Year 9 Autumn Term 1 Timetable and Scheme of Work.

Y9 Half term 1	Topic Studied
1	C9 Crude oil
2	P1 Conservation and dissipation
3	B18 Biodiversity and ecosystems

· At the end of year 11, students will be sitting the Combined Science Trilogy GCSE from AQA. The specification can be found here: https://www.aqa.org.uk/subjects/science/gcse/combined-science-trilogy-8464

· During this autumn term, students will be learning about the topics outlined above.

· The scheme of work below is what students would follow if they were in school and is based on the Oxford University Press 5 year curriculum.

· We will aim to set tasks following this lesson by lesson structure however many of the activities will be different for home learning however they may give you some ideas on how to take your learning further.

· You may find the objectives most useful as this highlights what the pupils need to understand /know for each grade

GCSE Chemistry C9 Crude Oil and Fuels			
What are we learning?	What knowledge, understanding and skills will we gain?	What does excellence look like?	What additional resources are available?
The extraction and uses of crude oil	**Knowledge** • Crude oil is a mixture of hydrocarbons • Names of some hydrocarbons and the properties of long and short chains • The definition of hydrocarbons, alkanes and alkenes • The mixture of hydrocarbons is separated using fractional distillation	Explaining the relationship between chain length and BP using particle model. Applying mathematical formula and use of 'n' to write alkanes and alkenes Independent research into the use of crude oil and the products we make from it, evaluation of their	BBC Bitesize Doddle – power points and quick quizzes You tube: 'Free science lessons' Seneca learning platform Microsoft teams assignments

	• Uses of hydrocarbons • Hydrocarbons can be split using cracking **Understanding** • Identifying hydrocarbons, alkanes and alkenes through words, symbols, display formula or bromine test of saturation • Comparison between alkanes and alkenes • Explanation of how hydrocarbons are separated using their boiling points • Evaluating the uses of hydrocarbons • Detailed description of cracking, the conditions required and evaluation of use of its products **Skills** • Use conservation of mass to predict products of reactions • Balance symbol equations • Use scientific terminology to describe and explain	use against the impact on our environment and suggestion of alternatives Independent research on a big question with references – such as 'when will we run out of fuel?' Extended and detailed scientific writing on this topic that summarises how important crude oil is.	

Scheme of Work 2019 - 2020

Subject: GCSE Science: C9: Crude Oil and Fuels (Never Ending Riches?)

Year Group:9

Specification: AQA Combined Science Trilogy

Skill focus: : 18 and 20

Lesson No	Topic & Objectives	Big Question – What will students learn?	Key Activities & Specialist Terminology (Do Now Task / Starter/Tasks/Plenary	Planned Assessment	Homework or flipped learning resources DODDLE resources	Lit Num SMSC Codes
C9.1 Hydrocarbons	**Aiming for Grade 4 LOs:** • Describe the composition of crude oil. • State a definition of a hydrocarbon. • State a definition of an alkane. **Aiming for Grade 6 LOs:** • Describe how to separate crude oil into fractions in a school laboratory. • Classify a hydrocarbon as an alkane. • State the names and describe the first four alkanes. **Aiming for Grade 8 LOs:** • Explain why fractional distillation is used to separate crude oil into fractions. • Apply a general formula to generate a molecular formula and a displayed formula for a straight-chain alkane. • Classify and justify the classification of a chemical as an alkane.	What is crude oil and why is it so expensive?	**Lesson Overview** **Starters** **Diagram** (5 minutes) Show students the molecular formulae and displayed formulae of the first four alkanes. Students classify them as molecular formulae or displayed formulae. **Crude oil and hydrocarbons** (10 minutes) Students use the interactive to put a series of statements that describe the formation of crude oil in the correct order. They then match the name, chemical formula, and structural formula for the first four alkanes. **Main** **Distillation of crude oil** (40 minutes) Give students a molecular modelling kit and explain which pieces represent carbon atoms, hydrogen atoms, and covalent bonds. Then give students the formulae of the first four alkanes and ask them to make the molecular models of these. Tell students the names of these alkanes and ask them to draw a table with three columns (name, molecular formula, displayed formula). Demonstrate the distillation of crude oil as detailed in the practical box. Use question and answer to ensure that students understand the processes involved. Highlight that each fraction is in fact a mixture of hydrocarbon rather than a pure substance. Students should then draw a diagram of the equipment used and annotate it to describe and explain how distillation separates crude oil. **Plenaries**	QnA between teachers and students Written responses to questions Class discussion Identifying hydrocarbons task	Doddle: Hydrocarbons worksheet AQA Hydrocarbons mini quiz	So3 C3 Sp2 Sp9 Sp1 C5 So7

			Sorting (5 minutes) Give students a list of names, and molecular and displayed formulae for organic chemicals. Students identify whether the organic chemicals are hydrocarbons and whether the hydrocarbons are alkanes. **Discussing questions** (10 minutes) Show students an exam-style practice question. Ask students to discuss the answer and then choose a few students to share with the whole class the points they would include in their answer. Then reveal the mark scheme and any relevant points from the examiner's report for that question. Encourage students to evaluate the answer they came up with.			
C9.2 Fractional Distillation of Oil	**Aiming for Grade 4 LOs:** • Name the different fractions from crude oil. • State a use for each fraction from crude oil. **Aiming for Grade 6 LOs:** • Describe how the trend in colour, viscosity, flammability, and boiling point changes as the length of the hydrocarbon chain changes. • Describe how the properties of a fraction of crude oil make it appropriate for its use. **Aiming for Grade 8 LOs:** • Explain in detail how fractional distillation is used to separate crude oil into fractions. • Explain how chain length affects the properties of crude oil fractions. • Make predictions about the properties of crude oil fractions from the fraction's hydrocarbon chain length.	How do we separate all the fractions in crude oil so that they are useful?	**Lesson Overview** **Starters** **Distil the order** (5 minutes) Ask students to put the following words in the correct order to describe fractional distillation: mixture, separate, boil, heat, condense. (mixture → heat → boil → condense → separate) **Drawing a bar chart** (10 minutes) Ask students to plot a bar chart for methane (*M*r = 16, boiling point = −162 °C) ethane (*M*r = 30, boiling point = −89 °C), propane (*M*r = 44, boiling point −42 °C), and butane (*M*r = 58, boiling point −1 °C). Ask students to state the trend in this data. **Main** **Comparing fractions** (40 minutes) Give students the molecular formula of an alkane from each fraction of crude oil. Demonstrate the flammability of each fraction as detailed in the first practical box and ask students to state the trend. Then ask students to predict which would have the highest and lowest viscosity based on the molecular formula of the alkanes to be tested. Run the demonstration as detailed in the second practical box to test their predictions. Students should summarise the trends by writing a list of the fractions and adding an annotated arrow alongside to describe each trend (similar to how reactivity is shown in the metal reactivity series). Students should use the student book to include the trends in colour.	QnA between teachers and students Written responses to questions Class discussion Trends table completed	Doddle: Fractional Distillation worksheet AQA Crude Oil mini quiz	So3 C3 Sp2 C8 Sp9 C5 So7

			Plenaries makes it appropriate for its uses. **Spotting patterns** (10 minutes) Students use the calculation sheet to anaylse data and identify trends in the properties of hydrocarbons.			
C9.3 Burning Hydrocarbon Fuels	**Aiming for Grade 4 LOs:** • Define complete and incomplete combustion. • Write a word equation to describe the complete combustion of a hydrocarbon. • Write a word equation to describe the incomplete combustion of a hydrocarbon. **Aiming for Grade 6 LOs:** • Explain the differences between complete and incomplete combustion. Write balanced symbol equations for the complete and incomplete combustion of • hydrocarbons. • Explain how to test for the products of complete combustion. **Aiming for Grade 8 LOs:** • **Justify the use of a given fuel over another.** • Explain in detail how the production of carbon monoxide in incomplete combustion can be lethal. • **Use balanced symbol equations to calculate amounts of reactants or products in a combustion reaction.**	What are the consequences of burning hydrocarbon fuels?	**Lesson Overview** **Starters** **Lab tests** (5 minutes) Ask students to recall the simple laboratory test for: • oxygen (glowing splint re-lights) • carbon dioxide (limewater turns cloudy) • water (cobalt chloride paper turns from blue to pink). **Bunsen burner** (10 minutes) Set up a Bunsen burner on the safety flame. Ask students to name the fuel and give the molecular and displayed formulae. Demonstrate how the yellow flame is 'dirty' by holding some glassware in it to show the soot that coats it. Explain that this is incomplete combustion, producing carbon as one of the products. Open the air hole to show complete combustion and use question and answer to compare the flames. **Mains** **Products of complete combustion** (20 minutes) Explain to students that they are going to investigate the combustion of methane. Explain that this is a type of oxidising reaction and ask students to explain why. Encourage students to predict the products of the reaction and suggest simple laboratory tests that could be used to determine the identity of the products. Demonstrate the complete combustion of methane using a Bunsen burner. **Fuel for cars** (20 minutes) Explain that cars can be fuelled on petrol (which contains a lot of decane) as well as natural gas (mainly methane). The complete combustion of petrol releases 6779 kJ / mol and methane 882 kJ / mol. Students use the worked example in the student book to generate balanced symbol equations and	QnA between teachers and students Written responses to questions Class discussion Evaluate use of fuels	Doddle: What are the products of combustion animation	So3 C3 Sp5 Sp2 Sp9 C5 So7

