Government of **Western Australia**
School Curriculum and Standards Authority

Science: Biological sciences

Teaching, learning and assessment exemplar

Year 8

Cells

Acknowledgement of Country

Kaya. The School Curriculum and Standards Authority (the Authority) acknowledges that our offices are on Whadjuk Noongar boodjar and that we deliver our services on the country of many traditional custodians and language groups throughout Western Australia. The Authority acknowledges the traditional custodians throughout Western Australia and their continuing connection to land, waters and community. We offer our respect to Elders past and present.

Background

This teaching, learning and assessment exemplar (the exemplar) has been developed by the School Curriculum and Standards Authority (the Authority) as part of the *School Education Act Employees (Teachers and Administrators) General Agreement 2017* (Clause 61.1–61.3).

Disclaimer

Any resources such as texts, websites and so on that may be referred to in this document are provided as examples of resources that teachers can use to support their learning programs. Their inclusion does not imply that they are mandatory or that they are the only resources relevant to the course. Teachers must exercise their professional judgement as to the appropriateness of any they may wish to use.

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Contents

The Western Australian Curriculum

The *Western Australian Curriculum and Assessment Outline* (the *Outline* – https://k10outline.scsa.wa.edu.au) sets out the mandated curriculum, guiding principles for teaching, learning and assessment and support for teachers in their assessment and reporting of student achievement. The *Outline* recognises that all students in Australian schools, or international schools implementing the Western Australian Curriculum, are entitled to be given access to the eight learning areas described in the *Alice Springs* (*Mparntwe*) *Education Declaration*, December 2019.

The Science curriculum

The mandated curriculum is presented in the year-level curriculum documents. The Science curriculum delivers a sequential and age-appropriate progression of learning with the following key elements:

- a year level description that provides an overview of the context for teaching and learning in the year
- a series of content descriptions, populated through strands and sub-strands, that sets out the knowledge, understanding and skills that teachers are expected to teach and students are expected to learn
- an achievement standard that describes an expected level that the majority of students are achieving by the end of a given year of schooling. An achievement standard describes the quality of learning (e.g. the depth of conceptual understanding and the sophistication of skills) that would indicate the student is well placed to commence the learning required in the next year.

This exemplar

This Science exemplar articulates the content in the *Outline* and approaches to teaching, learning and assessment reflective of the Principles of Teaching, Learning and Assessment. This exemplar demonstrates a sequence of teaching and learning, including suggested assessment points, for nine lessons.

Catering for diversity

This exemplar provides a suggested approach for the delivery of the curriculum and reflects the rationale, aims and content structure of the learning area. When planning the learning experiences, consideration has been given to ensuring that they are inclusive and can be used in, or adapted for, individual circumstances. It is the classroom teacher who is best placed to consider and respond to (accommodate) the diversity of their students. Reflecting on the learning experiences offered in this exemplar will enable teachers to make appropriate adjustments (where applicable) to better cater for students' gender, personal interests, achievement levels, socio-economic, cultural and language backgrounds, experiences and local area contexts.

Safety

Science learning experiences may involve the use of potentially hazardous substances and/or hazardous equipment. It is the responsibility of the school to ensure that duty of care is exercised in relation to the health and safety of all students and that school practices meet the requirements of the *Work Health and Safety Act 2011* (Cth), in addition to relevant State health and safety guidelines.

Using this exemplar

This teaching, learning and assessment exemplar provides suggestions to support the delivery of the mandated curriculum content. The exemplar provides:

- a teaching and learning sequence
- the mandated curriculum content to be taught at each point of the teaching and learning sequence, suggested resources, a sample assessment task and marking key
- the number of lessons to deliver the teaching and learning experiences
- learning intentions and support notes that may provide focus questions and additional information and/or examples to assist with the interpretation of curriculum content
- support notes to assist teachers to unpack the content and support teaching and learning experiences
- teaching and learning experiences that outline the structure of the lesson. These explicitly state each activity that the lesson will progress through and the key focus area for that activity

Links to electronic resources

This sequence of lessons may utilise electronic web-based resources, such as videos and image galleries. Teachers should be present while an electronic resource is in use and close links immediately after a resource, such as a video, has played to prevent default 'auto play' of additional videos. Where resources are referred for home study, they should be uploaded through Connect, or an equivalent system, that filters advertising content.

Best practice

Teaching and learning

The teaching and learning opportunities offered in this exemplar are not exhaustive. Thus, teachers are encouraged to make professional decisions about which learning experiences, and the sequence in which they are delivered, are best suited to their classroom context, taking into account the availability of resources and student ability.

This sample may prove a useful starting point for amplifying creativity in the classroom, while presenting the embedded expectations of the Western Australian Curriculum: Science.

Teachers may find opportunities to incorporate the General Capabilities and the Cross-curriculum Priorities into the teaching and learning program.

Ways of teaching – teachers can locate additional information on the Ways of teaching from the School Curriculum and Standards Authority (the Authority) website https://k10outline.scsa.wa.edu.au/home/wa-curriculum/learning-areas/science/overview/science-ways-of-teaching.

Assessing

Assessment, both formative and summative, is an integral part of teaching and learning. Assessment should arise naturally out of the learning experiences provided to students. In addition, assessment should provide regular opportunities for teachers to reflect on student achievement and progress. As part of the support it provides for teachers, this exemplar includes suggested assessment points. It is the teacher's role to consider the contexts of their classroom and students, the range of assessments required, and the sampling of content descriptions selected to allow their students the opportunity to demonstrate achievement in relation to the year level achievement standard. Teachers are best placed to make decisions about whether the suggested assessment/s are used as formative or summative assessment and/or for moderation purposes.

