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| **B1.1 Cell structures** | **Guided teaching hours:** 4 hours |
| **Chapter overview**In this chapter, students will study cells in plants, animals, and single-celled organisms. They will be able to distinguish between these types of cell based on their different features, and will also be able to recognise the similarities. Students will be able to describe the main cell structures, including the nucleus, cell membrane, cytoplasm, and mitochondria, with the addition of the cell wall, chloroplasts, and vacuoles in plant and algal cells. They will be aware that not all plant cells contain chloroplasts, and will link this to work on specialised cells in B2.1 *Supplying the cell*. They will be able to recall differences between eukaryotic and prokaryotic cells along with information about the specialised subcellular structures of bacteria – flagella, pili, slime capsules, and plasmids.In their studies of microscopy, students will use light microscopes in practical lessons, and study the structures of plant cells, animal cells, and single celled organisms.Students will be aware that electron microscopes are commonly used in laboratories because they offer much greater resolution and magnification than light microscopes. They will be able to compare the advantages and disadvantages of light microscopes and electron microscopes. You can find additional support for the maths skills covered in this chapter on **MyMaths**, including making estimations of populations of bacteria without using a calculator, using an appropriate number of significant figures, and estimating orders of magnitude. |

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| **Lesson B1.1.1 Plant and animal cells**  |  |
| **Specification links:** B1.1b Explain how the main subcellular structures of eukaryotic cells (plants and animals) and prokaryotic cells are related to their functions.To include nucleus, genetic material, chromosomes, plasmids, mitochondria (contain enzymes for cellular respiration), chloroplasts (contain chlorophyll) and cell membranes (contain receptor molecules, provides a selective barrier to molecules).WS1.4a Use scientific vocabulary, terminology and definitions.WS2.a Carry out experiments.WS2.b Make and record observations and measurements using a range of apparatus and methods.WS2.c Present observations using appropriate methods.WS2.d Communicate the scientific rationale for investigations, methods used, findings and reasoned conclusions. | **Aiming for Grade 4 LOs:*** State the organelles (subcellular structures) present in a plant and animal cell.
* State the function of each of the main organelles present in a plant and animal cell.
* Label the organelles in representational models of plant and animal cells.
 | **Lesson Overview**Lesson begins with students identifying parts of a cell and drawing comparisons between plant cells and animal cells. Students then work in groups to build models of plant and animal cells, with each individual building and describing the structure and function of each of the organelles. They go on to teach the rest of their group what they have learnt before presenting their model to the class.Finally, students label a diagram showing a cell with no labels and table listing the organelles present in a plant and animal cell. | **Resources**Activity: Models of the cells.Interactive: Plant and animal cells. |
| **Aiming for Grade 6 LOs:*** Compare the organelles present in plant and animal cells.
* Explain the function of the organelles, relating to the structure and molecules present to the function of the organelles.
* Explain how a model cell is similar to, and different form, a real cell.
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| **Aiming for Grade 8 LOs:*** Discuss the reasons for the presence or absence of organelles in different plant and animal cells.
* Explain the roles of the molecules or structures within the organelles, such as the receptors in the cell membrane.
* Discuss the benefits and drawbacks of using a representational model to help in explaining the structures and functions of cell organelles.
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| **Lesson B1.1.2 Bacterial cells**  |  |
| **Specification links:** B1.1b Explain how the main subcellular structures of eukaryotic cells (plants and animals) and prokaryotic cells are related to their functions. To include nucleus, genetic material, chromosomes, plasmids, mitochondria (contain enzymes for cellular respiration), chloroplasts (contain chlorophyll), and cell membranes (contain receptor molecules, provides a selective barrier to molecules).WS1.4a Use scientific vocabulary, terminology, and definitions. | **Aiming for Grade 4 LOs:*** Name some examples of prokaryotes.
* State the main organelles present in a prokaryotic cell.
* Use a method, with some help to obtain results, working safely.
 | **Lesson Overview**Lesson begins with students watching a short clip introducing the discovery of bacteria.Students then carry out the practical, streaking an agar plate to culture single colonies. Students go on to draw and label a bacterial cell, indicating the structures present that are different to those in a plant or animal cell, and describing their functions.Finally, students sort statements into those that refer to eukaryotic cells and those that refer to prokaryotic cells.  | **Resources**Practical: Streak plates.Interactive: Eukaryotic and prokaryotic cells. |
| **Aiming for Grade 6 LOs:*** Compare prokaryotic and eukaryotic cells.
