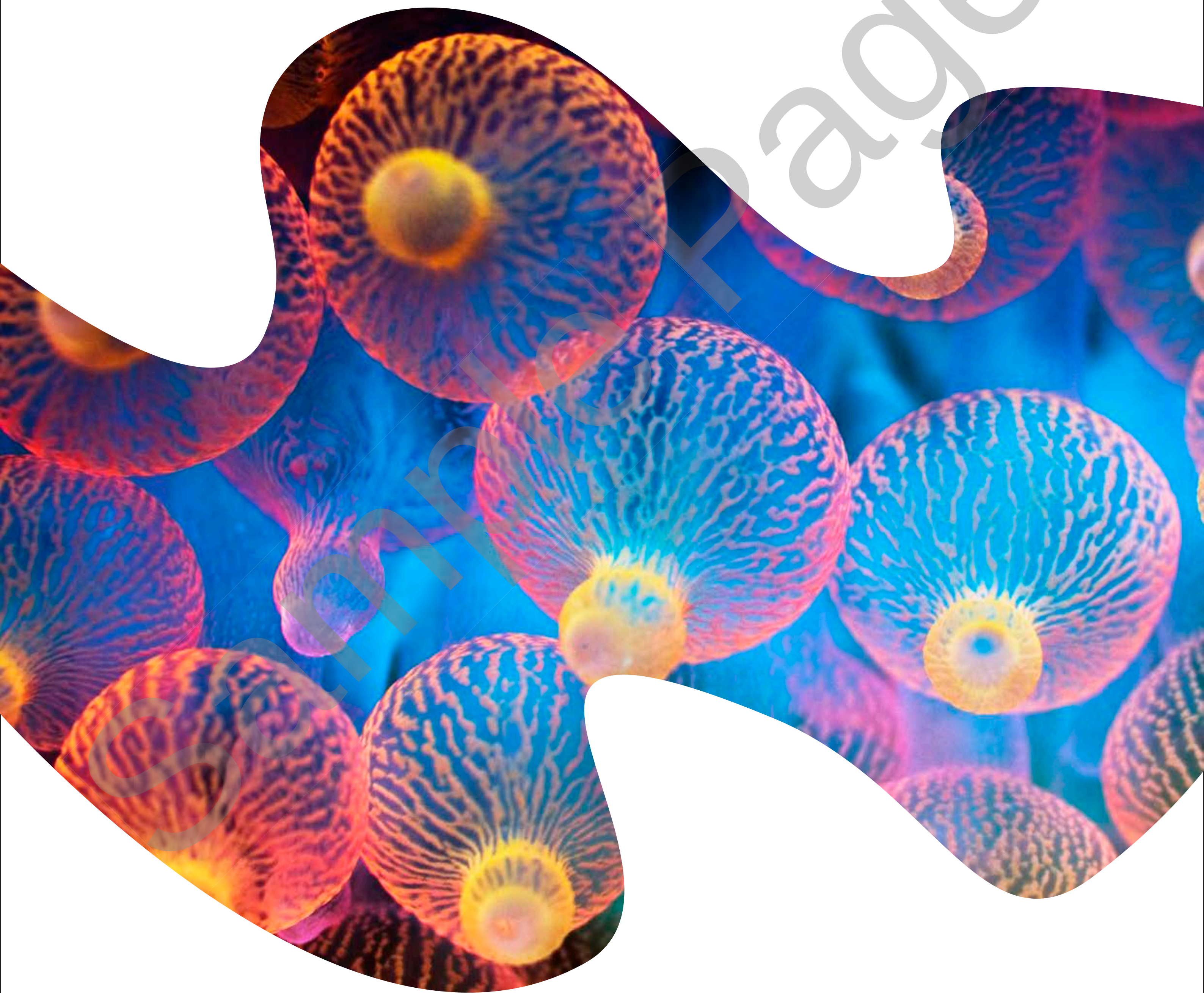
HEINEMANN

BIOLOGY 1

SKILLS AND ASSESSMENT



VCE UNITS 1 AND 2 • 2022-2026

Contents

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Unit 2 How does inheritance impact on diversity?

AREA OF STUDY 1

How is inheritance explained?

AREA OF STUDY 2

How do inherited adaptations impact on diversity?

AREA OF STUDY 3

How do humans use science to explore and communicate contemporary bioethical issues?