Ways of assessing – a range of assessment strategies that can enable teachers to understand where students are in their learning is available on the Authority website https://k10outline.scsa.wa.edu.au/home/teaching/curriculum-browser/science-v8/overview/ways-of-assessing.

Reflecting

Reflective practice involves a cyclic process during which teachers continually review the effects of their teaching and make appropriate adjustments to their planning. The cycle involves planning, teaching, observing, reflecting and replanning.

This exemplar supports reflective practice and provides flexibility for teachers in their planning. The exemplar shows how content can be combined and revisited throughout the year. Teachers will choose to expand or contract the amount of time spent on developing the required understandings and skills according to their reflective processes and professional judgements about their students' evolving learning needs.

Cells

The teaching and learning sequence will develop students' understanding of cells and microscopy and will enable them to compare plant and animal cells. Students will be provided with opportunities to engage with and explore cell processes and develop skills in using a compound light microscope.

The teaching and learning sequence enable students to develop the required knowledge and gain experience in identifying plant and animal cells and skills in the use of a compound light microscope. This prepares them to confidently apply their understanding in the summative assessment.

Year level description

In the early adolescence phase of schooling, students align with their peer group and begin to question established conventions, practices and values. Teaching and learning programs assist students to develop a broader and more comprehensive understanding of the contexts of their lives and the world in which they live.

Science provides opportunities for students to continue developing their understanding of important concepts and making connections between different areas of science and applications observed in their daily life.

In Year 8, students are introduced to cells and explore specialised flowering plant and vertebrate systems. They are also introduced to the structure of atoms and use representations to distinguish between elements and compounds. They classify elements as metals and non-metals based on their physical properties and distinguish between physical and chemical changes. They continue to develop a view of Earth as a dynamic system, exploring the interactions between processes occurring at plate boundaries and the rock cycle and how these processes explain patterns of change on Earth. They use physical properties to classify rocks and minerals and examine how properties of rocks reflect their formation and influence their use. They classify different forms of energy as kinetic or potential and represent energy transfer and transformation in simple systems. They explore in more detail how heat is transferred and electrical energy is transferred and transformed.

Students propose questions and make predictions based on scientific knowledge. They select appropriate equipment and manage risks when planning and conducting reproducible investigations. They select and construct appropriate representations to organise and process data. They analyse data to describe patterns and relationships and identify anomalies. They use evidence to support conclusions. They identify possible sources of error in their methods and suggest specific improvements. They select appropriate content, language and text features for their purpose and audience when communicating their ideas and findings. They examine situations where development of scientific knowledge has benefited from collaboration and influenced the development of human activity.

Achievement standard

By the end of the year:

Students describe the role of cell structures. They describe the structure and function of flowering plant and vertebrate systems. They distinguish between elements and compounds and identify metals and non-metals based on their physical properties. They identify physical and chemical changes. They describe the geological features that form at plate boundaries. They describe the different processes of rock formation and classify rocks and minerals using their physical properties. They describe different forms of energy and represent transfer and transformation of energy in simple systems.

Students plan and conduct reproducible investigations to test relationships and aspects of scientific models. They describe and manage risks involved in conducting investigations. They select and use equipment to generate and record data with precision. They select and construct appropriate representations to organise data and information. They analyse data and information to describe patterns and relationships and identify anomalies. They identify possible sources of error in methods and suggest specific improvements to their methods. They construct evidence-based arguments to support conclusions and support or dispute claims. They select and use language and text features appropriately for their purpose when communicating their ideas, findings and information to specific audiences. They describe situations where development of scientific knowledge has benefited from collaboration and has influenced the development of human activity.

Lessons 1–9

Cells

Lesson 1: Cell structure

The Western Australian Curriculum content addressed in this lesson is below.

Science understanding

Biological sciences

- Cells are the basic units of living things and can be viewed with a compound microscope; cells contain organelles and structures with specialised functions; animal cells include the cell membrane, cytoplasm, nucleus and mitochondria; plant cells include the cell membrane, cytoplasm, nucleus, mitochondria, cell wall, chloroplasts and large vacuoles

Science inquiry

Processing, modelling and analysing

- Construct appropriate representations, including tables, graphs, models and mathematical relationships, to organise and process data and information

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Resources

- ABC Education – Atoms Alive: A tour inside the cell
  https://www.abc.net.au/education/atoms-alive-a-tour-inside-a-cell/13891820
- Teach Genetics (Utah) – Amazing cells
  https://teach.genetics.utah.edu/content/cells/
- The Biology Corner – Teaching resources for cell biology and cytology
  https://www.biologycorner.com/lesson-plans/cells/
- Nucleus Medical Media – Biology: Cell Structure I Nucleus Medical Media
  https://www.youtube.com/watch?v=URUJD5NEXC8

Teacher information

- Cells are the basic unit of all living things. Some organisms are single-celled and others are made up of many cells (multicellular).
- An organelle is a specialised structure that carries out a particular function.
- A basic animal cell includes the following organelles:
  - cell membrane – surrounds the cell and allows certain substances to pass in and out
  - cytoplasm – a liquid/jelly-like part of the cell which has the other organelles suspended in it
  - nucleus – contains DNA and controls what happens in the cell
  - mitochondria – where chemical processes such as aerobic respiration take place to provide cell with energy.
- Plant cells include the above organelles and the following:
  - cell wall – composed of cellulose, it supports/provides structure to the cell and surrounds the outside of the cell membrane
  - chloroplasts – contain chlorophyll, which allows the plant to absorb the energy from light needed in photosynthesis
  - vacuole – a storage structure which provides support.

