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| **B2.1 Supplying the cell** | **Guided teaching hours:** 6 hours |
| **Chapter overview**  In this chapter, students have studied diffusion, including where it occurs in the body and factors that affect its rate. They should make links to the diffusion of glucose, oxygen, and carbon dioxide in B1.3 *Respiration* and B1.4 *Photosynthesis*.  This topic also links with B2.2 *The challenges of size* where factors affecting the rate of diffusion are considered, and transport of substances in a range of organisms. Students have also looked at osmosis and the concept of water potential. They should have studied the effect of changing the water potential of a solution on animal cells and plant cells. They have experimented with potato chips immersed in different concentrations of sugar solution, and measured the percentage change in mass and length. They have also studied active transport, and should be able to give examples of this process in plants and animals.  Students should understand the link between osmosis, active transport, and cell specialisation in considering how water and mineral ions are taken up by root hair cells in plants. They have studied the cell cycle including mitosis, along with its role in growth and repair. Linked to this is an understanding of cell differentiation, and how the adaptations of each cell are linked to its function. Finally students should be able to describe what is special about stem cells, where they are found in plants and animals, and their potential future uses in medicine. | |

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| **Lesson B2.1.1 Diffusion** | | |  |
| **OCR GATEWAY spec link:**  B2.1a Explain how substances are transported into and out of cells through diffusion, osmosis, and active transport. To include examples of substances moved, direction of movement, concentration gradients, and use of the term water potential (no mathematical use of water potential required).  WS1.1b Use models to solve problems, make predictions, and to develop scientific explanations and understanding of familiar and unfamiliar facts. | **Aiming for Grade 4 LOs:**   * State some examples of diffusion. * State factors that affect the rate of diffusion. * Describe by communicating simply, producing text with basic structure * and familiar vocabulary. | **Lesson Overview**  **Starters**  **Demonstrating diffusion** (5 minutes) Use a large beaker of cold tap water and carefully add a large crystal or a very small spatula measure of potassium manganate(VII) down the side of the beaker, and ask the class to describe what they observe. The effect is improved if you can place the beaker on an overhead projector (OHP). Students have learnt about diffusion at Key Stage 3, so they should use the correct vocabulary.  **Diffusion drama** (10 minutes) The class all stand at one end of the laboratory. One student acts as a narrator, and reads a script, which is made of a series of statements. These statements describe the process of diffusion, whilst giving instructions for the students to move in a random way to spread out around the lab.  **Mains**  **Investigating diffusion** (30 minutes) Students carry out the practical investigation. They 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.  **Explaining diffusion** (10 minutes) Show the students a picture of a red blood cell. State that oxygen enters the red blood cell when the cell is in the lungs and exits when it is in the tissues. Ask students to produce an extended written explanation of the diffusion of oxygen in and out of the cell. The explanation should include details of the three factors discussed during the lesson. Give communication-based success criteria.  **Plenaries**  **Linking factors** (5 minutes) Use the interactive in which students decide which factors affect the rate of diffusion and then sort statements as to whether they would increase or decrease the rate of diffusion in the body.  **The alveolus** (10 minutes) Show students the standard image of an alveolus with a blood capillary wrapped around it, but remove all labels. Remind students that oxygen is taken up into the blood in the alveolus. Give students 2–3 minutes to discuss, in their groups, why diffusion is so efficient in the lungs. Ask some groups to present their views to the class. Their explanations should refer to surface area and concentration gradients. | **Resources**  **Practical:** Diffusion  **Interactive:** Diffusion |
| **Aiming for Grade 6 LOs:**   * Describe the process of diffusion. * Describe the effect of factors on the rate of diffusion. * Describe by communicating effectively, producing coherent text, which is well structured, and use some appropriate scientific vocabulary. |
