge Organiser B2<https://www.bbc.co.uk/bitesize/guides/zps82hv/revision/3> |

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**Knowledge Rich Curriculum Plan**

SCIENCE- Biology Year 10

B3 Infection & Response

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| **Lesson/Learning Sequence**  | **Intended Knowledge:***Students will know that…* | **Prior Knowledge:***In order to know this, students need to already know that…* | **Working Scientifically** | **Tiered Vocabulary and Reading Activity** | **Support** |
| **Lesson 1:****Communicable (infectious) diseases** | Communicable diseases are diseases that spread because they are caused by pathogensPathogens are microorganisms that cause disease The 4 pathogens are viruses, bacteria, protists and fungi They may infect plants or animals and can be spread by direct contact, by water or by air, sharing dirty needs, unprotected sexual intercourse, insects, dirty drinking water, undercooked/out of date food. The spread of diseases can be reduced or prevented by isolating patients who are ill, using antimicrobial cleaning products/sanitizer, cooking food properly, using condoms, using insect repellents/netsNon-specific defence systems of the human body against pathogens, including the: skin which forms a complete barrier, ciliated cells covered in mucus which traps pathogens and cilia waft to the throat, stomach acid, tears which contain enzymes. | *Students will already know that there are some diseases you can catch from other people and some diseases which you can’t catch. Examples could be given.**Students should have some knowledge of how diseases spread and ways to reduce the spread of disease.* | Describe and evaluate ways of tackling problems (WS1.4) | MicroorganismsPathogensContaminatedSymptoms | B3 infection and response KO<https://www.bbc.co.uk/bitesize/guides/zxr7ng8/revision/1> |
| **Lesson 2:****Viral Diseases** | * Viruses live and reproduce rapidly inside cells, causing cell damage which causes symptoms of the disease.
* Because viruses are inside cells, treatment are difficult so vaccinations are used to try to prevent you catching a virus.
* Measles is a viral disease showing symptoms of fever and a red skin rash. Measles is a serious illness that can be fatal if complications arise.
* The measles virus is spread by inhalation of droplets from sneezes and coughs.
* HIV is a sexually transmitted disease. It is spread by sexual contact or exchange of body fluids such as blood by sharing dirty needles. It is caused by a virus what destroys white blood cells. Initially causes a flu-like illness.
* There is no treatment for HIV but antiretroviral drugs can be used to slow the rate at which the virus reproduces .
* Late stage HIV infection, or AIDS, occurs when the body's immune system becomes so badly damaged it can no longer deal with other infections or cancers.