Lesson outline

Learning intentions:
Students will: • understand cells are the basic building block of living things • identify plant and animal cell organelles and describe their function • draw and label diagrams of typical plant and animal cells • distinguish between a typical plant and animal cell.

Introduction

- Provide students with picture cards of living and non-living things.
- In small groups, students sort the picture cards into the categories 'living' and 'non-living'.
- As a class, discuss the seven attributes of a living thing.
- Inform students that all living things are made composed of cells.

Lesson activities

Activity 1

- Explicitly teach the following:
  - an introduction to cells
  - the basic structure of an animal and plant cell
  - the structure and function of the organelles found in an animal cell and a plant cell.
- Draw or provide a diagram of a generalised plant and animal cell for students to colour and label.
- Instruct students to take notes and draw diagrams on the information presented.

Activity 2

- Students construct a plant and animal cell showing organelles from any resources available, such as clay, playdough, lollies, beads, cardboard, aluminium foil.
- Students draw a diagram of their models (or take pictures with a digital device) and annotate their drawings/images to include the name and function of the organelles of both a plant and animal cell.
- Students complete a gallery walk around the classroom with the teacher to view other students' plant and animal cell models.

Concluding activity

- Provide students with a Venn diagram to complete comparing the structures and functions of a plant and animal cell.
- Provide students with a glossary sheet, or have students start their own glossary, to record definitions they encounter throughout the unit.

Optional activities

- Research the structure of a one celled organism such as amoeba, algae, paramecium.

Lesson 2: Introduction to compound light microscope

The Western Australian Curriculum content addressed in this lesson is below.

Science understanding

Biological sciences

- Cells are the basic units of living things and can be viewed with a compound microscope; cells contain organelles and structures with specialised functions; animal cells include the cell membrane, cytoplasm, nucleus and mitochondria; plant cells include the cell membrane, cytoplasm, nucleus, mitochondria, cell wall, chloroplasts and large vacuoles

Science inquiry

Planning and conducting

- Select and use equipment to generate and record data with precision, using digital tools as appropriate

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Resources

- NC Community Colleges BioNetwork – Virtual microscope
  https://www.ncbionetwork.org/iet/microscope/
- Science Learning Hub – Label the microscope
  https://www.sciencelearn.org.nz/labelling_interactives/6-label-the-microscope

Teacher information

- Microscopes allow us to see small things that are not visible with the naked eye. The object being looked at under the microscope is called a specimen.
- The magnification used to see an object under the microscope can be calculated by multiplying the magnification of the eye piece (ocular lens) with the magnification of the objective lens. (Total magnification = ocular lens × objective lens)
- The field of view (FOV) is how much of the specimen can be observed through the microscope at any point of time/magnification. The higher the magnification, the smaller the field of view.

Lesson outline

Learning intentions:
Students will: • label and describe the function of each part of a compound light microscope • identify the orientation, and calculate the magnification, of an image viewed under a compound light microscope • predict how the field of view changes when magnification is increased/decreased.

Introduction

- Begin the lesson with a compound light microscope or microscopes at the front of the class for students to see as they walk in.
- Display an image on the board of a cell projected from a compound microscope or digital resource.
- Students discuss what they see and what they already know about microscopes, how they are used and what they are used for.

Lesson activities

Activity 1

- Explicitly teach the following:
  - the parts of and usage of the compound light microscope
  - how to calculate magnification.
- Provide students with a diagram of a compound light microscope to label and annotate.

Activity 2

- Instruct students to highlight the ocular and objective lenses on their diagram and practice calculating total magnification. Provide students examples of magnification for ocular and objective lenses to practice calculating total magnification.
- Set up compound light microscopes at stations around the classroom, each with a different slide that is already in focus. Students view a properly focussed slide while studying the microscope.
- Students use the ocular and objective lens magnification and calculate the total magnification at each station. A different total magnification is set up at each station for students to see the difference between the images produced.
- Students sketch some cells viewed under the microscope at different stations and different magnifications.

Concluding activity

- Use a quiz to review students' understanding of the content covered in the lesson.
- Students add definitions for new terms to their glossary sheet.

Optional activities

- Research and design a timeline of the history and development of the compound microscope.
- Investigate different types of microscopes and their uses, e.g. electron microscope, phase contrast microscope.
- Design and build your own microscope using lenses and cardboard rolls.

Lesson 3: Using the compound light microscope

The Western Australian Curriculum content addressed in this lesson is below.