			calculate the amount of carbon dioxide produced. Ask students to evaluate the use of each fuel thinking about the ease of ignition, storage, supply, energy density, and type of flame produced. **Plenaries** **The dangers of incomplete combustion** (5 minutes) Explain to students that methane can be used in homes for central heating. Ask students to suggest why boilers should be serviced regularly to ensure that only complete combustion is happening. **Balancing equations** (10 minutes) Students use the maths skills interactive to practise balancing symbol equations for combustion reactions, including using fractions.			
C9.4 Cracking hydrocarbons	**Aiming for Grade 4 LOs:** • Define the process of cracking. • Generate a word equation to describe cracking. • Recognise and give examples of alkenes. **Aiming for Grade 6 LOs:** • Describe the process of cracking, including conditions. • Generate a balanced symbol equation to describe cracking. • Describe a chemical test to show an alkene is present. **Aiming for Grade 8 LOs:** • Use examples to explain the process of cracking and why it is so important to the petrochemical industry. • Explain the similarities and differences between alkanes and alkenes. • Explain, using balanced symbol equations, the reaction between bromine water and an alkene.	How can we make the longer chains more useful?	**Lesson Overview** **Starters** **Ethane and ethene** (5 minutes) Students sort statements according to whether they describe ethane, ethene, or both. Students then complete equations to describe potential products formed in the cracking of decane. **Molecular model** (10 minutes) Give students a molecular modelling kit. Ask them to make a bromine molecule, and a hydrocarbon with the formula C_2H_4 (ethene). Then ask students to imagine that when these chemicals are mixed together they add to make one product. Ask students to make that product. Encourage students to attempt a balanced symbol equation for this reaction. **Mains** **Cracking** (40 minutes) Complete the practical as detailed. Ask students to draw a labelled diagram of the experiment and add annotations to explain how the reaction occurs. This should include the equation for the reaction, a definition of an alkene, a chemical test for alkenes, and an explanation why cracking is useful for industry. **Plenaries**	QnA between teachers and students Written responses to questions Class discussion Cracking practical complete	Doddle: Cracking hydrocarbons worksheet Cracking in the laboratory animation	So3 C3 Sp2 Sp9 C5 C8 So7

			Crack the equation (5 minutes) Ask students to write as many equations as they can for the cracking of decane, $C_{10}H_{12}$. **Comparing hydrocarbons** (10 minutes) Students produce a comparison table of the similarities and differences between alkanes and alkenes. Their tables should include interpretations of structural formulae.			

GCSE Physics P1 Conservation and Dissipation of Energy			
What are we learning?	What knowledge, understanding and skills will we gain?	What does excellence look like?	What additional resources are available?
Energy is transferred but not created or destroyed	**Knowledge** • List the types of energy including energy stores and potential energy • Work done, potential energy kinetic energy and power equations **Understanding** • Explain how energy can be wasted if not destroyed or 'used up' and conserved in closed systems • Explanation of how work done can be reduced and / or energy transfer can be more efficient • Evaluate the methods to improve energy efficiency • Calculate gravitational potential, elastic potential or kinetic energy. • Explain the connection between energy and power **Skills** • Accurately taking measurements • Converting between measurements • Using scientific terminology to describe • Using scientific equations • Calculate a medium and mode	Confident in using and re-arranging equations to solve problems Deriving equations through deep understanding of how the components interact e.g. weight, height and gravitational potential energy. Completing multi-step calculations Extended scientific writing evaluating the methods of reducing energy waste Individually planning and possible conducting practical that could prove the connections in an equation.	BBC Bitesize Doddle – power points and quick quizzes You tube: 'Free science lessons' Seneca learning platform

Scheme of Work 2019 - 2020

Subject: GCSE Science: P1: Energy Transfer by Heating

Year Group: 9

Specification: AQA Combined Science Trilogy

Skill focus: 23, 20a, 24,25

Lesson No	Topic & Objectives	Big Question – What will students learn?	Key Activities & Specialist Terminology (Do Now Task / Starter/Tasks/Plenary	Planned Assessment	Homework or flipped learning resources DODDLE resources	Lit Num SMSC Codes
P1.1 Changes in Energy Stores	**Aiming for Grade 4 LOs:** • State some examples of energy stores. • State the processes that can transfer energy from one store to another. • Identify changes in some energy stores using simple examples. **Aiming for Grade 6 LOs:** • Describe a wide range of energy stores in different contexts. • Describe changes in energy stores in terms of the process that causes the change. • Use quantitative descriptions of changes in energy stores. **Aiming for Grade 8 LOs:**	Can energy ever be created or destroyed?	**Lesson Overview** **Starters** **Off like a rocket** (5 min) Show students a video of a firework. Ask them to draw an energy transfer diagram of what they see happening. Check through their diagrams to discuss the different energy stores. **What is energy?** (10 min) Ask students to express their ideas about what the word energy means. They could produce a visual summary to show their prior knowledge. **Main** **Energy stores and transfers** (15 min) Introduce the concept of energy stores and how they can be filled and emptied by energy transfers. Focus on the mechanisms (forces, current, and heating) that cause these changes, avoiding the idea that the energy itself is the cause. Analyse the energy transfers of a falling object, discussing the forces acting at different stages. Remind students that	Question & Answer, Mini white boards, Exam style question	**Rich question to research:** Energy often becomes dissipated. What does this mean? **Doddle task:** AQA Work and energy transfer (mini quiz) Microsoft teams assignments	C3 C3

	• Describe the nature of energy stores in detail including the relationship between objects. • Explain factors that affect the size of changes in energy stores. • Represent energy changes graphically, accounting for changes in all stores.		it is the action of unbalanced forces that causes the changes. **Energy circus** (25 min) Allow students to investigate some changes in energy stores using the practical. They should identify which stores are filling and emptying and the process that causes these changes. Ask the students to be specific about the forces – is a frictional or gravitational force acting? **Plenaries** **What's the transfer?** (5 min) Provide students with some examples of simple energy transfers they may encounter regularly (e.g., the ticking of a clock, the growth of a plant, or the ringing of the bell marking the end of the lesson). Students use the interactive to complete a description of what energy transfers are occurring. **Energy links** (10 min) Ask students to draw a large circle with all the different stores of energy listed around the outside. They must then link the stores of energy together with an arrow, labelled with a description of the process that can transfer the energy from one store to another			
P1.2 Conservation of Energy	**Aiming for Grade 4 LOs:** • State that energy is conserved in any transfer. • State that energy is dissipated (is no longer useful) when it heats the environment. • Investigate the energy transfers in a pendulum and a bungee. **Aiming for Grade 6 LOs:** • Apply the law of conservation of energy in straightforward situations. • Describe the changes in energy stores explaining why energy ceases to be useful. Describe the energy changes in a range of experiments and account for energy dissipation to the surroundings.	Where does the energy go?	**Lesson Overview** **Starters** **Where does it all go?** (5 min) Light a candle with a match and ask students to describe what happens to the chemical store of energy in the wax and the changes in the match. **A plane journey** (10 min) Students use the interactive to describe the changes in energy stores at each stage of an aeroplane journey, where the airplane lands back at the same place it took off. Ask them what has happened to the energy. Use the ideas that they produce here later in the lesson to discuss the idea that energy cannot 'go away' – it is all accounted for. **Main** **Investigating pendulums** (20 min) After a brief recap of changes in energy stores, students should investigate the	Question & Answer, Mini white boards, Exam style question	**Rich question to research:** Describe the energy transfers occurring during a bungee jump. **Doddle task:** AQA Work and energy transfer (mini quiz)	C3 C3

	Aiming for Grade 8 LOs: • Apply the law of conservation of energy to explain why forces cause hating effects. • Describe closed systems and the changes to energy stores within them using the principle of conservation energy. • Evaluate in detail experiments to investigate energy changes.		pendulum. As well as thinking about the processes that remove energy from the system (frictional forces) to explain why the pendulum slows, they will investigate whether energy is roughly conserved over the course of one swing. This allows discussion of energy transfers within a closed system. Discuss the concept of energy dissipation to the surroundings in the initial experiment and emphasise that the total energy is the same at all points in the process. The students must be able to state the law of conservation of energy. **Bungee jumping** (20 min) Discuss the energy transfers in a bungee jump and use the experiment to look at the forces, gravitational and tension, and reinforce the idea that energy is always conserved. Make sure that the heating effect in the bungee rope is discussed. **Plenaries** **Measuring the energy in food** (5 min) Ask students, as a class or in groups, to discuss some of the issues around designing an experiment to measure the energy in a food sample. Students should aim to minimise energy dissipation to the surroundings. **Evaluate and improve** (10 min) Students evaluate the results of their experiments and then design improvements to the experiment.		Microsoft teams assignments	
P1.3 Energy an Work	**Aiming for Grade 4 LOs:** • State that energy is measured in joules (J). • Calculate the work done by a force. • Measure the work done by a force experimentally. **Aiming for Grade 6 LOs:** • Describe the action of frictional forces on objects and the associated heating effect. • Use the equation for work done to calculate distances or size of forces.	How are energy and work connected?	**Lesson Overview** **Starters** **Defining work** (5 min) Students define the terms work and working as used in common language. Lead them to the idea of a force being involved in working. **Forces and energy** (10 min) Ask students to describe some situations where forces cause changes in energy stores. They should explain what factors would affect the size of changes in these stores. **Main**	Question & Answer, Mini white boards, Exam style question	**Rich question to research:** When you are holding a weight above your head, are you doing work? Explain	C3