| **Aiming for Grade 8 LOs:**   * Explain fully at a molecular level the process of diffusion. * Explain the reasons for the effects of factors on the rate of diffusion. * Describe by communicating with impact, producing effectively-structured texts, using a full range of precise scientific vocabulary. |

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| **Lesson B2.1.2** **Osmosis** | | |  |
| **OCR GATEWAY spec link:**  B2.1a Explain how substances are transported into and out of cells through diffusion, osmosis, and active transport. To include examples of substances moved, direction of movement, concentration gradients, and use of the term water potential (no mathematical use of water potential required).  WS1.3a Present observations and other data using appropriate methods.  BM2.1i Use percentiles, and calculate percentage gain and loss of mass (M1c). | **Aiming for Grade 4 LOs:**   * State that osmosis is the movement of water molecules into or out of cells. * State that osmosis is a type of diffusion. | **Lesson Overview**  **Starters**  **Explaining osmosis** (5 minutes) Issue each group with a sheet of A4 paper, with a semi-permeable membrane drawn down the middle. Also issue two sets of paper discs, some larger than the pore size and labelled sugar; others smaller than the pore size labelled water. Allow students to explore the possible movement of the molecules across the membrane. Draw the diagram on the board and model the process of osmosis, eliciting responses from the class to help tell the story.  **The osmometer** (10 minutes) Set up a standard osmometer as a demonstration. Ensure the sugar solution is coloured with food dye and is very concentrated (exact value is unimportant) – this will cause visible and quick movement. Describe and explain what is happening as you set up the experiment. Finish with a definition of osmosis.  **Main**  **Osmosis in potato chips** (40 minutes) Students investigate osmosis in potato cylinders. During this lesson, the students set up the experiment and make predictions for the test, such as what will happen to the potatoes in each solution and why. They also answer questions about the method, such as what variables are they controlling, what are the dependent and independent variables, and so on. Follow a standard method for placing cylinders of potatoes (chips) in five sugar solutions of different concentrations between 0.25 mol/dm3 and 1.25 mol/dm3 glucose. In this lesson, students record initial mass and set up the experiment. The experiment needs to run for 24 hours. (The set-up can be left for up to two days, but not longer. You may need to make alternative arrangements for the collection of results outside the lesson, or you could supply data.) There will be time in the next lesson for students to write a conclusion, to describe and explain what has happened.  **Plenaries**  **Osmosis and plant and animal cells** (10 minutes) Use the interactive activity in which students identify the correct definition of osmosis, and link words connected with osmosis in plant and animal cells (plasmolysis, flaccid, osmosis, turgor) to their meanings.  **Osmosis in catering** (5 minutes) Provide students with small lengths (about 2–3 cm) of salad onions. They cut down the shaft of the onion for about 1 cm, using a scalpel and tile, then place in water. Ask students what will happen. Then show one prepared earlier, which will have splayed open. Explain why this has happened. The onion cells absorb water by osmosis, increasing their size, causing the strips to bend outwards. | **Resources**  **Practical:** Osmosis in potato chips  **Interactive:** Osmosis |
| **Aiming for Grade 6 LOs:**   * Describe the process of osmosis. * Explain why osmosis occurs. |
| **Aiming for Grade 8 LOs:**   * Explain the effect of osmosis on potato cells. Explain, in terms of water potential, why osmosis occurs. |

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| **Lesson B2.1.3 Active transport** | | |  |
| **OCR GATEWAY spec link:**  B2.1a Explain how substances are transported into and out of cells through diffusion, osmosis, and active transport. To include examples of substances  moved, direction of movement, concentration gradients, and use of the term  water potential (no mathematical use of water potential required).  