Science understanding

Biological sciences

- Cells are the basic units of living things and can be viewed with a compound microscope; cells contain organelles and structures with specialised functions; animal cells include the cell membrane, cytoplasm, nucleus and mitochondria; plant cells include the cell membrane, cytoplasm, nucleus, mitochondria, cell wall, chloroplasts and large vacuoles

Science inquiry

Planning and conducting

- Select and use equipment to generate and record data with precision, using digital tools as appropriate

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Resources

- NC Community Colleges BioNetwork – Virtual Microscope
  https://www.ncbionetwork.org/iet/microscope/
- BBC – How to observe cells under a microscope
  https://www.bbc.co.uk/bitesize/articles/zbm48mn#znbssk7

Teacher information

- Microscopes allow us to see small things that are not visible with the naked eye. The object being looked at under the microscope is called a specimen.
- The magnification used to see an object under the microscope can be calculated by multiplying the magnification of the eye piece (ocular lens) with the magnification of the objective lens. (Total magnification = ocular lens × objective lens)
- The field of view (FOV) is how much of the specimen can be observed through the microscope at any point of time/magnification. The higher the magnification, the smaller the field of view. For a typical school microscope:

Power	Ocular magnification	Objective lens magnification	Total magnification	Approximate diameter of field of view
low	x10	x4	40x	4.5 mm
medium	x10	x10	100x	1.8 mm
high	x10	x40	400x	0.45 mm

Lesson outline

Learning intentions:
Students will: • use a compound light microscope to examine cells and sketch cells • identify the orientation, and calculate the magnification, of an image viewed under a light microscope • estimate cell length by knowing the field of view of the microscope.

Introduction

- Explain safety procedures when using a microscope, such as handling and carrying.
- Demonstrate how to:
  - focus the compound light microscope on the low-power objective lens (40x total magnification)
  - change the focus of the compound light microscope to the medium-power objective lens (100x total magnification) then to the high-power objective lens (400x total magnification)
  - place the specimen slide on the stage of the microscope, and how to check the slide will not be damaged when changing the objective lens.

Lesson activities

Activity 1

- In pairs or groups of three, students set up a compound light microscope and review how to focus on low, medium and high power.
- Provide students with a specimen slide with a word on it from a newspaper or magazine.
- Students focus on the word using low power and observe the orientation of letters which appear upside down and backward as the lenses flip the image.
- Monitor students while conducting the activity for the safe and correct operation of the microscope and to ensure that they work safely and cooperatively.

Activity 2

- Explicitly teach the following:
  - the field of view of the compound light microscope
  - how the field of view diameter changes with different magnifications
  - how to measure the diameter of the field of view with a mini grid or clear plastic ruler
  - how to estimate the length of a cell.
- Draw a picture of a field of view on the whiteboard or have it projected. Demonstrate how to measure the diameter of the field of view using a mini grid.
- Draw cells across the diameter of the field of view. Explain to students how to estimate length of cell by dividing the diameter of field of view by number of cells. Demonstrate this at different magnifications.
- Instruct students to take notes and draw diagrams on the presented information.

Activity 3

- In pairs or groups of three, students return to the compound light microscope and use a mini grid or a clear plastic ruler to measure the diameter of the field of view for each magnification.
- Provide students with a variety of prepared slides to view, including plant cells, animal cells and single celled organisms.

- Students rotate through prepared slides and practise focussing on different magnifications, checking with the teacher.
- Students sketch and label visible cell structures at different total magnification (40x, 100x and 400x), such as cell wall and/or cell membrane, cytoplasm and the nucleus of the cell.
- Students calculate the length of a cell and add it to the sketch with the total magnification at which it was viewed.
- Monitor students while conducting the activity for the safe and correct operation of the microscope and to ensure that they work safely and cooperatively.

Concluding activity

- Compare the calculations as a class or in small groups to ensure students correctly estimated the length of cells.
- Write a set of steps to explain how to set up a compound light microscope to focus on low, medium and high power.
- Students add definitions for new terms to their glossary sheet.

Lesson 4: Onion cell slide

The Western Australian Curriculum content addressed in this lesson is below.

Science understanding

Biological sciences

- Cells are the basic units of living things and can be viewed with a compound microscope; cells contain organelles and structures with specialised functions; animal cells include the cell membrane, cytoplasm, nucleus and mitochondria; plant cells include the cell membrane, cytoplasm, nucleus, mitochondria, cell wall, chloroplasts and large vacuoles

Science inquiry

Planning and conducting

- Select and use equipment to generate and record data with precision, using digital tools as appropriate

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Resources

- Microscope world – How to prepare an onion cell slide https://www.microscopeworld.com/p-4817-how-to-prepare-an-onion-cell-slide.aspx
- Microscopes Australia – Fun microscope experiments for kids #3 https://microscopes.com.au/blogs/news/fun-microscope-experiments-for-kids?srsltid=AfmBOooEwnJZLUdYnc5Gh0hjuFJdtF60DfJkmT1G9fKRHObgtPN2a5pJ
- BBC – How to observe cells under a microscope https://www.bbc.co.uk/bitesize/articles/zbm48mn#znbssk7

Teacher information

- A wet-mount slide is used to observe living specimens or fresh tissue placed in a drop of water or a solution such as a stain.
- Stains are used to make structures in cells visible. Potassium iodide solution is a stain that reacts with starch in plant cells.

Lesson outline

Learning intentions:
Students will: • prepare a wet-mount onion cell slide • use a compound light microscope to examine the onion cell slide • select and draw representative cells observed.

Introduction

- Project an image onto the board of onion epithelial or cheek epithelial cells under a compound light microscope.
- Demonstrate using a pencil how to draw one or two of the observed representative cells. Indicate on the drawing a title, the total magnification and the estimated cell size, labelling the observed organelles and structures observed.
- Provide students with a couple of images of cells as seen under a compound light microscope to practice drawing representative cells and include a title, total magnification, label organelles and structures observed and estimated cell size.