	Use repeat values to measure the work done by a force experimentally. **Aiming for Grade 8 LOs:** • Use the principle of conservation of energy and forces to explain why objects become heated by frictional forces. • Apply the equation for work done in a wide range of contexts. Evaluate in detail an experiment to measure work done, explaining why there is variation in the measurements.		**Doing work** (40 min) Build on the previous idea of forces causing changes in energy stores to introduce the idea of doing work on something. Be careful with the definition here – it is very specific as opposed to the general term work, with which the students will be familiar. Students should perform a few calculations to embed the equation. Students then carry out the practical, including supporting calculations. There will be considerable errors in the experiments, which the students should discuss. Discuss the heating effect of frictional forces using the examples. These can be supported by practical demonstrations such as hand rubbing, bicycle brakes, and so on. **Plenaries** **Working or not?** (5 min) Hold a heavy weight but do not lift or drop it. Ask if mechanical work is being done on the weight, and if not, why energy is being transferred as you hold it. **Mathematical work out** (10 min) Students use the interactive to answer some additional questions involving the equation for work done		**Doddle task:** AQA Work and energy transfer (mini quiz) Work done (presentation) Power, work done and time (interactive) Microsoft teams assignments	C3 C3 C3
P1.4 Gravitational Potential Energy Stores	**Aiming for Grade 4 LOs:** • State the factors that affect the change in the gravitational potential energy store of a system. • Calculate the gravitational potential energy store of a system using the weight of an object and its height. • Measure the gravitational potential energy store changes in a system with a simple practical activity. **Aiming for Grade 6 LOs:** • Describe the effect of a different gravitational field strength on the gravitational potential energy store changes of a system. • Calculate the gravitational potential energy store of a system	What makes the best rollercoasters?	**Lesson Overview** **Starters** **Lifting work** (5 min) Remind students of the idea of work being done by a force when an object moves a distance. Demonstrate lifting things from the floor to a desk and ask them to describe changes in energy stores. Ask them to explain what factors affect the size of energy transfers. **All work** (10 min) Give students some scenarios and let them decide if mechanical work is being done. Students use the interactive to explain whether work is being done or not. **Mains** **Gravitational potential energy transfers** (15 min) Link the equation for work done ($W = F\,s$) to the idea of changing height as the distance. Ask the students to form a simple	Question & Answer, Mini white boards, Exam style question	**Rich question to research:** Does a space shuttle travelling to and from the Moon require the same amount of fuel for **both** journeys? **Doddle task:** Potential and kinetic energy (presentation)	C3 C3 C3

	using the mass, gravitational field strength, and height. • Describe energy changes that involve a heating effect as opposed to movement of an object. **Aiming for Grade 8 LOs:** • Perform calculations using rearrangements of the gravitational potential energy store equations. • Apply the gravitational potential energy store equations in a wide range of contexts. • Account for all changes of energy during falls or increases in height, including heating effects.		equation linking change in height to work done. Ask where the energy provided to the lifted object would now be stored, and lead on to the idea of gravitational potential energy stores. Define the gravitational potential energy equation. The students should then perform some simple calculations of work done and changes in gravitational potential energy stores. **Stepping up** (25 min) Introduce the idea of calculating weight from $m \times g$ and expand the original GPE equation. As before, students should perform some calculations including some set on different planets. Students can carry out the simple practical to reinforce their use of the GPE equation. **Plenaries** **How high?** (5 min) Ask students to calculate the *E*p of a jumbo jet (400 000 kg) with a cruising altitude of 10 700 m. The *E*p is 41 986 800 000 J (~42 GJ). **A hard day** (10 min) Students estimate the energy they transfer by climbing stairs when moving between lessons during a typical day by estimating the height changes and their weight.		Energy transfer at terminal velocity (animation) Microsoft teams assignments	
P1.5 Kinetic and Elastic Stores	**Aiming for Grade 4 LOs:** • State the factors that affect the size of a kinetic energy store of an object. • State the factors that affect the elastic potential energy store of a spring. • Describe energy changes involving elastic potential energy and kinetic energy stores. **Aiming for Grade 6 LOs:** • Calculate the kinetic energy store of an object. • Calculate the elastic potential energy store of a stretched spring.	How can you calculate kinetic and elastic energy?	**Lesson Overview** **Starters** **Mass and velocity** (5 min) Using mini-whiteboards, the students must give accurate definitions of mass and velocity and their units. **Kinetic objects** (10 min) Show students various moving objects with the mass and the velocity of the object. Students use the interactive to put them into order from which object has the smallest kinetic energy store to the largest. **Mains**	Question & Answer, Mini white boards, Exam style question	**Rich question to research:** Thorpe Park has a ride called "The Stealth". Describe the energy transfers occurring during this ride. https://www.youtube.com/watch?v=8dFryAUWMn4	C3

	• Investigate the relationship between the energy stored in a spring and the kinetic energy store of an object launched from it. **Aiming for Grade 8 LOs:** • Perform calculations involving the rearrangement of the kinetic energy equation. • Perform calculations involving the rearrangement of the elastic potential energy equation. • Perform a wide range of calculations involving transfer of energy.		**Investigating kinetic energy stores** (25 min) Students carry out the practical to investigate the factors that affect the amount of energy in a kinetic store by using the practical. They may need reminding beforehand about gravitational potential energy stores. The data provided in the student book may be used if the experiment does not provide suitable results. Introduce the kinetic energy equation. Demonstrate a set of calculations before expecting students to perform their own. **Investigating a catapult** (15 min) This energy transfer needs careful explanation as there are two linked concepts with corresponding equations. The practical can be used as a demonstration to show how stretching the band further stores more energy. **Plenaries** **Higher/lower** (5 min) Go through a series of objects with different masses and velocities and ask the students to say (or calculate) if the kinetic energy store is higher or lower than the previous one. **Kinetic cards revisited** (10 min) The students now have to calculate the energy of each of the cards used in the second starter to check their order. Use this task to make sure that the students are treating the calculations correctly.		**Doddle task:** Potential and kinetic energy (presentation) Potential and kinetic energy (worksheet) Microsoft teams assignments	C3 C3
P1.6 Energy Dissipation	**Aiming for Grade 4 LOs:** • Identify useful and wasted energy in simple scenarios. • Describe energy dissipation in terms of heating the surroundings. • Measure the frictional force acting on an object. **Aiming for Grade 6 LOs:** • Analyse energy changes to identify useful and less useful energy transfers. • Describe energy dissipation and how this reduces the capacity of a system to do work. • Investigate the factors that affect frictional forces.	Where does the energy go if it cannot be destroyed?	**Lesson Overview** **Starters** **Useful or useless?** (5 min) Show energy transfer diagrams and ask students to use the interactive to identify the useful energy transfers and the useless ones in each case. **Overheating** (10 min) Ask students to explain why humans become hot when they work hard. How is this excess energy transferred from the body? Why do people need to eat less in hot weather? Links can be made to biological processes. This can lead to a discussion about where the energy in food actually ends up. **Main**	Question & Answer, Mini white boards, Exam style question	**Rich question to research:** What is meant by regenerative braking systems? **Doddle task:** AQA Energy transfers and efficiency (mini quiz)	C3 C3 C3

	Aiming for Grade 8 LOs: • Use a wide range of energy stores and physical processes to decide on wasted and useful energy transfers. • Apply the concept of energy dissipation in a wide range of scenarios. • Evaluate in detail an experiment to measure the frictional forces acting on an object.		**Investigating friction** (40 min) Discuss some example energy transfers. Use as many examples as possible until the students are clear on the useful and wasteful transfers. Students then observe or try the practical, noting that heating of the surroundings is the ultimate effect of most energy transfers. The idea of a force being the pathway by which energy is transferred should be emphasised. Show a video clip of brakes in action – Formula One cars are ideal. Discuss whether the energy in the resulting thermal stores can be reused in any way. Link back to the earlier demonstrations when discussing dissipation. Ensure that the students know that there is still the same amount of energy but eventually it is too spread out to be useful. Ensure that the students can use the term dissipated correctly. **Plenaries** **Sticky problems** (5 min) Ask students to draw a table of the ways friction can be reduced and give examples of exactly where this happens. A table of suggested places can be provided – ask students to complete it to explain how the friction could be reduced. **What's wrong?** (10 min) Ask students to correct some sentences describing energy and friction. This can be used to challenge some misconceptions. Examples can include: 'When a car stops at traffic lights, the speed energy is destroyed by the brakes and is lost.'		AQA Forces and braking (mini quiz) Microsoft teams assignments	
P1.7 Energy and Efficiency (H)	**Aiming for Grade 4 LOs:** • Describe an efficient transfer as one that transfers more energy by a useful process. • State that the efficiency of an energy transfer is always less than 100%. • Calculate the efficiency of a simple energy transfer. **Aiming for Grade 6 LOs:** • Calculate the efficiency of a range of energy transfers.	How can we maximise efficiency?	**Lesson Overview** **Starters** **Staying on** (5 min) Ask students to explain why some electrical devices of the same type (e.g., two different models of phone) last longer than others even though they use the same batteries. **Efficiency** (10 min) Ask students what is efficiency and why is it wanted? What are the advantages of an efficient device? Form students into groups and ask them to agree	Question & Answer, Mini white boards, Exam style question	**Rich question to research:** What is the purpose of a Sankey diagram? **Doddle task:**	C3

	• Use the law of conservation of energy to explain why efficiency can never be greater than 100%. • Investigate the efficiency of a motor. **Aiming for Grade 8 LOs:** • Describe design features that can be used to improve the efficiency of an energy transfer. • Rearrange the efficiency equation to find input or total output energy. • Evaluate in detail an efficiency investigation to justify conclusions.		on a simple description of what efficiency is and why it is important. **Main** **Investigating efficiency** (40 min) Recap the systems used for measuring quantities, particularly the joule and newton as these are required later. Discuss input and output energy in terms of how much energy is transferred from the starting stores into the stores we want it to be. This leads to calculations of efficiency based on these values. Students should try a few of the calculations to ensure that they can do them. Explain the limits to efficiency, linking this to the law of conservation of energy. Students try an efficiency measurement using the practical. Ensure that they are calculating work done correctly and finding the energy supplied to the motor. **Plenaries** **Car efficiency** (5 min) Show students advertisements for car. Students use the interactive to arrange them in order of energy efficiency, using the fuel consumption figures in the small print. **Improving efficiency** (10 min) Discuss the design features used to improve efficiency of a range of devices, supported by demonstration where possible.		Energy transfers and efficiency (presentation) AQA Energy transfers and efficiency (mini quiz) Microsoft teams assignments	C3 C3
P1.8 Electrical Appliances	**Aiming for Grade 4 LOs:** • List some example electrical devices. • Survey a range of electrical devices and their operation. • Describe the energy transfers carried out by electrical devices. **Aiming for Grade 6 LOs:** • Rank electrical devices in terms of their power. • Compare mains-powered and battery-powered devices. • Describe the processes that waste energy in electrical devices.	What is using energy in your home?	**Lesson Overview** **Starters** **Electricity everywhere** (5 min) Ask students to list all of the electrical appliances that they use during the day, including mains-powered and battery-powered. They then describe how their lives would be more difficult if these appliances did not exist. **Using energy** (10 min) Challenge students to design an experiment to compare how much energy is stored in different batteries. Their ideas could include measuring how long a bulb could stay lit or even how long a toy operates.	Question & Answer, Mini white boards, Exam style question	**Rich question to research:** Electric cars are increasing on our roads. Would an electric airplane be possible? **Doddle task:**	C3 C3