Tobacco mosaic virus (TMV) is a widespread plant pathogen affecting many species of plants including tomatoes. It gives a distinctive ‘mosaic’ pattern of discolouration on the leaves. Chloroplasts are damaged which means there is less chlorophyll to absorb sunlight so less photosynthesis so less glucose made for growth.  | *Students familiar with concept that all living things are made from cells. Viruses are not cells**Viruses are extremely small but can make us ill**Students will have life experiences of having cold/flu which are caused by viruses.* |  | SymptomsDiscolourationChlorophyllReading activity- TMV, HIV and Measles | <https://www.bbc.co.uk/bitesize/guides/zxr7ng8/revision/1> |
| **Lesson 3:****Bacterial Disease** | Bacteria reproduce in the body by binary fission and produce poisons (toxins) that damage tissues and make us feel ill (symptoms). Salmonella food poisoning is spread by bacteria ingested in food, or on food prepared in unhygienic conditions. In the UK, poultry are vaccinated against salmonella to control the spread. Fever, abdominal cramps, vomiting and diarrhoea are caused by the bacteria and the toxins they secrete. Gonorrhoea is a sexually transmitted disease (STD) with symptoms of a thick yellow or green discharge from the vagina or penis and pain on urinating. It is caused by a bacterium and was easily treated with the antibiotic penicillin until many resistant strains appeared. Gonorrhoea is spread by sexual contact. The spread can be controlled by treatment with antibiotics or the use of a barrier method of contraception such as a condom.Antibiotics are medication that are only used to treat bacterial infections. They are not effective against viruses are viruses are inside cells. The first antibiotic discovered by Alexander Fleming was penicillin. Bacteria can become resistant to antibiotics and: Should only be prescribed when neededThe full course should be completed by the patient to reduce the chance of this happening. | *Students will have life experiences of having cold/flu which are caused by viruses.* |  | Binary FissionAntibioticsPenicillinToxinsDischargeReading activity- Bacterial Infections | B3 infection and response KO<https://www.bbc.co.uk/bitesize/guides/zxr7ng8/revision/1> |
| **Lesson 4:** **Fungal Disease** | Rose black spot is a fungal disease where purple or blackspots develop on leaves, which often turn yellow and drop early. It affects the growth of the plant as photosynthesis is reduced. Chloroplasts are damaged which means there is less chlorophyll to absorb sunlight so less photosynthesis so less glucose made for growth. It is spread in the environment by water or wind. Rose black spot can be treated by using fungicides and/or removing and destroying the affected leaves.Athletes foot is a fungal infection. Treated using antifungal cream/powder. | *Students may already know that mushrooms belong to the fungi family and that some can be dangerous. Students should already know that fungi are eukaryotic cells as they have DNA inside a nucleus.* *Students may have heard of athletes foot.* |  | MycologyHyphae | B3 infection and response KO<https://www.bbc.co.uk/bitesize/guides/zxr7ng8/revision/1> |
| **Lesson 5:****Protist diseases** | * The pathogens that cause malaria are protists. The malarial protist has a life cycle that includes the mosquito. The mosquito bites and infected person, the protist travels to the liver of the host (the person) where it can reproduce. Infected liver cells burst releasing the protists into the blood infecting the red blood cells. Infected red blood cells burst and more protists are released infecting more red blood cells. If the infected person gets bitten, the protist will be carried to another person via the mosquito (vector). ,Malaria causes recurrent episodes of fever and can be fatal. The spread of malaria is controlled by preventing the vectors, mosquitos, from breeding and by using mosquito nets insect repellents to avoid being bitten. Insecticides can be used to kill the mosquitos to prevent them from reproducing. Draining stagnant water removed their breeding place.
 | *KS3-Structure of unicellular cells* | Describe and evaluate ways of tackling problems (WS1.4)WS1.3- Explain why data is needed to answer scientific questions and why it may be uncertain or incomplete/not available | InsecticideStagnantParasite HostVector Fatal | B3 infection and response KO<https://www.bbc.co.uk/bitesize/guides/zxr7ng8/revision/1> |