Lesson activities

Activity 1

- Demonstrate how to:
  - safely extract a thin sheet of cells between onion layers
  - place the sheet on a slide without folding it, add a drop of water and cover with a coverslip
  - prepare a second slide and add a stain such as potassium iodide solution.
- Review how to focus the compound light microscope at low, medium and high power.

Activity 2

- Provide students with instructions on how to prepare the onion cell slides.
- In pairs or groups of three, students produce the two types of onion cell slides and show the teacher.
- Students observe the onion cells at low, medium and high power.
- Students choose the best magnification to draw and estimate the length of cells. Students show the teacher their drawing and cells in focus under microscope.
- Monitor students while conducting the activity for the safe and correct operation of the microscope and to ensure that they work safely and cooperatively.

Concluding activity

- Students record their responses to the following questions in their notebooks:
  - What was the purpose of using a stain?
  - What organelles and structures are visible under the compound light microscope?
- Students add definitions for new terms to their glossary sheet.

Optional activities

- Use cavity slides to observe cells and organisms in pond water or the water from a vase.
- Prepare wet-mount slides of other plant tissue cells.
- Conduct a practical assessment to demonstrate students' skills in the use of a microscope to view and draw cells.

Lesson 5: Cell membrane

The Western Australian Curriculum content addressed in this lesson is below.

Science understanding

Biological sciences

- Cells are the basic units of living things and can be viewed with a compound microscope; cells contain organelles and structures with specialised functions; animal cells include the cell membrane, cytoplasm, nucleus and mitochondria; plant cells include the cell membrane, cytoplasm, nucleus, mitochondria, cell wall, chloroplasts and large vacuoles

Science inquiry

Planning and conducting

- Select and use equipment to generate and record data with precision, using digital tools as appropriate

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Resources

- Britannica – Cell membrane
  https://www.britannica.com/science/cell-membrane
- Southern Biological – Osmosis and diffusion
  https://www.southernbiological.com/osmosis-and-diffusion/?srsltid=AfmBOoqsMrNgeEUewE00IZa4LPhzXEpxRafFgVxDiG9tUoUMiJDwPEIR
- Science North – Diffusion and osmosis - For Teachers
  https://www.youtube.com/watch?v=Xxp6oponwkg
- Science buddies – Shrink a potato with osmosis
  https://www.sciencebuddies.org/stem-activities/potato-osmosis

Teacher information

- The cell membrane surrounds the cell and allows certain substances to pass in and out.
- The cell membrane has several functions, including:
  - providing a boundary between the internal and external environment
  - transporting nutrients into the cell and wastes out of the cell
  - communication and recognition between cells
  - structural support.
- It is a semi-permeable membrane which allows some molecules to cross if they are small enough.
- Osmosis is the movement of water across the membrane from a dilute solution to a concentrated solution.
- Diffusion is the movement of molecules from a region of high concentration to a region of low concentration.

Lesson outline

Learning intentions:
Students will: • identify the functions of the cell membrane • recall that all living cells continually require molecules to enter and wastes to exit • identify the cell membrane as a semi-permeable membrane • understand how molecules move across the cell membrane by osmosis and diffusion.

Introduction

- Conduct a class discussion. Ask the following the questions:
  - What do cells need to obtain to function and survive?
  - What do cells need to remove to function and survive?
  - Do animal and plant cells have the same requirement?
  - How do molecules move in and out of a cell?

Lesson activities

Activity 1

- Explicitly teach the following:
  - the functions of the cell membrane
  - the requirements of an animal cell to survive, such as obtaining water, oxygen, glucose and removing waste such as carbon dioxide
  - the requirements of a plant cell to survive such as obtaining carbon dioxide, water, nutrients and removing other wastes
  - that a cell membrane is semi-permeable, allowing some molecules to move through it
  - that water moves across the membrane by osmosis
  - that other molecules such as oxygen, glucose and carbon dioxide move across the membrane by diffusion.
- Instruct students to take notes and draw diagrams on the presented information.

Activity 2

- Demonstrate and explain a practical activity to observe osmosis and diffusion across a semi-permeable membrane.
- In groups of three, students conduct practical activity on osmosis and diffusion across a semi-permeable membrane.
- Monitor students while conducting the activity for the safe and correct operation of the apparatus and to ensure they work safely and cooperatively.

Concluding activity

- Students summarise the outcome of the practical activities by drawing and labelling diagrams that show the movement of molecules and explain the transport process involved.
- Students add definitions for new terms to their glossary sheet.

Optional activities

- Research how large molecules move across the membrane by endocytosis and exocytosis.
- Investigate the structure of the cell membrane.

Lesson 6: Chloroplasts

The Western Australian Curriculum content addressed in this lesson is below.

Science understanding

Biological sciences

- Cells are the basic units of living things and can be viewed with a compound microscope; cells contain organelles and structures with specialised functions; animal cells include the cell membrane, cytoplasm, nucleus and mitochondria; plant cells include the cell membrane, cytoplasm, nucleus, mitochondria, cell wall, chloroplasts and large vacuoles

Science inquiry

Processing, modelling and analysing

- Analyse data and information to describe patterns and relationships, identify anomalies and draw conclusions based on evidence

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Resources

- Southern Biological – Photosynthesis
  https://www.southernbiological.com/photosynthesis/
- Science Buddies – Measure photosynthesis with floating leaves
  https://www.youtube.com/watch?v=gCHW7f88bAc
- Project Learning Tree – Activities and experiments to explore photosynthesis in the classroom
  https://www.plt.org/educator-tips/activities-experiments-photosynthesis-classroom/
- Visible Body | Learn Site – Photosynthesis: Reactants and products
  https://www.visiblebody.com/learn/biology/photosynthesis/reactants-products