	Aiming for Grade 8 LOs: • Compare electrical devices in terms of efficiency. • Calculate the efficiency of an electrical device. • Explain the operation of electrical devices in terms of forces and electric current.		**Mains** **Everyday electrical appliances** (20 min) Discuss a range of electrical appliances with the students, ideally showing them some examples. The students can then list as many more as they can think of and explain their purpose. Carry out the practical demonstration to show the possible effects of an electric current. **Mains- or battery-powered** (20 min) The students could compare mains and battery-powered devices, noting that mains devices can transfer energy far more quickly. This can be linked to the voltage and size of the current. Students should also be made aware of clockwork devices and shown one if possible. Students then analyse the different devices mentioned in the student book, discussing how they operate and link this back to the effects of a current from earlier in the lesson. **Plenaries** **Making connections** (5 min) Interactive where students complete the paragraph 'Electrical current is a very convenient way of transferring energy because...' and include these words energy, transfer, and current. Students then calculate the efficiency of a series of electrical appliances. **Electrical energy table** (10 min) Ask students to produce a table similar to the one in the student book with additional electrical appliances. You could use a mobile phone, projector, vacuum cleaner, and electric fan. For some students, you could add challenging appliances such as a computer.		Investigating power consumption (interactive) Microsoft teams assignments	
P1.9 Energy and Power	**Aiming for Grade 4 LOs:** • State the unit of power as the watt and kilowatt. • With support, rank electrical appliances in order of power. • Identify 'wasted' and 'useful' energy transfers in electrical devices.	What is the relationship between energy and power?	**Lesson Overview** **Starters** **Big numbers** (5 min) Give students a set of units with SI prefixes and ask them to place the units in order of size. These could be mm, cm, m, km, and another set containing mg, g, and kg. Then add in larger units such as	Question & Answer, Mini white boards, Exam style question	**Rich question to research:** Could renewable sources replace all fossil fuel power stations for the UK?	C3

	Aiming for Grade 6 LOs: • Calculate the energy transferred by an electrical device. • Calculate the efficiency of a device from power ratings. • Find the wasted power of a device. **Aiming for Grade 8 LOs:** • Compare the power ratings of devices using standard form. • Apply the efficiency equation in a range of situations, including rearrangement of the equation. • Combine the electrical power equation with other equations to solve complex problems.		mega (M) and giga (G) that students may not have encountered. **Match up** (10 min) Ask students to sort a range of electrical appliances into order of energy transfer (power rating). You could do this with real objects or with cards to represent them. The objects could be set up on a long bench and students should add sticky notes for their ranking. Discuss these rankings after everybody has had a go. **Main** **Efficiency and power** (40 min) Carry out the practical demonstration to show the difference in energy use between different devices. Discuss the transfer of energy at different rates leading to the power equation. The students need to try some calculations to ensure that they are performing them correctly and using the correct units. Describe some of the power ratings of typical devices using some of the examples from the student book so that the students understand the stages in the calculation. They should then try an example of their own. A maths skills interactive is available to support students with the calculations and provide some examples for them to carry out themselves. Students then identify the useful and wasted power output of a range of devices and then use this data to find the efficiency. Emphasise careful layout of calculations to avoid mistakes. A support sheet is available where students develop their knowledge of the units of energy and power and also practise using energy terms. **Plenaries** **Matching the power** (5 min) Give students a set of pictures of household electrical appliances and a set of power ratings. Ask them to match the ratings with the appliances. For example, kettle 2 kW, washing machine 0.5 kW (average over washing cycle), desktop computer 200 W, dishwasher 1.5 kW, electric clock 1 W, iron 1 kW, CD player 30 W, blender 300 W. **Calculation loop** (10 min) Students match up calculation questions with their numerical answers. There should be a		**Doddle task:** Electrical power (presentation) Microsoft teams assignments	C3

GCSE Biology B18 Biodiversity and Ecosystems			
What are we learning?	What knowledge, understanding and skills will we gain?	What does excellence look like?	What additional resources are available?
The impact that Humans have on the environment	**Knowledge** • Definition of biodiversity • List types of pollution and name some of the causes and consequences of these • List ways that we can protect biodiversity **Understanding** • Critically evaluate data to consider the extent of human impact on the increase of pollution levels • Evaluate the effectiveness with which we try to maintain biodiversity • Explain how various types of pollution have been caused **Skills** • Understand that scientific ideas change over time • Writing to critique a claim and examine consequences • Draw detailed conclusions from graphs and data sets	Extended writing that consolidates, and critically evaluates the data from several secondary sources to evaluate the impact of human population growth on the environment. Detailed explanation with key scientific terminology of the causes and consequences of pollution. Suggesting how we could reduce the impact of human population growth on the environment Independent case study on the effect of a specific pollution on an ecosystem or species. Independent project that investigates food security	BBC Bitesize Doddle – power points and quick quizzes You tube: 'Free science lessons' Seneca learning platform Microsoft teams assignments

			set of calculations and only one card with the correct answer. Students work out the correct answer and then ask the question on that card. Repeat until all of the questions are answered.			

Scheme of Work 2019 - 2020

Subject: GCSE Science: B18: Biodiversity and Ecosystems (We all need each other!)

Year Group: 9

Specification: AQA Combined Science Trilogy

Skill focus: : 14, 16a, 21

Lesson No	Topic & Objectives	Big Question – What will students learn?	Key Activities & Specialist Terminology (Do Now Task / Starter/Tasks/Plenary	Planned Assessment	Homework or flipped learning resources DODDLE resources	Lit Num SMSC Codes
B18.1 The Human Population Explosion	**Aiming for Grade 4 LOs:** • Describe what biodiversity means. • List some resources that humans are using up. • Describe some ways that air, water, and land are polluted. **Aiming for Grade 6 LOs:** • Describe why a good level of biodiversity is important to the future of the human species. • Describe some effects of human population growth. • Analyse and interpret data and information concerning human population growth. **Aiming for Grade 8 LOs:** • Explain in detail why a high level of biodiversity is important to the stability of ecosystems.	How many people could survive on Earth?	**Lesson Overview** **Starters** **Estimating human population** (10 min) Ask students to write on a piece of paper their estimation of the number of people in the world. Ask them to stand in a line so their estimates are in numerical order. Reveal whose estimate is the closest. You can show students a population counter (found online) that shows the current population changing. **Resource issues** (5 min) Show the class a series of stimulus images showing the problems surrounding human population growth, e.g., air and water pollution, landfill sites, deforestation, shanty towns. Ask them to discuss in groups what each image is showing in terms of how humans are affecting the environment, and examples of consequences. **Mains** **Biodiversity** (15 min) Tell the class that a rainforest has a high level of biodiversity, and ask students to suggest	Mind map on land, water and air pollution Class discussion students' responses to questions	Learn the key words from the topic: Biodiversity population ecosystem survive pollution pesticide herbicide fertilizer nitrates phosphates bioaccumulation	SO3 SO9 SP1 SP2 SP5 SP9 C2

	• Explain why human population change differs from population change of other animals. • Suggest and evaluate solutions to the problems caused by human population growth.		what this means. Ask pairs of students to list possible reasons why a high level of biodiversity is important to: a) other plants and animals in the same ecosystem, and b) the entire human population. **The problem with human population** (25 min) Ask students for examples of resources that humans need, e.g., air, clean water, food. Discuss where we get each of these things. Divide the class into small groups and give each a topic to research – air, water, land, natural resources (e.g., minerals/fossil fuels), biodiversity. Ask them to prepare a short presentation on how the growth in human population is impacting negatively on their resource, and why. Students can use information from the student book, other books and the Internet. **Plenaries** **Solutions** (10 min) For each of the problems presented in Main 2, ask students to suggest solutions. For example, the depletion of fossil fuels can be reduced by using more renewable energy resources. **Land, air, or water** (5 min) Present different ways in which we are polluting the Earth. Ask students to classify them as air, water, or land pollution.		eutrophication deforestation greenhouse effect greenhouse gases methane acid rain sulphur dioxide, deforestation global warming Doddle: Biodiversity presentation 2020 We are diverse planet lesson Microsoft teams assignment	
B18.2 Land and	**Aiming for Grade 4 LOs:** • List some substances that pollute water and land.	How are humans causing	**Lesson Overview** **Starters**	Students' write up on how human	Doddle: Plastic in the oceans- worksheet	SO3 SO9