| **Lesson 7:****White Blood Cell Action** | If a pathogen enters the body the immune system tries to destroy the pathogen. Pathogens have antigens on their surface. Antigens are proteins found on the surface of pathogens. White blood cells recognise antigens that don’t belong to the body and respond to destroy the pathogenWhite blood cells help to defend against pathogens by: phagocytosis – They engulf and ingest the pathogenantibody production – They make specific antibodies to attach to the antigens on the pathogens to destroy themantitoxin production- Produce antitoxins to neutralise the toxins made by bacterial cells.Antibodies remain in the body providing immunity to a particular disease.Students should be able to describe a graph comparing primary and secondary response.  | *Students will already know that white blood cells are in our blood for fight infections. Students will know the immune system is the system in the body responsible for defending the body against disease.**Student will already know the non specific first lines of defence (skin, HCl, mucus, cilia)* | WS3.5 Recognise trends in data and form conclusions | AntigensAntibodiesToxinsAntitoxinsIngestEnzymesReading task- White blood cells | B3 infection and response KO<https://www.bbc.co.uk/bitesize/guides/zxr7ng8/revision/8><https://www.bbc.co.uk/bitesize/guides/zxr7ng8/revision/9><https://www.youtube.com/watch?v=p5OWjdGWN1Q><https://www.youtube.com/watch?v=qWSWWPZYGHU> |
| **Lesson 8:****Vaccination** | Students will learn how the first vaccine was developed by looking at the story of James Phipps. Students should be able to explain how vaccination will prevent illness in an individual, and how the spread of pathogens can be reduced by immunising a large proportion of the population. Vaccination involves introducing small quantities of dead or inactive forms of a pathogen into the body to stimulate the white blood cells to produce antibodies. If the same pathogen re-enters the body the white blood cells respond quickly to produce the correct antibodies, preventing infection. Some people choose not to get vaccinated as they are scared of needles, worried about side effects, it goes against religious beliefs. | *Students will know that vaccinations are given as a way to reduce the spread of disease**Students will know that some vaccines have unwanted side effects.* | Processing data into graphical formInterpreting data.  | Vaccinations comprehension | B3 infection and response KO<https://www.bbc.co.uk/bitesize/guides/z8fkmsg/revision/1><https://www.youtube.com/watch?v=23fQscOSqVU> |
| **Lesson 9:****Discovery and development of drugs** | Students will learn the Traditionally drugs were extracted from plants and microorganisms.Painkillers include paracetamol, ibuprofen The heart drug digitalis originates from foxgloves. The painkiller aspirin originates from willow. Penicillin was the first antibiotic discovered by Alexander Fleming from the Penicillium mould. Most new drugs are synthesised by chemists in the pharmaceutical industry. However, the starting point may still be a chemical extracted from a plant. New medical drugs have to be tested and trialled before being used to check that they are safe and effective. New drugs are extensively tested for toxicity, efficacy and dose. Preclinical testing is done in a laboratory using cells, tissues and live animals. Clinical trials use healthy volunteers and patients.  Very low doses of the drug are given at the start of the clinical trial. If the drug is found to be safe, further clinical trials are carried out to find the optimum dose for the drug.  In double blind trials, some patients are given a placebo. | *Plant adaptations. Chemicals produced by plants are an adaptation to prevent them being eaten Drugs are chemicals that effect the body.* *KS3- The effects of recreational drugs (including substance misuse) on behaviour, health and life processes.* *Students may hear the term ‘drugs’ and have the misconception that all drugs are dangerous.* | Students should be able to describe the process of discovery and development of potential new medicines, including preclinical and clinical testing.WS1.4 Explain everyday applications of scienceWS1.6 Understand the importance of peer review  | ToxicityEfficacyDosageAntibiotics)Painkillers PlaceboReading Activity:Drugs discovery  | B3 infection and response KO |
| **Lesson 11:****Monoclonal antibodies (Triple Biology only) (HT only)** | Monoclonal antibodies are produced from a single clone of cells. The antibodies are specific to one binding site on one protein antigen and so are able to target a specific chemical or specific cells in the body. They are produced by stimulating mouse lymphocytes to make a particular antibody. The lymphocytes are combined with a particular kind of tumour cell to make a cell called a hybridoma cell. The hybridoma cell can both divide and makes the antibody. Single hybridoma cells are cloned to produce many identical cells that all produce the same antibody. A large amount of the antibody can be collected and purified. Students should be able to describe some of the ways in which monoclonal antibodies can be used. Some examples include: for diagnosis such as in pregnancy tests in laboratories to measure the levels of hormones and other chemicals in blood, or to detect pathogens in research to locate or identify specific molecules in a cell or tissue by binding to them with a fluorescent dye to treat some diseases: for cancer the monoclonal antibody can be bound to a radioactive substance, a toxic drug or a chemical which stops cells growing and dividing. It delivers the substance to the cancer cells without harming other cells in the body. Students are not expected to recall any specific tests or treatments but given appropriate information they should be able to explain how they work.Monoclonal antibodies create more side effects than expected. They are not yet as widely used as everyone hoped when they were first developed. | * ***White blood cells produce antibodies that stick to microbes’ antigens and kill them.***