Teacher information

- Photosynthesis is the process plants use to convert light energy into chemical energy. The energy is in the form of a sugar called glucose.
- Photo means 'light', and synthesis means 'put together'.
- The word equation for photosynthesis is:
  - light energy + carbon dioxide + water → glucose + oxygen
- Most photosynthesis occurs in the leaf cells of plants. Carbon dioxide enters through stomata in the leaves of the plant, water enters from the roots and travels up the plant and sunlight is absorbed by the chloroplasts. Chlorophyll, the green pigment found in chloroplasts, absorb the light energy from the sun and is where photosynthesis takes place.
- The products of photosynthesis, glucose and oxygen, are used by plant cells for aerobic respiration to produce energy for cell processes.

Lesson outline

Learning intentions:
Students will: • define photosynthesis • write the word equation for photosynthesis • recall that photosynthesis occurs in the chloroplasts of a plant cell • understand how photosynthesis enables plants to survive.

Introduction

- In groups, revise plant cell structure. Label a generalised plant cell and describe the functions of a cell wall, cell membrane, cytoplasm, nucleus, chloroplast and vacuole.

Lesson activities

Activity 1

- Explicitly teach the following:
  - the function of the chloroplast in photosynthesis
  - the word equation for photosynthesis
  - the structures of the plant involved in providing the reactants for photosynthesis (leaf, stomata, roots and xylem).
- Instruct students to take notes and draw diagrams on the presented information.

Activity 2

- Demonstrate and explain a practical activity to observe photosynthesis in plant cells, such as the floating leaves experiment.
- In groups of three, students conduct a practical activity to observe photosynthesis in plant cells.
- Monitor students while conducting the activity for the safe and correct operation of the apparatus and to ensure they work safely and cooperatively.

Concluding activity

- Students summarise the outcome of the practical activity.
- Students draw a leaf to show photosynthesising cells and label the diagram, showing the movement of reactants and the products of photosynthesis.
- Students add definitions for new terms to their glossary sheet.

Optional activities

- Research the structure of a chloroplast or a leaf.
- Investigate the effect of light intensity, light colour, carbon dioxide concentration or another factor on the rate of photosynthesis.

Lesson 7: Mitochondria

The Western Australian Curriculum content addressed in this lesson is below.

Science understanding

Biological sciences

- Cells are the basic units of living things and can be viewed with a compound microscope; cells contain organelles and structures with specialised functions; animal cells include the cell membrane, cytoplasm, nucleus and mitochondria; plant cells include the cell membrane, cytoplasm, nucleus, mitochondria, cell wall, chloroplasts and large vacuoles

Science inquiry

Processing, modelling and analysing

- Analyse data and information to describe patterns and relationships, identify anomalies and draw conclusions based on evidence

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Resources

- Southern Biological – Cellular respiration and fermentation https://www.southernbiological.com/cellular-respiration-and-fermentation/
- Britannica kids – Cellular respiration https://kids.britannica.com/students/article/cellular-respiration/603291
- S4 Project – The Yeast Respiration Experiment with S4's Biologist Ali https://www.youtube.com/watch?v=1IPKuzuU81E
- The Sci Guys – Fermentation of yeast and sugar - The Sci Guys: Science at home https://www.youtube.com/watch?v=FYClCHVT00M

Teacher information

- Mitochondria is the organelle where chemical processes such as aerobic respiration take place to provide the cell with energy.
- Aerobic respiration is the process where plant and animal cells convert glucose and oxygen into energy, carbon dioxide and water.
- The word equation for aerobic respiration is:
  - glucose + oxygen → cell energy + carbon dioxide + water
- Glucose is a sugar that present in cells. It is present in animal cells by consuming food and in plant cells by photosynthesis.
- The energy produced from aerobic respiration is used for many cell processes, such as movement, growth and repairing the cell.

Lesson outline

Learning intentions:
Students will: • define aerobic respiration • write the word equation for aerobic respiration • recall that aerobic respiration occurs in the mitochondria of plant and animal cells • understand how aerobic respiration enables plants and animals to survive.

Introduction

- In groups, revise animal and plant cell structure. Recall the word equation for photosynthesis.

Lesson activities

Activity 1

- Explicitly teach the following:
  - the function of the mitochondria in aerobic respiration
  - the word equation for aerobic respiration
  - how cells obtain the reactants for aerobic respiration.
- Instruct students to take notes and draw diagrams on the presented information.

Activity 2

- Demonstrate and explain a practical activity to observe aerobic respiration in germinating seeds.
- In groups of three, students conduct a practical activity to observe aerobic respiration in germinating seeds.
- Monitor students while conducting the activity for the safe and correct operation of the apparatus and to ensure they work safely and cooperatively.

Concluding activity

- Students summarise the outcome of the practical activity.
- Students compare the processes of photosynthesis and aerobic respiration by drawing a diagram to show the relationship between the two processes.
- Students add definitions for new terms to their glossary sheet.

Optional activities

- Research the structure of mitochondria.
- Compare aerobic and anaerobic respiration.
- Research and investigate anaerobic respiration in yeast.

Lesson 8: Specialised cells

The Western Australian Curriculum content addressed in this lesson is below.