Water Pollution	• Describe some effects of rubbish, pesticides, and sewage on land and water. • Display data appropriately with guidance. **Aiming for Grade 6 LOs:** • Describe how sewage, fertilisers, pesticides, and herbicides pollute the land and water. • Describe the processes of eutrophication and bioaccumulation. • Draw conclusions from data. **Aiming for Grade 8 LOs:** • Explain in detail how pollution affects biodiversity. • Explain how pesticides in water can kill top predators in food chains. • Consider a land- or water-based pollution issue, stating opinions with reasoning.	pollution to the land and water that surrounds them?	**Water pollution key words** (10 min) Ask students to work in pairs to write down definitions of the key words – pesticide, sewage, herbicide, fertiliser. Ask them to share their definitions, and state what they all have in common. Discuss that they can all pollute water. **Waste** (5 min) Ask students to list the things that get thrown away from their house every day. Discuss the fact that these include paper, metal, plastic, and food waste as well as sewage and waste water from washing machines, etc. . **Main** **Impact of waste** (15 min) Ask students to consider where waste from homes ends up, and to use information from the student book to describe how it can cause water and land pollution. **Water pollution** (25 min) Set up in advance the demonstration to show the effect of extra nitrates and phosphates in the water supply on the growth of plants. Students then collect data and analyse the results. Ask them to link this to the problem of eutrophication, using the information in the student book. **Plenaries** **Effects of farming** (10 min) Give small groups of students a substance that is used or produced by farms (e.g., fertilisers, herbicides, pesticides, sewage, etc). Ask them to discuss how it can damage ecosystems. **Chernobyl** (5 min) Show students the map in the student book (Figure 1). Ask them to analyse what it shows, and come up with one conclusion.	causing pollution to land and water Peer discussion	plastic in the ocean mini quiz Water pollution and eutrophication animation Microsoft teams assignment	SP1 SP2 SP5 SP9 C2
B18.3 Air Pollution	**Aiming for Grade 4 LOs:** • State that acid rain is caused as a result of burning some fuels. • List some effects of acid rain on plants and animals. • Analyse observations and data, with guidance.	How do some lakes and rivers become acidic?	**Lesson Overview** **Starters** **Production of acidic gases** (10 min) Demonstrate that the burning of a fuel (produces acidic gases. Discuss where	Mind map on acid rain Class discussion	Doddle: The effect of acid on plant growth (Chemistry Section)	SO3 SO9 SP1

	Aiming for Grade 6 LOs: • Describe how acid rain is formed. • Plan an investigation to find out how acid rain affects the germination of seeds. • Choose a suitable method for analysing data. **Aiming for Grade 8 LOs:** • Use word and symbol equations to show how burning some fuels produces acidic gases. • Explain what causes global dimming and smog, and describe their effects. • Analyse in detail data showing sulfur emissions over the last 30 years, and suggest reasons for the trend.		coal is burnt, and ask students to suggest why burning coal has an impact on the environment. **Testing rainwater** (5 min) Supply students with a test tube of rainwater. Ask them to use universal indicator paper to test the sample and write a conclusion. It will be slightly acidic but students shouldn't conclude that it can be classed as acid rain. **Main** **The effect of acid rain** (10 min) Supply students with a diagram that shows the steps in the production of acid rain but has labels missing. Ask them to complete the diagram using information from the student book. Discuss that rain is naturally slightly acidic because carbon dioxide reacts with rainwater to form an acid, but the addition of nitrogen oxides and sulfur dioxide from burning fuels has made rainwater more acidic. Ask students to use information from the student book to list the effects of acid rain on living organisms. Students then plan an investigation into the effect of acid rain on the germination of cress seeds. Ask students to write a method and prediction, then allow them to carry out the investigation. Time will be needed in subsequent lessons to gather results and analyse them. Students can calculate the percentage germination and display the results in a suitable chart or graph. **Plenaries** **The reduction in sulfur emissions** (10 min) Show the class data that shows how sulfur emissions have fallen in the UK over the last 30 years. Ask them to analyse the data, and then suggest reasons for the trend. **Acid rain** (5 min) Use the interactive in which students order the stages in the production of acid rain.	Students response to questions from AQA Biology book	Microsoft teams assignment	SP2 SP5 SP9 C2
B18.4 Deforestation an Peat	**Aiming for Grade 4 LOs:** • Define deforestation • Describe an effect of deforestation • Give a use for peat	Why should we save our rainforests?	**Lesson Overview** **Starters**	Brainstorm on deforestation	Doddle: Maintaining biodiversity	SO3 SO9

Destruction	**Aiming for Grade 6 LOs:** • Explain the effects of deforestation and peat removal. • Categorise reasons for and effects of deforestation as environmental, social, economic, and/or political. • Describe why there is a conflict between using peat to increase food production and the need to conserve peat bogs. • **Aiming for Grade 8 LOs:** • Explain in detail how deforestation and peat removal increase the amount of carbon dioxide in the air. • Analyse data to describe a trend in deforestation rate, and give an explanation. • Explain the conflict between using peat to increase food production and the need to conserve peat bogs.		**Looking at deforestation** (5 min) Show the class an image of deforestation. Ask them why it is considered a bad thing. Then ask if there are any benefits. **For peat's sake!** (10 min) Let students study samples of compost that contains peat and peat-free compost, or show them samples yourself. Students should wear gloves when handling the samples. Ask them to write down their observations about the differences. Ask them to suggest why gardeners often use peat in their compost (it improves the properties of the soil by increasing mineral content and helping with water retention). **Main** **Deforestation mind map** (20 min) Let students use information from the student book spread, other books, and/or the Internet to study the reasons for, and effects of deforestation. Ask them to organise this information as a visual summary with diagrams and pictures as well as text. They should categorise the reasons and effects as environmental, social, economic, and/or political, and show how they are linked together. **Peat problems** (20 min) Give the class a series of true or false statements on peat – what it is, where it comes from, what it is used for, problems with its use. Ask students to use information from the student book to help them decide which are true and which are false. They should write down the true statements and correct versions of the false ones. Discuss the conflict between using peat to increase food production and the need to conserve peat bogs. **Plenaries** **Put the peat down** (10 min) Ask students to write an email to a gardener, persuading them to use peat-free compost. **Deforestation rates** (5 min) Use the interactive, in which students look at a chart of deforestation of time and answer a multiple choice question about possible reasons for increased deforestation rates.	Class discussion Exam questions	Microsoft teams assignment	SP1 SP2 SP5 SP9 C2

B18.5 Global Warming	**Aiming for Grade 4 LOs:** • Describe how global warming is caused by increased levels of carbon dioxide and methane in the atmosphere. • Give one biological consequence of global warming. **Aiming for Grade 6 LOs:** • Use the terms greenhouse effect, global warming, and climate change correctly. • Describe in detail the biological consequences of global warming. **Aiming for Grade 8 LOs:** • Produce scale diagrams showing some of the contributors to the greenhouse effect. • Explain in detail the causes and effects of rising carbon dioxide and methane levels in the atmosphere.	What are the consequences of a 1 degree rise in global temperature?	**Lesson Overview** **Starters** **Carbon cycle review** (10 min) Ask students to help you compile a diagram of the carbon cycle on the board by thinking about ways in which carbon dioxide is removed from the atmosphere, and ways in which it is added. Discuss that for thousands of years these processes were in balance and the amount of carbon dioxide in the air remained relatively constant. **Polar bear peril** (5 min) Show the class an image or video clip of an ice sheet breaking up. Ask them to share what this image means to them. **Main** **Global warming** (20 min) Use a diagram of the greenhouse effect to show how greenhouse gases (methane and carbon dioxide) in the atmosphere help maintain the Earth at a temperature suitable for life. Discuss how human activity has increased the volume of these gases in the air. Ask students to use the information in the student book to summarise this as a flow chart. **Changing conditions** (20 min) Tell the class about the two main consequences of global warming – rising sea levels and climate change. Use a map from the Internet to show predictions for flooding in areas of the UK as sea levels rise. Ask students to divide a sheet of paper in two and write 'rising sea levels' in the middle of one side of the page and 'climate change' in the middle of the other. They can use information from the student book to draw a spider diagram to show how each will affect living organisms. **Plenaries** **Effects on food production** (10 min) Ask the class to consider how global warming will impact on food production in the UK. How would it affect the types of crops farmers could grow? Can they think of negative and positive changes?	Mind map on greenhouse gases Class discussion on global warming poster explaining consequences of global warming Exam questions	Doddle: Food Security presentation Microsoft teams assignment	SO3 SO9 SP1 SP2 SP5 SP9 C2

			What is happening to Earth? (5 min) Students use the interactive tocomplete a cloze paragraph to explain the greenhouse effect and global warming.			

Year 9 Autumn Term 2 Timetable and Scheme of Work.

Y9 Half term 1	Topic Studied
1	P2 Energy transfer by heating.
2	B1 cell structure and transport.

· At the end of year 11, students will be sitting the Combined Science Trilogy GCSE from AQA. The specification can be found here: https://www.aqa.org.uk/subjects/science/gcse/combined-science-trilogy-8464

· During this autumn term, students will be learning about the topics outlined above.

· The scheme of work below is what students would follow if they were in school and is based on the Oxford University Press 5 year curriculum.

· We will aim to set tasks following this lesson by lesson structure however many of the activities will be different for home learning however they may give you some ideas on how to take your learning further.