HOW TO USE THIS BOOK

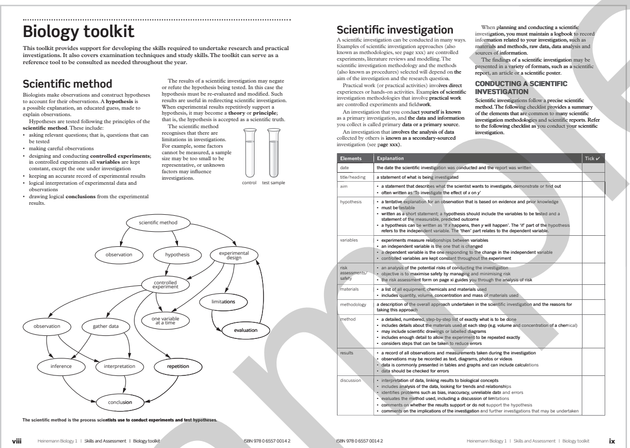
The *Heinemann Biology 1 Skills and Assessment* book provides the opportunity to practise, apply and extend your learning through a range of supportive and challenging activities. These activities reinforce key concepts and skills, and enable a flexible approach to learning. There are also regular opportunities for reflection and self-evaluation in the final worksheet in each Area of Study.

This resource has been written to the VCE Biology Study Design 2022–2026 and is divided into six areas of study—three in Unit 1 and three in Unit 2. Areas of Study 1 and 2 in each unit consist of four main sections:

- key knowledge
- worksheets
- practical activities
- exam-style questions.

BIOLOGY TOOLKIT

The Biology toolkit supports development of the skills and techniques needed to undertake primary and secondary-sourced investigations, and covers examination techniques and study skills. It also includes checklists, models, exemplars and scaffolded steps. The toolkit can serve as a reference tool and be consulted as needed.

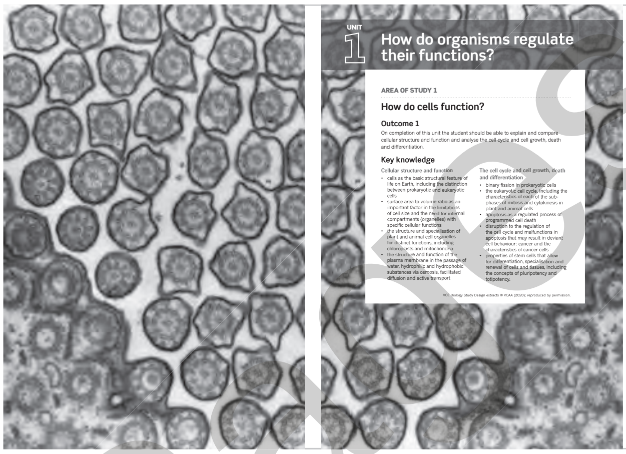


TEACHER SUPPORT

Comprehensive answers and fully worked solutions for all worksheets, practical activities and exam questions are provided via the *Heinemann Biology 1* <TBC>. In-depth support for Unit 1 Area of Study 3 and Unit 2 Area of Study 3 in the form of samples, templates and teacher notes is also included, along with an interactive SPARKlab for every practical activity.

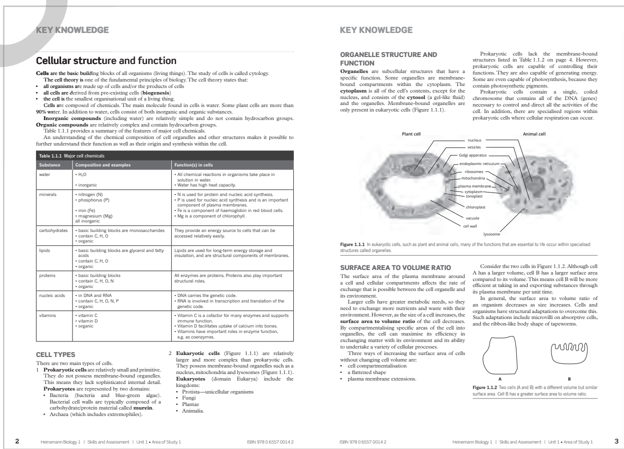
UNIT AND AREA OF STUDY OPENER

Heinemann Biology 1 Skills and Assessment is structured to follow the study design units and areas of study. The area of study opening page lists the study design key knowledge for easy reference to the following activities.