WS1.1b Use models to solve problems, make predictions, and to develop scientific explanations and understanding of familiar and unfamiliar facts. | **Aiming for Grade 4 LOs:**   * State some examples of active transport. * State the differences between active transport and diffusion. * Record measurements from an experimental method, and calculate a change in mass. | **Lesson Overview**  **Starters**  **Revolving door** (5 minutes) Remind students of diffusion and osmosis. Tell students that there is a third method called active transport. Then set up a kinaesthetic model. Arrange the desks with a gap between two tables. This represents the membrane. Then ask three or four students to form a wheel in the gap, with arms extended acting as spokes – this is the carrier protein. Arrange the other students with most of them on one side of the membrane (table). There should be space between the ‘spokes’ (arms) to fit a student (who represents a molecule). The wheel then rotates and the molecule student moves across the membrane.  **The problems of getting sugar into cells** (10 minutes) Have a drawing of a cell membrane on the board. Ask if there are glucose molecules in the cell. Students should reply that there is. Draw sugar on one side of the membrane. Ask how it got there. They then need to explore the reasons why diffusion and osmosis cannot explain this. Tell them there is a third way. Ask them to discuss in groups how it could work. At short intervals ask for ideas, or provide additional hints, for example, draw a carrier protein in the membrane.  **Mains**  **Investigating osmosis results analysis** (20 minutes) Obtain results from the osmosis experiment in B2.1.2. Calculate the percentage change in mass, then plot this against concentration on a graph. Students write a short conclusion to explain what has happened.  **Modelling active transport** (20 minutes) Students work in small groups to carry out a model of active transport. Ask for a couple of groups to demonstrate their model, while the rest evaluate its effectiveness and comment on possible improvements.  **Plenaries**  **Which route?** (10 minutes) Provide students with a list of substances (oxygen, carbon dioxide, water, glucose, sodium ions, nitrate ions, etc.) Ask which method is used for the substance to enter or leave the cell. Then ask student pairs to spend a minute or so discussing similarities and differences between active transport and diffusion, and explaining the importance of both in plants and animals.  **Conditions for active transport** (5 minutes) Use the interactive activity in which students select true or false for statements about active transport. | **Resources**  **Practical:** Osmosis in potato chips  **Activity:** Modelling active transport  **Interactive:** Active transport |
| **Aiming for Grade 6 LOs:**   * Describe examples of active transport in plants and animals. * Describe how molecules move by active transport. * Record measurements from an experimental method, and calculate a percentage change in mass. |
| **Aiming for Grade 8 LOs:**   * Explain the importance of active transport in plants and animals. * Explain how carrier proteins function in the process of active transport. * Record measurements from an experimental method, calculate a percentage change in mass, and plot the data to determine the concentration that is equal to the cell. |

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| **Lesson B2.1.4 Mitosis** | | |  |
| **OCR GATEWAY spec link:**  B2.1b Describe the process of mitosis in growth, including the cell cycle, to include the stages of the cell cycle such as DNA replication, movement of chromosomes, followed by the growth of the cell.  WS1.1b Use models to solve problems, make predictions, and to develop scientific explanations and understanding of familiar and unfamiliar facts. | **Aiming for Grade 4 LOs:**   * State the stages of the cell cycle. * State the purpose of mitosis. * Use a model to illustrate the major steps in the cell cycle. | **Lesson Overview**  **Starters**  **Role play of cell cycle** (10 minutes) Create a circular walkway around the class, with three sections called: DNA replication, mitosis, and cell growth. One student with one length of string (DNA) starts a walk around the cycle at the end of the cell growth sector. As they move into DNA replication, they are given a second length of string. This represents DNA replication. As they move into mitosis, they ‘divide’ by a second student joining the walk, and being given one of the lengths of string. They then enter cell growth. The process continues. Before continuing with the lesson, check that students can state the purpose of mitosis.  **Growth** (5 minutes) Pose the question to the class in groups: ‘How do we grow?’ Elicit any responses. List ideas on the board. Show any short film that shows cell growth of a shoot tip or embryo as a process of cell division. Ask students to describe what they have seen in the film.  **Mains**  **Wall chart of the cell cycle and mitosis** (40 minutes) Teacher draws an outline of the cell cycle to show outlines of a cell in Stage 1: DNA replication, up to four cells in Stage 2: Movement of chromosomes (Mitosis), and the two product cells in Stage 3: Cell growth. Give students some wool (2-ply), scissors, and sellotape. Using information in the Student Book, use the wool to create the chromosomes in a cell with two chromosomes. Each outline represents the cell at the various stages of the cell cycle. Gives students some wool, scissors, and sellotape. Using information in the Student Book, use the wool to create the chromosomes in a cell with two chromosomes. Each outline represents the cell at the various stages of the cell cycle. Complete the poster by adding annotations, ensuring that the purpose of mitosis is included. Each group looks at a poster produced by another group and points out one thing about the poster that helps them to understand the cell cycle, and suggests one improvement.  **Plenaries**  **Drag and drop sort** (5 minutes) Use the interactive which asks students to select the correct events that happen during mitosis and then match the event to the correct stage of mitosis.  **Jumbled statements** (10 minutes) Produce the statements from the Student Book on ‘How is DNA replicated’ or ‘How do the chromosomes move?’ as separate statements on separate cards. Student groups sort the cards into the right sequence. If there is time, swap the card sets between groups to complete both processes. | **Resources**  **Activity:** Modelling mitosis  **Interactive:** Mitosis |
| **Aiming for Grade 6 LOs:**   * Describe the key features of each stage of the cell cycle. * Describe the process of mitosis. * Use a representational model to describe the key events during the cell cycle. |
| **Aiming for Grade 8 LOs:**   * Explain the process of DNA replication in the cell cycle. * Explain the process of mitosis in terms of the movement of chromosomes. * Use a representational model to develop scientific explanations of all of the events during the cell cycle. |

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| **Lesson B2.1.5 Cell differentiation** | | |  |
| **OCR GATEWAY spec link:**  B2.1c Explain the importance of cell differentiation. To include the production of specialised cells allowing organisms to become more efficient and examples of specialised cells.  WS1.3a Present observations and other data using appropriate methods. | **Aiming for Grade 4 LOs:**   * State what is meant by cell differentiation. * State some examples of specialised cells. * Use text to be able to describe features with some accuracy. | **Lesson Overview**  **Starters**  **The fate of cells** (10 minutes) Ask students to create an epigenetic landscape model (look up the model on the internet). They do this by building a branching series of channels, using long cylinders of modelling clay on a tray. It starts at the top of the tray with one trough between two cylinders, which branch several times as you descend the tray. At the end of every branch are the names of different types of cell in the human body. Using a marble as a cell, hold it at the top of the initial branch and allow it to roll down the tray. It will roll into one channel, illustrating that it becomes a differentiated cell. Link this to events in the body as cells differentiate. (To save time, the models could be made beforehand).  **Why specialise?** (5 minutes) Divide the class into small groups. Issue some groups with a small set of plain Lego bricks, whilst other groups will have a selection of Lego bricks, doors, wheels and so on. Ask the groups to build something. Elicit that the groups with the selection of Lego pieces could build more complicated models because they had specialised bricks. Link this to the idea of cell differentiation.  **Mains**  **Special cells for special jobs** (15 minutes) Set up a carousel of microscopes around the lab with slides of ciliated epithelium, adipose (fat) cells, red blood cells, and palisade cells, (or images from the internet). Also have the Student Book open for students to read about the cell they are looking at. Students make notes about the special features of the cells, the functions of cells, and the role of the special part in carrying out the function. Lead a brief discussion to elicit some benefits of cell differentiation, including the need for cellular differentiation in multicellular organisms.  **Using the knowledge** (25 minutes) Student pairs create a quiz/ crossword based on the special cells (names, special parts, and their functions). This could be done using IT. The finished task is passed to the neighbouring pair, who attempt to answer. The answering pair checks that the clues and answers are correct, and suggests improvements to the puzzle or quiz.  **Plenaries**  **Landscapes revisited** (10 minutes) Return to the epigenetic landscape model built at the start of the lesson. Ask students if the cells can swap channels. The answer is no. Then ask why. Students should point out, using what they have learnt from the main activity, that the cells have developed special parts for one function. These parts cannot be unmade.  **Parts to functions** (5 minutes) Use the interactive, which asks students to match specialised cells with their functions and then to decide which adaptations belong to which type of specialised cell. | **Resources**  **Activity:** Specialised cells for specialised jobs  **Interactive:** Cell differentiation |