· You may find the objectives most useful as this highlights what the pupils need to understand /know for each grade

GCSE Physics P2 Energy Transfer By Heating			
What are we learning?	What knowledge, understanding and skills will we gain?	What does excellence look like?	What additional resources are available?
Transfer of heat energy via conduction and specific heat capacity	**Knowledge** • Heat can be transferred though a substance by conduction • Definition of specific heat capacity, insulators and conductors • Equation to calculate specific heat capacity **Understanding** • Explanation of how heat energy is transferred by conduction and therefore why some materials are better conductors / insulators • Calculation of specific heat capacity and use of the equation to explain real world examples of this (swimming pools) • Evaluation (including cost analysis) of heating and insulating buildings. **Skills** • Consider the reliability of references • Generate a simple hypothesis and write a prediction and refer to this in the conclusion • Identify variables • Plot data in a graph and draw simple conclusions • Describe using scientific language • Use scientific equations	Independent study on the absorption and emission of infrared radiation. Model home /ice box cooler in which material selection has been justified to ensure insulation. Independent practical planning (and/or investigation) into real life application of insulators e.g. sleeping bags / duvet tog ratings. Confident in re-arranging the equation to perform necessary calculations ensuring appropriate units and conversion of units where needed.	BBC Bitesize Doddle – power points and quick quizzes You tube: 'Free science lessons' Seneca learning platform

Scheme of Work 2019 - 2020

Subject: GCSE Science: P2: Energy Transfer By Heating

Year Group: 9

Specification: AQA Combined Science Trilogy

Skill focus: 1b, 2a, 3a,4a, 9a,13d,14d,20b, 24

Lesson No	Topic & Objectives	Big Question – What will students learn?	Key Activities & Specialist Terminology (Do Now Task / Starter/Tasks/Plenary	Planned Assessment	Homework or flipped learning resources DODDLE resources	Lit Num SMSC Codes
P2.1 Energy Transfer	• **Aiming for Grade 4 LOs:** • Describe materials as good or poor thermal conductors. • Compare the thermal conductivities of materials in simple terms. • Relate the thermal conductivities of a material to the uses of that material in familiar contexts. • **Aiming for Grade 6 LOs:** • Analyse temperature change data to compare the thermal conductivity of materials. • Describe the changes in the behaviour of the particles in a material as the temperature of the material increases. Apply understanding of thermal conductivity in	How can you keep your ice cream cold on a very hot day?	**Lesson Overview** **Starters** **Frying tonight?** (10 min) Crack an egg onto a frying pan and a heat resistant mat and use Bunsen burners to heat them (Alternatively, show a video of an egg frying.). Students describe the processes that allow energy to reach the eggs and compare the rate of energy transfer. **Spoons** (5 min) Ask students to explain, if a metal spoon and a wooden spoon are put into boiling water, why only the end of one spoon will get hot. **Main** **Testing sheets of materials as insulators** (40 min) Students complete the practical, focusing on producing results that are as accurate as possible from this experiment by refining the control of variables and eliminating sources of random error.	P1: An investigation to determine the specific heat capacity of one or more materials. The investigation will involve linking the decrease of one energy store (or work done) to the increase in temperature and subsequent increase in thermal energy stored.	**Rich question to research:** Why is water used in our heating systems? **Doddle task:** Conducting experiments (presentation) Investigating thermal insulation (animation) Microsoft teams Assignment	C3 C3 C3

	reducing energy dissipation through the choice of appropriate insulating materials. **Aiming for Grade 8 LOs:** • Explain the different thermal conductivities of materials using the free electron and lattice vibration explanations of conduction. • Evaluate the results of an experiment into thermal conductivity in terms of repeatability and reproducibility of data, and the validity of conclusions drawn from the data. • Justify the choices of a material involved in insulation or conduction using the concept of thermal conductivity and other data.		Links should be made to the idea of trapped air in foams or fluffy materials used for insulation and reduction of energy dissipation. For students studying *AQA GCSE Physics* this is a required practical. For students studying *AQA GCSE Combined science: Trilogy* this is **not** a required practical. **Plenaries** **Chilling effect** (5 min) Explain to students what a defrosting plate is. (You could show students a photo or video of one.) Ask students to explain why an ice cube will melt a lot quicker on a defrosting plate than on a plastic surface, in terms of conduction. (Defrosting trays are made of materials that have a high thermal conductivity and will transfer thermal energy more efficiently than a plastic surface.) **Conduction modelling** (10 min) Ask students to describe a large-scale model of conduction through lattice vibration to provide a visual idea of the process.			
P2.4 Specific Heat Capacity	**Aiming for Grade 4 LOs:** • Describe materials in terms of being difficult or easy to heat up (increase the temperature of). • List the factors that affect the amount of energy required to increase the temperature of an object. • With some support, measure the specific heat capacity of a material. **Aiming for Grade 6 LOs:** • Describe the effects of changing the factors involved in the equation.	Why paddling pools are never warm enough?	**Lesson Overview** **Starters** **Hot metal** (10 min) Heat a relatively small block of metal until it is clearly very hot using a Bunsen burner, gauze, and tripod. Use tongs to drop it into a bucket of water. Students explain the small change in temperature for the water. Safety: Take care with the hot metal. Put the hot metal carefully into the bucket of water. Make sure the bucket or container of water is made of an appropriate material for the experiment. **Boiling up** (5 min) Explain to students that of two kettles, one full and one half full, the half full kettle will boil first. Ask students to come up with their own explanation as to why the half full kettle boils first.	Question & Answer, Mini white boards, Exam style question	**Rich question to research:** How do storage heaters work? **Doddle task:** Calculating Specific Heat Capacity of metals (animation) Microsoft teams Assignment	C3 C3

	• Calculate the energy required to change the temperature of an object. Measure the specific heat capacity of a material and find a mean value. **Aiming for Grade 8 LOs:** • Evaluate materials used for transferring energy in terms of their specific heat capacity. • Use the specific heat capacity equation to perform a wide range of calculations in unfamiliar contexts. • Evaluate in detail the results of an experiment to measure specific heat capacity.		**Main** **Measuring specific heat capacity** (40 min) Discuss the factors that may affect the temperature change of a material when it is heated, using ideas from the starters. Lead the students through the calculation for specific heat capacity step by step, ensuring they understand each of the terms of the equation. Students then carry out the practical to attempt to find a value for the specific heat capacity of a metal. It is likely that their value will not match an accepted value and so they should discuss the reasons that their values are different. This is mainly due to energy transferred to the environment. Students can use the Maths skills interactive to rearrange the equation for specific heat capacity. **Plenaries** **Hot water** (5 min) Why is water used in central heating systems? Students could come up with a range of reasons why it is chosen. **Crossword** (10 min) Students use the interactive to complete a crossword on the content from this and the previous lessons. This should form a summary of their learning about energy transfer.			
P2.5 Heating an Insulating Buildings	**Aiming for Grade 4 LOs:** • Describe some design features used to prevent energy transfer to the surroundings in the home. • Calculate the payback time of a simple home improvement features **Aiming for Grade 6 LOs:** • Describe how some design features used to reduce energy dissipation from a home work. • Compare home improvement features in terms of payback time. **Aiming for Grade 8 LOs:**	How can we design the ultimate energy efficient building?	**Lesson Overview** **Starters** **Worth it?** (10 min) Swapping over your mobile phone to a new one will cost you £200 but you will be able to enter a new contract for £10 less each month on a two-year contract. Should you swap your phone? What other factors would you have to consider? **Hot house** (5 min) Show students a large diagram of a house showing the various locations where energy can be transferred to its surroundings. Students suggest ways to save energy. Students could copy the diagram, or the diagram could be provided to students for them to annotate. **Main**	Question & Answer, Mini white boards, Exam style question	**Rich question to research:** What do we mean by the U-value of a material? Why is knowledge of the U-value important? **Doddle task:**	C3 C3

	• Evaluate in detail design features used to reduce energy transferred from the home. • Decide on home improvement features using payback time and savings beyond the payback time.		**Reducing energy transfers in the home** (25 min) Discuss the features used to prevent energy transferred in a house one by one. Use example materials (e.g., bricks, insulation foam) if any are available. Provide students with some examples of costs, as these will be useful later. **Payback time** (15 min) The students compare the payback time of some of the design features, using real data. **Plenaries** **Energy neutral house** (10 min) Students can use their knowledge of energy transfer to design an energy neutral house. They can use all of the design features here and may include some of the developing ideas in electricity generation. **House analysis** (5 min) Provide a set of home improvements costs and savings. Students use the interactive to sequence them in the order in which the improvements should be done.		Factors affecting thermal insulation (animation) Microsoft teams Assignment	

Scheme of Work 2019 - 2020

Subject: GCSE Science: B1: Cell Structure and Transport (Keeping Alive)

Year Group: 9

Specification: AQA Combined Science Trilogy

Skill focus: 9c, 13, 15,17,19,20,25

Lesson No	Topic & Objectives	Big Question – What will students learn?	Key Activities & Specialist Terminology (Do Now Task / Starter/Tasks/Plenary	Planned Assessment	Homework or flipped learning resources	Lit Num

					DODDLE resources	SMSC Codes
B1.1 **The World of Microscopes**	**Aiming for Grade 4 LOs:** • Use a light microscope. • State why microscopes are useful in the study of cell biology. • Calculate total magnification.	How do we know what we are saying is true? How are we able to see know what we have never seen before?	**Lesson Overview** **Starters** **What is it?** (10 min) Show students a range of magnified images of everyday objects. Students try to identify the objects and give a qualitative indication of how much bigger the image is than the actual object. **Why do we use microscopes?** (5 min) Show the class a light microscope and ask students to discuss in pairs what it is and why it is a useful scientific tool **Mains** **Observation of animal cells under a microscope** (30 min) Students observe animal (cheek) cells using a light microscope and draw images. The slides can either be prepared or students can make their own. They carry out magnification calculations. **Light and electron microscopes** (10 min) Inform the class that there is a limit on what can be seen using a light microscope and introduce the electron microscope. Ask the students to use the information from the student book to describe the main advantages and disadvantages of using a light and an electron microscope. They should mention the terms magnification and resolution in their answers. **Plenaries** **Size order** (10 min) Students arrange images of different objects in order of size. Ask students to group objects according to what can be seen by the naked eye, a light microscope, and an electron microscope.	B1: Use a light microscope to observe, draw and label a selection of plant and animal cells. A magnification scale must be included. (Spec.:4.1.1.5, Collins: 1.4)	Learn the Keywords for the topic: Microscope magnification resolution electron microscope eukaryotic prokaryotic root hair cells mitochondria ribosomes cell wall cell membrane, vacuole cytoplasm, osmosis diffusion active transport ions Doddle: Microscopy lesson How to collect onion and check cells- animation	SO3 SO9 SP1 SP2 SP5 SP9 C2
	Aiming for Grade 6 LOs: • Describe the difference between magnification and resolution. • Describe the advantages and disadvantages of using a light and an electron microscope. • Use the formula: magnification = size of image / size of real object.					
	Aiming for Grade 8 LOs: • Compare and contrast the magnification and resolution obtained by using light and electron microscopes. • Justify the use of an electron microscope. • Rearrange the magnification formula and measure the size of cells.					