Science understanding

Biological sciences

- Cells are the basic units of living things and can be viewed with a compound microscope; cells contain organelles and structures with specialised functions; animal cells include the cell membrane, cytoplasm, nucleus and mitochondria; plant cells include the cell membrane, cytoplasm, nucleus, mitochondria, cell wall, chloroplasts and large vacuoles

Science inquiry

Planning and conducting

- Select and use equipment to generate and record data with precision, using digital tools as appropriate

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Resources

- Britannica – The major parts of the animal cell
  https://www.britannica.com/video/what-are-the-major-parts-of-an-animal-cell/-313989
- The Biology corner – Teaching resources for cell biology and cytology
  https://www.biologycorner.com/lesson-plans/cells/
- Teach Genetics (Utah) – Amazing cells
  https://teach.genetics.utah.edu/content/cells/
- ABC Education – Atoms Alive: A tour inside a cell
  https://www.abc.net.au/education/atoms-alive-a-tour-inside-a-cell/13891820
- Britannica – How are plant cells different from animal cells?
  https://www.britannica.com/video/plant-cells-animal-cells-cell-science-eukaryotic-botany-zoology/-299944

Teacher information

- Multi-cellular organisms are composed of many specialised cell types.
- Examples of specialised cells in animals include red blood cells, white blood cells, muscle cells (smooth, cardiac and skeletal), neurones and epithelial cells.
- Examples of specialised cells in plants include epidermal cells, guard cells, palisade cells, spongy cells, xylem and phloem.

Lesson outline

Learning intentions:
Students will: • identify some specialised plant and animal cells • describe how specialised cells have specific features that allow them to carry out their function.

Introduction

- On the board, display various images of specialised plant and animal cells.
- In groups, students identify the plant images and the animal images.
- Review parts of the plant and animal cells and identify them in the images displayed.
- Lead a class discussion about why all cells do not look the same.

Lesson activities

Activity 1

- Review how to safely use and focus the compound light microscope at low, medium and high power.
- Provide students with a range of prepared specialised plant and animal cell slides to view under the microscope.
- Students observe the specialised cells and draw a diagram identifying any specialised features.
- Monitor students while conducting the activity for the safe and correct operation of the microscope and to ensure they work safely and cooperatively.

Activity 2

- Conduct a class discussion. Ask the following questions for each cell observed:
  - What specialised feature did you observe?
  - Why do you think the cell requires this?
- Provide students with a suitable table to include the key structures and functions of each type of cell observed.

Concluding activity

- Provide students with revision activities, such as worksheets, questions and a graphic organiser to review Lessons 1–8 in preparation for the summative assessment.

Lesson 9: Summative assessment

The Western Australian Curriculum content addressed in this lesson is below.

Science understanding

Biological sciences

- Cells are the basic units of living things and can be viewed with a compound microscope; cells contain organelles and structures with specialised functions; animal cells include the cell membrane, cytoplasm, nucleus and mitochondria; plant cells include the cell membrane, cytoplasm, nucleus, mitochondria, cell wall, chloroplasts and large vacuoles

Science inquiry

Processing, modelling and analysing

- Construct appropriate representations, including tables, graphs, descriptive statistics, models and mathematical relationships, to organise and process data and information

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Resources

- Appendix A: Assessment task

Teacher information

- Students work individually under test conditions for one 50-minute lesson.

Lesson outline

Learning Intention:
Students will demonstrate their understanding of: • the structure and function of plant and animal cell organelles • how to use a compound light microscope.

Introduction

- Follow the instructions provided in the assessment task in Appendix A.

Activity

- Students complete the assessment task individually under test conditions.

Appendix A

Assessment task

Cells and microscopes

Task details

Title	Cells and microscope test
Description	Students will demonstrate their understanding of: • the structure and function of plant and animal cell organelles • how to use a compound light microscope
Type of assessment	Summative
Ways of assessing	Completion of the student assessment sheet
Evidence to be collected	Student assessment sheet
Suggested time	One 50-minute lesson
Differentiation	Teachers should differentiate their teaching and assessment to meet the specific learning needs of their students, based on their level of readiness to learn and their need to be challenged. Where appropriate, teachers may either scaffold or extend the scope of the assessment tasks.

Content descriptions

Science understanding

Biological Sciences

- Cells are the basic units of living things and can be viewed with a compound microscope; cells contain organelles and structures with specialised functions; animal cells include the cell membrane, cytoplasm, nucleus and mitochondria; plant cells include the cell membrane, cytoplasm, nucleus, mitochondria, cell wall, chloroplasts and large vacuoles

Science inquiry

Processing, modelling and analysing

- Construct appropriate representations, including tables, graphs, descriptive statistics, models and mathematical relationships, to organise and process data and information

Key concepts

Plant and animal cell organelles and structures, compound microscope use

Information for teachers

This task follows the completion of the sequence of lessons, where students have had prior opportunities and practice to identify and describe the structures and functions of plant and animal cell organelles and the use of a compound light microscope.

Students will be provided with a student assessment sheet. They will be required to apply their understanding of structures and functions of plant and animal cell organelles and the use of a compound light microscope.

Students will work individually under test conditions for one 50-minute lesson.

Student assessment sheet: Cells and microscopes

Answer all the questions in the spaces provided.

You have 50 minutes in class under test conditions.

1.