* Explain the function of the organelles, relating the structure to the function of the organelles.
* Use a method independently to obtain results, noting some major hazards.
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| **Aiming for Grade 8 LOs:*** Discuss the reasons for the presence or absence of organelles in different prokaryotic cells.
* Discuss how the organelles of the prokaryote can carry out all of the functions of the eukaryotic cell.
* Use a method independently to obtain results, justifying the steps to minimise risks.
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| **Lesson B1.1.3 Light microscopy**  |  |
| **Specification links:** B1.1a Describe how light microscopes and staining can be used to view cells. To include lenses, stage, lamp, use of slides and coverslips, and the use of stains to view colourless specimens or to highlight different structures/tissues and calculation of magnification.WS1.2c Apply knowledge of a range of techniques, instruments, apparatus, and materials to select those appropriate to the experiment.WS1.4c Use SI units and IUPAC chemical nomenclature unless inappropriate.WS1.4d Use prefixes and powers of ten for orders of magnitude (tera, giga, mega, kilo, deci, centi, milli, micro, and nano).WS1.4e Interconvert units.BM1.1i Demonstrate an understanding of number, size, and scale, and the quantitative relationship between units (M2a, M2h).BM1.1ii Use estimations and explain when they should be used (M1b). | **Aiming for Grade 4 LOs:*** Identify the components of the light microscope.
* Describe how to use a microscope to observe cells.
* Use a microscope to observe and draw a cell.
 | **Lesson Overview**Lesson begins with students labelling parts of the light microscope with sticky notes and explaining the function of each part. Students then carry out a practical, observing animal (cheek) cells using a light microscope, drawing images, and carrying out magnification calculations.Students go on to look at other slides and draw and label some parts of the cells.Finally students arrange images of different specimens in order of actual size and discuss what magnification might be used to observe such cells/tissues. | **Resources**Interactive: The light microscope.Practical: Observation of cells under a microscope.Extension: Microscopes and magnification. |
| **Aiming for Grade 6 LOs:*** Explain the role of each part of the microscope.
* Explain why stains are used to highlight cell features.
* Draw an accurate representation of a cell and calculate the magnification used to make the drawing.
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| **Aiming for Grade 8 LOs:*** Discuss why different lenses on the microscope are needed.
* Discuss why different stains might be required when viewing different cells or tissues.
* Calculate specimen size, image size, and magnification by substituting values into an equation, rearranging when necessary.
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| **Lesson B1.1.4 Electron microscopy**  |  |
| **Specification links:**B1.1c Explain how electron microscopy has increased our understanding of subcellular structures, to include increased resolution in TEM.WS1.1a Understand how scientific methods and theories develop over time.WS1.4c Use SI units and IUPAC chemical nomenclature unless inappropriate.WS1.4d Use prefixes and powers of ten for orders of magnitude (tera, giga, mega, kilo, deci, centi, milli, micro, and nano).BM1.1i Demonstrate an understanding of number, size, and scale, and the quantitative relationship between units.BM1.1iii Calculate with numbers written in standard form (M1b). | **Aiming for Grade 4 LOs:*** Describe simply how a transmission electron microscope (TEM) works.
* State an advantage of using an electron microscope.
* State the resolution achieved by an electron microscope in SI units using the correct order of magnitude.
 | **Lesson Overview**The lesson begins with students designing a new microscope that would be of more use to a biologist than a light microscope, listing three characteristics that it would have that would make it more useful.Students then complete information cards on the major features of each type of microscope before going on to create a proposal for the school management to buy an electron microscope.Finally students drag and drop the characteristic features, resolutions, advantages, and disadvantages for each type of microscope.   | **Resources**Activity: Electron microscopes.Interactive: Light and electron microscopes. |
| **Aiming for Grade 6 LOs:*** Explain how electron microscopy has increased understanding of subcellular structures.
* Describe the advantages of using the electron microscope compared with the light microscope.
* Compare the increase in resolution, in standard form, of an electron microscope with that of a light microscope.
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| **Aiming for Grade 8 LOs:*** Discuss how useful the electron microscope has been in medicine and biology.
* Evaluate the relative advantages and disadvantages of using an electron microscope compared with a light microscope.
* Calculate how many times greater the resolution of an electron microscope is compared with a light microscope.
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