			The world of the microscope (10 min) Students use the interactive to label a diagram of a light microscope, then summarise the difference between a light microscope and an electron microscope.		Microscopy –min quiz Microsoft teams assignment	
B1.2 Animal and Plant Cells	**Aiming for Grade 4 LOs:** • Identify a plant and an animal cell from a diagram. • Name the main parts of cells. • Prepare a microscope slide. **Aiming for Grade 6 LOs:** • Describe the functions of the parts of cells. • Compare plant and animal cells. • Use a microscope to study plant and algal cells. **Aiming for Grade 8 LOs:** • Explain how the main structures of cells are related to their functions. • Suggest reasons why some cells do not contain all cell structures. • Compare the sizes of cells using units of length and standard form.	What are the differences between animal and plant cells? Why are plants rigid and animals soft?	**Lesson Overview** **Starters** **Label the cells** (5 min) Show students unlabelled diagrams of plant and animal cells and ask them to work in small teams to name as many of the cell parts as they can. Reveal the answers. **Cell** (10 min) Students use the interactive to match the organelles of a cell with their function. Students then identify if statements on the organelles of cells are true or false. **Main** Looking at cells (40 min) Students make slides of plant and algal cells. They study them under a microscope and compare structures that they can see. Discuss why they cannot see all the structures in the cells and link back to work done in Topic B1.1 on magnification and resolution. Plenaries Which cell? (5 min) Show the class micrographs of cells (these can be found on the Internet) and ask them to identify them as plant or animal. Modelling a cell (10 min) Ask the students to work in pairs. Tell them that the school could be a model of a cell. Ask them to assign parts of the school to parts of the cell that carry out a similar role. For example, the headteacher's office is like the nucleus as they manage the school. They should justify their choices to the rest of the class.	Drawing alien plant and animal cells, labelling their parts and describing their functions.	Doddle: Cells presentation and mini quiz Microsoft teams assignment	SO3 SO9 SP1 SP2 SP5 SP9 C2

B1.3 Eukaryotic and Prokaryotic Cells	**Aiming for Grade 4 LOs:** • Identify structures in prokaryotic cells. • State that prokaryotic cells do not contain a nucleus and eukaryotic cells do. • Use orders of magnitude to correctly order objects according to size. **Aiming for Grade 6 LOs:** • Compare prokaryotic and eukaryotic cells. • Describe the functions of the parts of a prokaryotic cell. Use orders of magnitude to compare the sizes of organisms. **Aiming for Grade 8 LOs:** • Explain how the main structures of prokaryotic cells are related to their functions. Perform calculations to work out orders of magnitude.	What were the first types of cell to ever exist? How old is bacteria? • Did eukaryotic cells evolve from prokaryotes, what is the evidence of this?	**Lesson Overview** **Starters** **Eukaryotic and prokaryotic cells** (5 min) Introduce the idea that eukaryotic cells have a nucleus and organelles whilst prokaryotic cells are single-celled organisms. Show students a range of eukaryotic cells and prokaryotic cells and have them sort them accordingly. Students then sort some statements about eukaryotic cells and prokaryotic cells. **Wipe out!** (10 min) Initiate a class discussion by telling the class that you think all bacteria should be killed so no more exist on Earth. Discuss the fact that bacteria can be pathogens and cause disease but the vast majority are harmless and some are even useful (e.g., decomposers, those that make medicines and food). **Mains** **Eukaryotic vs. prokaryotic** (20 min) Show the class a diagram of a bacterial cell without labels. Introduce this as a bacterial or prokaryotic cell. Ask them how it is different to the plant and animal (eukaryotic) cells they studied in Topic B1.2. Students copy the diagram and use information from the student book to label the parts. Ask them to highlight features not found in the eukaryotic cells previously studied and write in the functions of these parts. **Scale and size** (20 min) Show students a series of images of different objects and organisms of different sizes, for example, a buckyball, a grain of sand, a virus, a human hair, a child, and so on. Provide students with a range of sizes, all in metres, and have them match the image to the size. Students then answer a series of questions on orders of magnitude. **Plenaries** **Cells of different organisms** (10 min) Students consider sample answers to an exam question about cells from	Mind map on differences between prokaryotic and Eukaryotic Matching differences and similarities between prokaryotic and Eukaryotic Exam questions		SO3 SO9 SP1 SP2 SP5 SP9 C2

			different types of organisms. Discuss their conclusions as a class. ***Euglena*** (5 min) Show the class a labelled diagram of *Euglena.* Ask them to discuss in pairs what type of cell they think it is and why			
B1.4 Specialisation in Animal Cells	**Aiming for Grade 4 LOs:** • Identify specialised animal cells from diagrams. • Describe the function of specialised animal cells. • Write a basic explanation of how animal cells are adapted. **Aiming for Grade 6 LOs:** • Explain why animals have specialised cells. • Compare the structure of a specialised and a generalised animal cell. • Write a coherent explanation of how animal cells are adapted. **Aiming for Grade 8 LOs:** • Discuss how the structure of specialised animal cells is related to their function within an organ and the whole organism. • Suggest the function of an unknown specialised cell based on its structure. • Write an effectively structured explanation of how animal cells are adapted.	Is there only one type of animal or plant cell?	**Lesson Overview** **Starters** **Sex cells** (5 min) Show the class an image of sperm and egg cells that includes the cell sizes. Ask them to discuss in pairs how these cells differ from the generalised animal cells previously studied. **Multicellular** (10 min) Display an outline of a person on the board. Invite students to name a type of specialised cell that they remember from KS3 and point to where on/in the body you would find it. Discuss why you have so many different types of cell. **Mains** **Types of specialised cells** (20 min) Students use information from the student book to label a specialised animal cell. Students then complete a table to describe the structure of specialised animal cells and explain how they are adapted to their function. **The human eye** (20 min) Show students a diagram of the eye and discuss the function of the retina. Students do some research on the specialised cells found in the retina (rods and cones) and apply their understanding to write an explanation of how the structure of these cells is adapted to their function. **Plenaries** **Specialisation in animal cells** (10 min) Students match specialised	Question answers between teacher and students Exam questions Checking students' work and providing them feedback	Doddle: Specialised cells presentation Microsoft teams assignment	SO3 SO9 SP1 SP2 SP5 SP9 C2

			animal cells to their structures and functions. **True or false?** (10 min) Ask the students to stand up. Ask them a series of true or false questions based on the content of Topic B1.4. If they think the answer is false, they sit down.			

B1.5 Specialisation in plant cells	**Aiming for Grade 4 LOs:** • Identify specialised plant cells from diagrams. • Describe the function of specialised plant cells. • Use a light microscope to view a root hair cell. **Aiming for Grade 6 LOs:** • Compare the structure of a specialised and a generalised plant cell. • Describe the adaptations of specialised plant cells. • Draw a scientific drawing of a root hair cell observed using a light microscope. **Aiming for Grade 8 LOs:** • Discuss how the structure of specialised plant cells is related to their function within an organ and the whole organism. • Design a cell, tissue, or organ to perform a certain function. • Measure a root hair cell observed using a light microscope.	How are plant cells specialised?	**Lesson Overview** **Starters-Plant cell** (5 min) Show the students a diagram of a leaf cross-section and explain what it is showing. Ask them to identify a cell that is similar to the generalised plant cell previously studied (palisade cell). Discuss how other cells are different in structure and suggest why this might be. **Plant organs** (10 min) Ask students to draw a plant and label as many organs and tissues as they can. Ask students to peer assess each other's diagrams and count how many organs and tissues they have named correctly. **Mains-Specialised plant cells** (20 min) Ask the students to work in groups of four. Each student researches one specialised plant cell – photosynthetic cell, root hair cell, xylem, or phloem. They use information from the student book to research their cell. Display images of the four specialised cells. Students in each group read out what they have found out (without mentioning the cell name). The other members of the class say which cell they are describing. **Looking at root hair cells** (20 min) Students study prepared slidesshowing root hair cells of mung beans using a light microscope, draw scientific drawings, and answer questions about adaptations. If you have more time, students can make their own slides. They place the roots of sprouting mung seeds on slides and dye with iodine solution. **Plenaries** **Specialisation in plant cells** (5 min) Students use the interactive to match specialised plant cells to their structures and functions. **What am I?** (10 min) Write the names of different specialised animal and plant cells on cards. Ask students to work in groups and give each student a card that they must hold in front of them without looking. Students ask questions in order to determine which cell they are.	Class discussion between teachers and students. Exam questions Checking student's written responses	Doddle: Specialised cells presentation Specialised cells quiz Microsoft teams assignment	SO3 SO9 SP1 SP2 SP5 SP9 C2

B1.6 Diffusion	**Aiming for Grade 4 LOs:** • State that diffusion is the spreading of the particles of any substance in solution, or particles of a gas. • List the factors that affect the rate of diffusion. • Write a simple hypothesis. **Aiming for Grade 6 LOs:** • Predict which way substances will move across a cell membrane. • Explain why surface area affects the rate of diffusion. • Write a hypothesis using scientific knowledge. **Aiming for Grade 8 LOs:** • Explain how temperature and concentration gradient affect the rate of diffusion. • Write a hypothesis using detailed scientific knowledge and explain how it could be tested.	How to molecules move into and out of cells?	**Lesson Overview** **Starters** **Diffusion demonstration** (10 min) Carry out a simple demonstration by adding a crystal of potassium permanganate(VII) to a large beaker of water at room temperature. Ask the class to make observations. Remind them that this is an example of diffusion. Then repeat using hot water. **Cell diagram** (10 min) Draw an image of an animal cell on the board. Ask students to copy it and draw arrows to show the movement of different types of substances in and out of the cell. Discuss the fact that these substances move in and out by diffusion and explain the reason for this movement in terms of differences in concentration of substances inside and outside the cell. **Main** **Investigating diffusion** (30 min) Students look at diffusion and one of the factors that affects the rate of diffusion – temperature. They also look at diffusion across a membrane to embed the idea that diffusion can occur across cell membranes. **Discussing factors** (10 min) Return to Starter 1 or carry it out now. Ask students to identify factors that would speed up the rate of diffusion. Examples include increasing the temperature of the water, grinding up the crystal into a powder (increasing surface area), adding more potassium permanganate crystals (increasing concentration gradient), or stirring. **Plenaries** **Diffusion** (5 min) Students answer questions about diffusion.	Investigating diffusion AQA biology B.1.3.1. Student practical	Doddle: What happens in gas exchange animation? Microsoft teams assignment	SO3 SO9 SP1 SP2 SP5 SP9 C2