| **Aiming for Grade 6 LOs:**   * Explain why cells become differentiated. * Describe the adaptations of a range of specialised cells. * Summarise text, with accuracy, to show clear understanding of cell features. |
| **Aiming for Grade 8 LOs:**   * Explain the need for cellular differentiation in multicellular organisms. * Explain the link between the adaptation of each specialised cell and its function. * Summarise text showing detailed and perceptive understanding of cell features and functions. |

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| **Lesson B2.1.6 Stem cells** | | |  |
| **OCR GATEWAY spec link:**  B2.1d Recall that stem cells are present in embryonic and adult animals, and in meristems in plants.  B2.1e Describe the functions of stem cells. To include division to produce a range of different cell types for development, growth, and repair.  B2.1f Describe the difference between embryonic and adult stem cells in animals.  WS1.1e Explain everyday and technological applications of science.  WS1.1f Evaluate associated personal, social, economic, and environmental implications.  WS1.1h Evaluate risks both in practical science and the wider societal context. | **Aiming for Grade 4 LOs:**   * State where stem cells are found. * State some uses of stem cells. * Use general references to scientific texts to support their comments and opinions. | **Lesson Overview**  **Starters**  **What do you want to know?** (5 minutes) State that the lesson is about stem cells and show an image of a newspaper headline about stem cell research. Issue each student with a sticky note. Allow them a few minutes to discuss in pairs what they know about stem cells, and ask them to write a question on the sticky note that they want to learn about in this lesson. Place the questions on a board for the end of the lesson.  **Stem cells** (10 minutes) Use the interactive activity in which students read statements about stem cell research and select whether they think the statement agrees or disagrees with stem cell research.  **Mains**  **Writing scientifically with stem cells** (35 minutes) Students are provided with example articles on stem cells. (Alternatively, provide students with short examples of science articles printed from websites or cut out from magazines.) Ask them to discuss in pairs what they think about the articles – how did the articles capture their attention and hold it? Did the articles explain the science well? Did the articles leave them wanting to know more? Go through the main points of how to write a science article with the class. Students then research how stem cells are used to help medical conditions and use the information to write their own article on stem cells. Students should include the following in their articles:   1. State what is meant by a stem cell, and describe a difference between a stem cell and a differentiated cell. 2. List three sources of stem cells. 3. What medical conditions are stem cells used to treat? 4. For one named condition describe briefly how stem cells are used. 5. Describe some arguments that can be used in favour of stem cell research. 6. Describe some arguments that can be used against stem cell research.   **Plenaries**  **What have we learnt?** (5 minutes) Return to the question board from Starter 1. Select a few questions from the board and ask students for the answers.  **Advantages and disadvantages of the types of stem cells** (10 minutes) Use the interactive, which asks students to drag and drop statements into one of three categories (adult stem cells, embryonic stem cells, plant stem cells). These statements are a selection of advantages and disadvantages of using stem cells in medical treatments. | **Resources**  **Interactive:** Stem cells  **Activity:** Writing scientifically with stem cells |
| **Aiming for Grade 6 LOs:**   * Describe the difference between a stem cell and a differentiated cell. * Describe the function of stem cells. * Use appropriate references to scientific texts to support their understanding and opinions. |
| **Aiming for Grade 8 LOs:**   * Explain the difference between embryonic and adult stem cells. * Evaluate the advantages and disadvantages of using stem cells in medicine. * Justify their understanding and opinions with illuminating use of references to scientific texts. |