(a) Label the following parts of the microscope on the diagram above with:

- arm (1 mark)
- base (1 mark)
- coarse focus (1 mark)
- eyepiece (ocular lens) (1 mark)
- objective lens (1 mark)
- stage (1 mark)

(b) Explain how to calculate total magnification. (3 marks)

(c) Complete the table by adding in the missing values for calculating magnification. (3 marks)

Eyepiece	Objective lens	Total magnification
10X	4X	
10X		100X
	40X	400X

(d) Describe the function of the following parts of a microscope. (4 marks)

Part	Function
arm	
objective lens	
fine focus	
stage	

2.

(a) In the space below, draw and label a diagram of a plant cell to show the following structures:

- cell wall (1 mark)
- cell membrane (1 mark)
- cytoplasm (1 mark)
- nucleus (1 mark)
- mitochondria (1 mark)
- chloroplast (1 mark)
- vacuole (1 mark)

(b) Describe the function of the following cell structures. (4 marks)

Cell structure	**Function**
nucleus	
cell membrane	
cell wall	
vacuole	

(c) Name the main process occurring in the mitochondrion and write a word equation for this process. (3 marks)

_____

_____

_____

(d) Explain the process of photosynthesis and where it occurs in a plant cell. (5 marks)

_____

_____

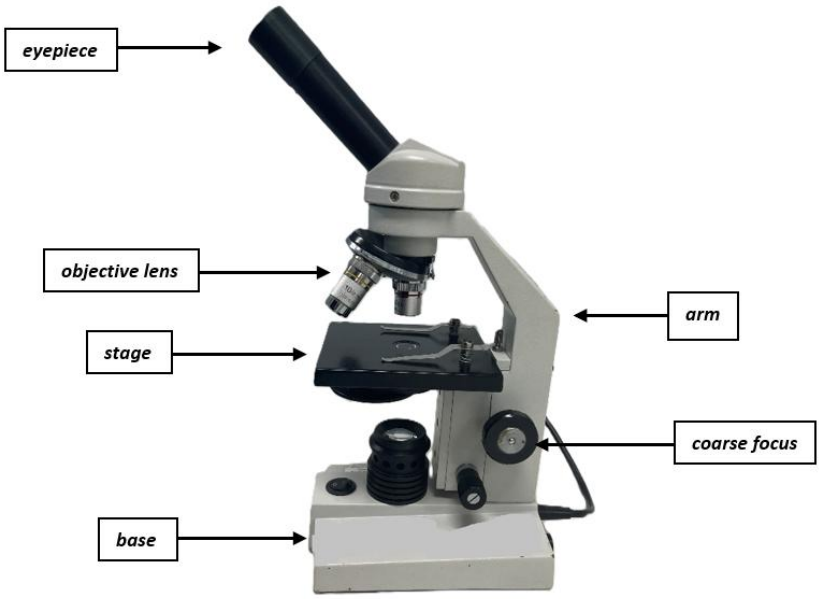
_____

_____

_____

_____

Marking key

<table>
<tr><th>Description</th><th>Marks</th></tr>
<tr><td colspan="2">1. (a) Label the following parts of the microscope</td></tr>
<tr><td>One mark for each of the parts correctly labelled.
 
</td><td>1–6</td></tr>
<tr><td>Subtotal</td><td>/6</td></tr>
<tr><td colspan="2">(b) Explain how to calculate total magnification.</td></tr>
<tr><td>multiply</td><td>1</td></tr>
<tr><td>eyepiece (ocular lens) magnification</td><td>1</td></tr>
<tr><td>objective lens magnification</td><td>1</td></tr>
<tr><td>Subtotal</td><td>/3</td></tr>
<tr><td colspan="2">(c) Complete the table by adding in the missing values for calculating magnification.</td></tr>
<tr><td>
<table>
<tr><th>Eyepiece</th><th>Objective lens</th><th>Total magnification</th></tr>
<tr><td>10X</td><td>4X</td><td>40X</td></tr>
<tr><td>10X</td><td>10X</td><td>100X</td></tr>
<tr><td>10X</td><td>40X</td><td>400X</td></tr>
</table>
</td><td>1–3</td></tr>
<tr><td>Subtotal</td><td>/3</td></tr>
</table>

Description	Marks
(d) Describe the function of the following parts of a microscope	
arm: used to carry microscope when transporting	1
objective lens: the magnification lens closest to the slide	1
fine focus: the second knob, used to get a clearer image of the slide	1
stage: where the slide is placed to focus	1
Subtotal	**/4**
2. (a) Draw and label a diagram of a plant cell to show the following structures	
One mark for each of the following structures correctly drawn and labelled • cell wall • cell membrane • cytoplasm • nucleus • mitochondrion • chloroplast • vacuole	1–7
Subtotal	**/7**
(b) Describe the function of the following cell structures.	
nucleus: controls what happens in the cell	1
cell membrane: controls the movement of substances in and out of the cell	1
cell wall: supports/provides structure to the cell	1
vacuole: a storage structure which provides support	1
Subtotal	**/4**
(c) Name the main process occurring in the mitochondrion and write a word equation for this process.	
aerobic respiration	1
glucose + oxygen → cell energy + carbon dioxide + water 1 mark for correct reactants (glucose + oxygen) 1 mark for correct products (cell energy + carbon dioxide + water)	1–2
Subtotal	**/3**
(d) Explain the process of photosynthesis and where it occurs in a plant cell.	
the process plants use to convert light energy into energy for the plant cell	1
(reactants) carbon dioxide and water	1
react in the presence of sunlight to produce	1
(products) glucose and oxygen	1
occurs in chloroplasts	1
Subtotal	**/5**
Total	**/35**