			Intestinal cell (5 min) Show students a diagram of an intestinal cell. Ask them to discuss in pairs how it is adapted for efficient diffusion.			
B1.7 Osmosis	**Aiming for Grade 4 LOs:** • Describe what osmosis is. • State that if animal cells lose or gain too much water by osmosis they can stop working properly.	What is the difference between osmosis and diffusion?	**Lesson Overview** **Starters** **Which way?** (10 min) Draw a diagram of an animal cell on the board and draw dots inside to show water particles. Draw a higher concentration of dots outside the cell. Ask students to discuss in pairs what they think will happen to the movement of water. Go through their ideas and introduce osmosis as a special type of diffusion where water is moved across a partially permeable membrane. **Salting meat** (5 min) Show the students images of a piece of meat before and after it has been left in salt. Ask them to discuss in pairs what has happened and why. Go through their ideas and allow them to reach the conclusion that water has been lost from the meat because of a process called osmosis. **Mains** **Investigating osmosis** (20 min) Set up a demonstration as shown in the student book (Figure 1). Explain that Visking tubing is partially permeable like the cell membrane and explain what this means. Draw diagrams on the board using different coloured dots to show the concentration of solutions inside and outside the Visking tubing bags. Ask students to predict what they think will happen and why.	B3: Investigate the effect of a range of concentrations of salt or sugar solutions on the mass of plant tissue. (spec.: 4.1.3.2, collins: 3.2)	Doddle: Osmosis practical quiz Microsoft teams assignment	SO3 SO9 SP1 SP2 SP5 SP9 C2

			Keeping things constant (20 min) Tell the class that the concentration of water in the blood is kept constant. Ask them to discuss in pairs why this is important and feed back to the rest of the class. Then allow the class to use information from the student book to write a full explanation using correct scientific terminology. **Plenaries** **Osmosis** (5 min) Students complete the interactive to match osmosis key terms with their definitions. They then sort statements into whether they describe osmosis or diffusion. **Model cells results** (10 min) Return to the model cells set up in the 'Investigating osmosis' activity. Show the class the results and ask them to compare these to their predictions. Ask them to state whether the outside solutions were isotonic, hypertonic, or hypotonic, and to explain what happened in terms of osmosis.			
	Aiming for Grade 6 LOs: • State the differences between osmosis and diffusion. • Use ideas about osmosis to explain why maintaining constant internal conditions in living organisms is important. • Write a prediction using scientific knowledge of osmosis. **Aiming for Grade 8 LOs:** • Explain how a model shows osmosis in a cell. Use the terms isotonic, hypotonic, or hypertonic to explain the movement of water across a cell membrane.					
B1.8 Osmosis in plants	**Aiming for Grade 4 LOs:** • State that if a plant loses too much water from its cells then they become soft.	Why does water concentration matter?	**Lesson Overview** **Starters**		Doddle: cell transport lesson	SO3 SO9

	• Write a simple method with support. • Use given data to plot a suitable graph with some support.		**Wilting plant** (10 min) Show the class a wilted plant or an image of one. Ask them to discuss in pairs what has happened, why it has happened, and how they could restore the plant. **Vacuole function** (5 min) Show the class a diagram of a plant cell and ask them where the vacuole is. Ask them to write down the function of the vacuole. **Mains** **Investigating osmosis in plant cells** (40 min) Supply students with a diagram of two plant cells showing a clear permanent vacuole. Explain that the vacuole is full of sap that contains a low concentration of sugars and minerals. Ask students to modify the diagrams to show what would happen to the cells if they were placed in a concentrated sugar solution or in water. After checking their answers, ask students to use information from the student book to add the terms turgor, turgid, and flaccid to their diagrams. Students then plan their own investigation to find out how salt or sugar solutions affect plant tissue. Allow them to do some initial research in order to find examples of suitable methods (including use of the student book). Students need to plan to collect quantitative data. They should write down their independent, dependent, and control variables before writing a simple plan. You may wish to allow time for students to do a preliminary test to check the suitability of their method. Students calculate percentage change and plot a line graph with a line of best fit. They write their conclusion and evaluate their method. Students will need another lesson to gather and analyse their results. **Plenaries** **Osmosis in plants** (5 min) Students use the interactive to check their		Microsoft teams assignment	SP1 SP2 SP5 SP9 C2

			understanding of this topic by completing a paragraph about osmosis in plants. **Water your plants** (5 min) Ask students to write a short explanation about why you need to water your house plants, using what they have learnt about osmosis in plant cells.			
	Aiming for Grade 6 LOs: • Use osmosis to explain the effect of placing plant tissue in salt or sugar solutions. • Write a suitable plan to investigate the effect of salt or sugar solutions on plant tissue. • Calculate percentage change and use this to plot a line graph with negative numbers and draw a line of best fit.					
	Aiming for Grade 8 LOs: • Explain the mechanisms that lead to turgid or flaccid plant cells and plasmolysis. • Write a detailed plan for an investigation independently. • Use a line graph to estimate the concentration of solution inside a plant cell.					
B1.9 Active Transport	**Aiming for Grade 4 LOs:** • Define active transport as the movement of a substance against a concentration gradient using energy. • Identify where active transport takes place. • Use a representational model to show active transport.	How does a cell continue to absorb more of what it needs?	**Lesson Overview** **Starters** **Absorption of mineral ions** (5 min) Show the class an unlabelled diagram showing active transport in plant roots and ask them why mineral ions cannot move from the soil into the roots via diffusion. Reveal the labels and explain that mineral ions have to move from a low to a high concentration (against the concentration gradient). A	Class discussion Students' responses		SO3 SO9 SP1 SP2

	Aiming for Grade 6 LOs: • Explain why active transport is important for living organisms. • Explain the differences between diffusion, osmosis, and active transport. • Suggest some limitations of/improvements to a representational model that shows active transport. **Aiming for Grade 8 LOs:** • Describe how active transport takes place. • Suggest how a cell that carries out active transport is adapted to this function. • Design and evaluate a representational model to show active transport.		process called active transport is used, which requires energy. **Plant roots** (10 min) Ask students to write down what substances move into roots from the soil. Then ask them what process moves water into the plant roots. Explain that osmosis is used because water is travelling from a high to low concentration. Explain that mineral ions cannot move into roots via diffusion because they are very dilute in the soil. Because they have to move from a low to high concentration of mineral ions (against the concentration gradient) a process called active transport is used which requires energy. **Main** **Active transport** (20 min) Introduce active transport to students. Ask them to use information from the student book to fi nd one example of where active transport is used in humans and explain why it is important. Students then work in small groups to design a model of active transport. Ask for a couple of groups to demonstrate their model, whilst the rest of the students evaluate its effectiveness and comment on possible improvements. **Plenaries** **Exchange of materials** (10 min) Give students a series of statements on osmosis, diffusion, and active transport. Students identify which statements relate to which process. **Active transport** (10 min) Students label a diagram of active transport, then match some key words relating to active transport to their definitions.	Q &A between students and teachers 6 marks exam question		SP5 SP9 C2

B1.10 Exchanging materials	**Aiming for Grade 4 LOs:** • State the function of exchange surfaces in plants and animals. • State that a single-celled organism has a relatively large surface area to volume ratio. • Calculate the surface area to volume ratio of a cube. **Aiming for Grade 6 LOs:** • Describe how the effectiveness of exchange surfaces is increased. • Use ideas about surface area to volume ratio to describe why multicellular organisms need exchange surfaces. • Calculate the surface area to volume ratio of a cylinder. **Aiming for Grade 8 LOs:** • Link ideas about diffusion to explain how the adaptations of exchange surfaces increase their effectiveness. • Use ideas about surface area to explain the shape of a leaf. • Calculate the surface area to volume ratio of a sphere.	How can we speed up exchange?	**Lesson Overview** **Starters** **Types of exchange surface** (10 min) Ask students to match the names of some exchange surfaces in animals and plants with their functions. Discuss why these organs are important in multicellular organisms and explain that as an organism gets bigger, the distance between the surface and the centre of the organism increases – so simple diffusion is not enough to exchange materials. **Exchange of materials** (5 min) Students match up statements about surface area to volume ratio and about factors affecting the effectiveness of an exchange surface. **Main** **Investigating surface area to volume ratios** (40 min) Students calculate surface area to volume ratios for different 3D shapes (cubes, cylinders, and spheres). Modelling clay could be provided for students to make the shapes. They decide on the best shape for a single-celled organism and explain why. Students then use the student book to explain how an exchange surface is adapted to increase its effectiveness. **Plenaries** **Surface area to volume ratio** (10 min) Students calculate the difference in total surface area of one 10 cm × 10 cm × 10 cm cube versus ten 1 cm × 1 cm × 1 cm cubes. **Sailors' eyeballs** (5 min) Show the class an image of *Valonia ventricosa,* also known as bubble algae or sailors' eyeballs. Tell them that they are one of the largest single-	Class discussion Practice exam questions Questions Checking students' responses		SO3 SO9 SP1 SP2 SP5 SP9 C2

			celled organisms and can grow up to 5 cm in diameter. Ask students to write down why there is a limit to how big they can grow.			