 | WS 1.3 Appreciate the power of monoclonal antibodies and consider any ethical issues.  | HybridomaMonoclonalReading activity- Uses of monoclonal antibodies | B3 KO TRIPLE ONLY<https://www.youtube.com/watch?v=vKn8u9MoElY><https://www.youtube.com/watch?v=I6jE99Fjbvo><https://www.bbc.co.uk/bitesize/guides/zt8t3k7/revision/1><https://www.youtube.com/watch?v=XrUW54Ea598> |
| **Required practical activity 2** **If not done in B1 cells (Triple Biology only)** | Students will learn that bacteria reproduce by a process of binary fission… once every 20 minutes]Students will investigate the effect of antiseptics or antibiotics on bacterial growth using agar plates and measuring zones of inhibition.Students will learn that aseptic techniques ensure the microorganisms being investigated do not escape or become contaminated with an unwanted microorganism. This can be achieved by:* Wiping bench with disinfectant/alcohol.
* Not fully removing the lid .
* Using sterile loops when transferring cultures.
* Flaming culture bottle necks to prevent contamination.
* Sterilising (using an autoclave) or disposing of all used equipment
* Incubation at 25oC
 | * *Discovery of antibiotics by Alexander Fleming involved the use of bacterial growth on petri dishes*
* *Antibiotics are only used to treat bacterial infections*
* *Students will already know the names of some common antimicrobial cleaning products*
* *Students should already know that* πr2 is used to calculate area of a circle.
* *Students should already know how to express answers in standard form*
 | In doing this practical student should cover these parts of the apparatus and techniques requirements.AT 1 – use appropriate apparatus to record length and area.AT 3 – use appropriate apparatus and techniques to observe and measure the process of bacterial growth.AT 4 – safe and ethical use of bacteria to measure physiological function and response to antibioticsand antiseptics in the environment.AT 8 – the use of appropriate techniques and qualitative reagents in problem-solving contexts to find the best antibiotic to use or the best concentration of antiseptic to use.**Key opportunities for skills development:**In doing this practical there are key opportunities for students to develop the following skills.WS 2.1 – develop hypotheses about the effectiveness of the antibiotics or antiseptics to be used.WS 2.2 – plan experiments to make observations, test hypotheses and explore phenomena.WS 2.4 – have due regard for accuracy of measurements, and health and safety when using bacterialcultures.MS 5c – calculate cross-sectional areas of bacterial cultures and clear agar jelly using πr2. | Aseptic techniquesClear zoneZone of inhibitionAntimicrobialReproducible resultsReading a method |  B3 KO TRIPLE ONLY<https://www.youtube.com/watch?v=AlGcpC0aqNU> |
| **Plant disease & Defences (Triple Biology only)** |  Plant diseases can be detected by: stunted growthspots on leavesareas of decay (rot)growthsmalformed stems or leavesdiscolourationthe presence of pests. Identification can be made by: reference to a gardening manual or websitetaking infected plants to a laboratory to identify the pathogenusing testing kits that contain monoclonal antibodies.Plants can be infected by a range of viral, bacterial and fungal pathogens as well as by insects.Students should review tobacco mosaic virus as a viral disease, black spot as a fungal disease and learn that aphids are insects which pierce the phloem to obtain glucose from the plant and as a consequence the plant would not have as much glucose for growth.Plants can be damaged by a range of ion deficiency conditions:stunted growth caused by nitrate deficiency (yellow leaves)chlorosis (yellow leaves) caused by magnesium deficiency.Nitrate ions are needed for protein synthesis and therefore growth, and magnesium ions needed to make chlorophyll. If no chlorophyll is made then photosynthesis cannot take place so no glucose is produced and so no/poor growthPlants have Physical defence responses to resist invasion of microorganisms. •• Cellulose cell walls. •• Tough waxy cuticle on leaves. •• Layers of dead cells around stems (bark on trees) which fall off. Chemical plant defence responses. •• Antibacterial chemicals. •• Poisons to deter herbivores. Mechanical adaptations. •• Thorns and hairs deter animals. •• Leaves which droop or curl when touched. •• Mimicry to trick animals. | *Students will already know that TMV is a plant disease cause by a pathogen**Students will already know that rose black spot is a fungal disease that affects plants.**Students should already know that the phloem carries sugars for the plant*  | WS1.4- Everyday applications  | MimicryChlorosisDeterrentReading Activity-Plant defences | B3 KO TRIPLE ONLY<https://www.bbc.co.uk/bitesize/guides/zwkbqhv/revision/1> |

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**Knowledge Rich Curriculum Plan**

SCIENCE- Biology Year 10

B4 Bioenergetics

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| **Lesson/Learning Sequence**  | **Intended Knowledge:*** *Students will know that…*
 | **Prior Knowledge:*** *In order to know this, students need to already know that…*
 | **Working Scientifically** | **Tiered Vocabulary and Reading Activity** | **Support** |
| **Lesson 1:****Photosynthesis & How Plants use the glucose made** | * Photosynthesis is represented by the equation: carbon dioxide + water ->glucose + oxygen
* Students should recognise the chemical symbols: (Light & Chlorophyll can be above& below the arrow)

6CO2 + 6H2O ->6O2 + C6H12O6.* Students should be able to describe photosynthesis as an endothermic reaction in which energy is transferred from the environment to the chloroplasts by light. The glucose produced in photosynthesis may be:

-used for respiration- converted into insoluble starch for storage- used to produce fat or oil for storage- used to produce cellulose, which strengthens the cell wall- used to produce amino acids for protein synthesis.* To produce proteins, plants also use nitrate ions that are absorbed from the soil.
 | * *Plants are producers. They produce their own food through photosynthesis. He reactants in, and products of, photosynthesis, and a word summary for photosynthesis*
* *The dependence of almost all life on Earth on the ability of photosynthetic organisms, such as plants and algae, to use sunlight in photosynthesis to build organic molecules that are an essential energy store and to maintain levels of oxygen and carbon dioxide in the atmosphere*
* *The adaptations of leaves for photosynthesis.*
 | WS 4.1 Use scientific vocabulary, terminology and definitions. | Endothermic - accompanied by or requiring the absorption of heat.Reactant – A substance which takes part in a reaction.Product – A substance formed as a result of a chemical reaction. | <https://www.bbc.co.uk/bitesize/topics/zgws7p3><https://www.savemyexams.co.uk/gcse/biology/aqa/18/revision-notes/4-bioenergetics/4-1-photosynthesis/4-1-1-photosynthetic-reaction/>B4 Knowledge Organiser |
| **Lesson 2:****Factors that affect the rate of photosynthesis** | * Students should be able to explain the effects of temperature, light intensity, carbon dioxide concentration, and the amount of chlorophyllin the rate of photosynthesis.
* Students should be able to:

Measure and calculate rates of photosynthesisExtract and interpret graphs of photosynthesis rate involving one limiting factorPlot and draw appropriate graphs selecting appropriate scale for axesTranslate information between graphical and numeric form.(HT only) These factors interact and any one of them may be the factor that limits photosynthesis.(HT only) Students should be able to explain graphs of photosynthesis rate involving two or three factors and decide which is the limiting factor. (HT only) Students should understand and use inverse proportion.– the inverse square law and light intensity in the context ofphotosynthesis.(HT only) Limiting factors are important in the economics ofenhancing the conditions in greenhouses to gain the maximum rate of photosynthesis while still maintaining profit.MS 3a, 3d(HT only) WS 1.4* Use data to relate limiting factors to the cost effectiveness of adding heat, light or carbon dioxide to greenhouses.
 | * *The reactants in, and products of, photosynthesis, and a word summary for photosynthesis*
* *The dependence of almost all life on Earth on the ability of photosynthetic organisms, such as plants and algae, to use sunlight in photosynthesis to build organic molecules that are an essential energy store and to maintain levels of oxygen and carbon dioxide in the atmosphere*
* *The adaptations of leaves for photosynthesis.*
 | (HT Only) - WS 1.4 Explain every day and technological applications of science; evaluate associated personal, social, economic and environmental implications; and make decisions based.WS 4.1 Use scientific vocabulary, terminology and definitions. | Chlorophyll - a green pigment, present in all green plants.Concentration - the relative amount of a given substance contained within a solution or in a particular volume of space.Pigment - the natural colouring matter of animal or plant tissue.Limiting - setting or serving as a limit to something | <https://www.bbc.co.uk/bitesize/topics/zgws7p3><https://www.savemyexams.co.uk/gcse/biology/aqa/18/revision-notes/4-bioenergetics/4-1-photosynthesis/4-1-1-photosynthetic-reaction/>B4 Knowledge Organiser |
| **Lesson 3 & 4:****Required practical** **Activity 5: investigate the effect of light intensity on the rate of photosynthesis** | * Required practical activity 5: investigate the effect of light intensity on the rate of photosynthesis using an aquatic organism such as pondweed.
 | * *Control, independent & dependant variables. -The reactants in, and products of, photosynthesis, and a word summary for photosynthesis*

*-The dependence of almost all life on Earth on the ability of photosynthetic organisms, such as plants and algae, to use sunlight in photosynthesis to build organic molecules that are an essential energy store and to maintain levels of oxygen and carbon dioxide in the atmosphere** *-The adaptations of leaves for photosynthesis.*
 | Apparatus used to measure O2 gas production(variables)Using a thermometer to monitor temperatureRate of production of gasTest a hypothesis based on scientific theories/explanationsRepeatability Record observationsProcessing data into graphical formInverse square law | Intensity – the quality or state of being intenseAquatic – relating to water. | <https://www.bbc.co.uk/bitesize/topics/zgws7p3><https://www.youtube.com/watch?v=id0aO_OdFwA><https://www.savemyexams.co.uk/gcse/biology/aqa/18/revision-notes/4-bioenergetics/4-1-photosynthesis/4-1-1-photosynthetic-reaction/>B4 Knowledge Organiser |
| **Aerobic Respiration** | * Students should be able to describe cellular respiration as an exothermic reaction which is continuously occurring in living cells. Respiration occurs in the mitochondria.
* Student will be able to recognise why breathing is different to respiration
* Respiration in cells can take place aerobically (using oxygen) or anaerobically (without oxygen), to transfer energy.
* Organisms need energy for:

Chemical reactions to build larger moleculesMovementKeeping warm.* Aerobic respiration is represented by the equation:

glucose + oxygen carbon dioxide + water* Students should recognise the chemical symbols:

C6H12O6, O2, CO2 and H2O.* Students will know that the reactants (glucose) come from eating and (oxygen) breathing,
 | *Students will already know the parts of the cell in order to recognise mitochondria are the site of respiration and the cell membrane controls what enters and leaves the cell.* * *Students will know the lungs are part of a system called the respiratory system. This often causes the misconception that breathing and respiration are the same thing.*
 | WS 4.1 Use scientific vocabulary, terminology and definitions. | Aerobic - relating to, involving, or requiring oxygen.Breathing – the process of taking air into and expelling it from the lungs.Respiration - a chemical reaction which occurs in all living cells, releasing energy from glucose. | <https://www.bbc.co.uk/bitesize/topics/zgws7p3><https://www.savemyexams.co.uk/gcse/biology/aqa/18/revision-notes/4-bioenergetics/4-1-photosynthesis/4-1-1-photosynthetic-reaction/>B4 Knowledge Organiser |
| **Lesson 6:****Anaerobic Respiration** | * Anaerobic respiration in muscles is represented by the equation: glucose lactic acid
* As the oxidation of glucose is incomplete in anaerobic respiration much less energy is transferred than in aerobic respiration.
* Anaerobic respiration in plant and yeast cells is represented by the equation:

glucose -> ethanol + carbon dioxide* Anaerobic respiration in yeast cells is called fermentation and has economic importance in the manufacture of bread and alcoholic drinks. Compare and contrast aerobic and anaerobic respiration.
 | * *Cellular respiration*
* *Aerobic and anaerobic respiration in living organisms, including the breakdown of organic molecules to enable all the other chemical processes necessary for life*
* *The process of anaerobic respiration in humans and micro-organisms, including fermentation, and a word summary for anaerobic respiration*
* *The differences between aerobic and anaerobic respiration in terms of the reactants, the products formed and the implications for the organism*
 | WS 4.1 Use scientific vocabulary, terminology and definitions. | Anaerobic - relating to, involving, or requiring an absence of oxygen. | <https://www.bbc.co.uk/bitesize/topics/zgws7p3><https://www.savemyexams.co.uk/gcse/biology/aqa/18/revision-notes/4-bioenergetics/4-1-photosynthesis/4-1-1-photosynthetic-reaction/>B4 Knowledge Organiser |
| **Lesson 7:****Response to Exercise** | * During exercise the human body reacts to the increased demand for energy.
* The heart rate, breathing rate and breath volume increase during exercise to supply the muscles with more oxygenated blood. If insufficient oxygen is supplied anaerobic respiration takes place in muscles. The incomplete oxidation of glucose causes a build-up of lactic acid and creates an oxygen debt. During long periods of vigorous activity muscles become fatigued and stop contracting efficiently.
* Investigations into the effect of exercise on the body.
* (HT only) Blood flowing through the muscles transports the lactic acid to the liver where it is converted back into glucose. Oxygen debt is the amount of extra oxygen the body needs after exercise to react with the accumulated lactic acid and remove it from the cells.
 | * Heart Rate and breathing rate increase during exercise.
* Blood transport oxygen around the body.
 |  | Heart rate – the speed at which the heart beats.Breathing rate - The number of breaths you take per minute. | <https://www.bbc.co.uk/bitesize/topics/zgws7p3><https://www.savemyexams.co.uk/gcse/biology/aqa/18/revision-notes/4-bioenergetics/4-1-photosynthesis/4-1-1-photosynthetic-reaction/>B4 Knowledge Organiser |
| **Lesson 8:****Metabolism** | * Students should be able to explain the importance of sugars, amino acids, fatty acids and glycerol in the synthesis and breakdown of carbohydrates, proteins and lipids.
* Metabolism is the sum of all the reactions in a cell or the body.
* The energy transferred by respiration in cells is used by the organism for the continual enzyme-controlled processes of metabolism that synthesise new molecules.
* Metabolism includes:

•• conversion of glucose to starch, glycogen and cellulose •• the formation of lipid molecules from a molecule of glycerol and three molecules of fatty acids •• the use of glucose and nitrate ions to form amino acids which in turn are used to synthesise proteins •• respiration •• breakdown of excess proteins to form urea for excretion. * All of these aspects are covered in more detail in the relevant specification section but are linked together here.
 | * *aerobic and anaerobic respiration in living organisms, including the breakdown of organic molecules to enable all the other chemical processes necessary for life*
* *A word summary for aerobic respiration*
* *The process of anaerobic respiration in humans and micro-organisms, including fermentation, and a word summary for anaerobic respiration*
* *The differences between aerobic and anaerobic respiration in terms of the reactants, the products formed and the implications for the organism.*
 | WS 4.1 Use scientific vocabulary, terminology and definitions. | Metabolism - The sum of all the reactions in a cell or the bodyThese reactions synthesise (make) molecules or break them down and involve enzymesEnzyme – A Biological catalyst which speeds up chemical reactions. | <https://www.bbc.co.uk/bitesize/topics/zgws7p3><https://www.savemyexams.co.uk/gcse/biology/aqa/18/revision-notes/4-bioenergetics/4-1-photosynthesis/4-1-1-photosynthetic-reaction/>B4 Knowledge Organiser |