KEY KNOWLEDGE

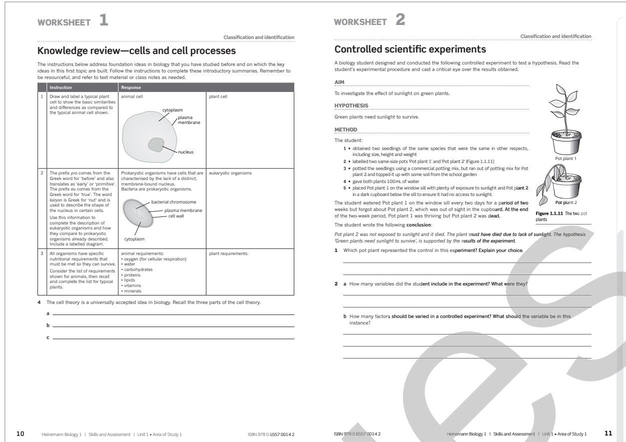
Each area of study begins with a key knowledge section. This consists of a set of summary notes that cover the key knowledge for that area of study. Key terms are in bold and are included in the glossary of the student book. The section also serves as a ready reference for completing the worksheets and practical activities.



HOW TO USE THIS BOOK

WORKSHEETS

The worksheets feature questions that allow you to practise and apply your knowledge and skills. Each area of study includes a 'Knowledge review' worksheet, to activate prior knowledge, and a 'Reflection' worksheet, which you can use for self-assessment. Other worksheets provide opportunities to revise, consolidate and further your understanding. All worksheets function as formative assessment and are clearly aligned with the study design. A range of questions building from foundation to challenging is included in each worksheet.

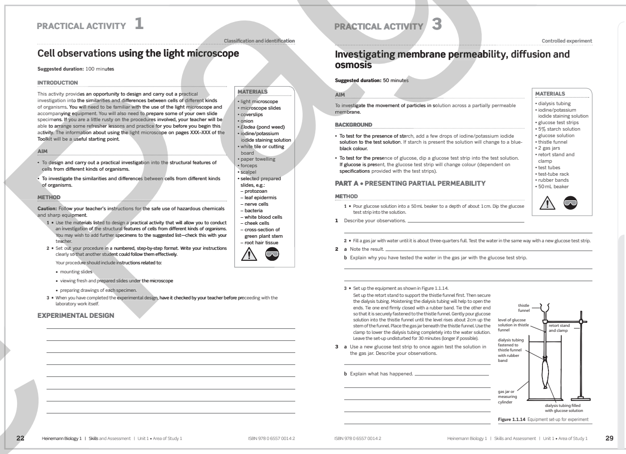

WORKSHEET 1
Knowledge review—cells and cell processes
WORKSHEET 2
Controlled scientific experiments

PRACTICAL ACTIVITIES

Practical activities offer you the chance to complete practical work related to the various themes covered in the study design. You have the opportunity to design and conduct scientific investigations, generate, evaluate and analyse data, appropriately record results, and prepare evidence-based conclusions. Where relevant, you will also need to conduct risk assessments to identify any potential hazards.

Each practical activity includes a suggested duration. Together with the Area of Study 3 scientific investigations, the practical activities meet the 34 hours of practical work mandated for Units 1 and 2 in the study design.

Each worksheet and practical activity is mapped to one or more of the scientific investigation methodologies outlined in the study design. Completing these activities gives you experience in applying the methodologies in a wide variety of contexts and prepares you for designing and conducting your own scientific investigation in Unit 1 Area of Study 3.


PRACTICAL ACTIVITY 1
Cell observations using the light microscope
PRACTICAL ACTIVITY 3
Investigating membrane permeability, diffusion and osmosis


WORKSHEET 14

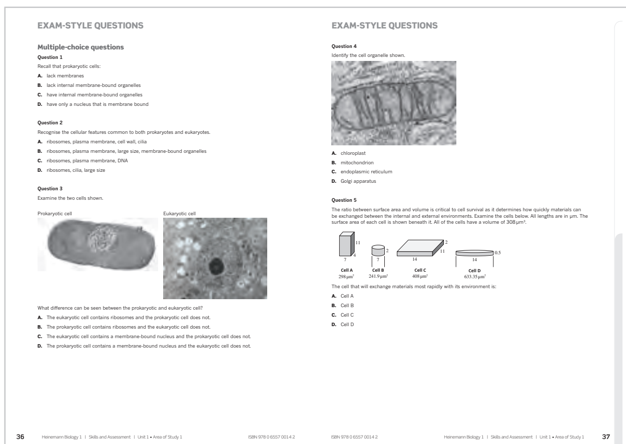
Classification and identification

The mammalian excretory system

1 Read the definitions listed in the boxes on the right-hand side of the page. Choose the correct term from the list below to match each definition and write this term in the corresponding box.

EXAM-STYLE QUESTIONS

Each area of study finishes with a selection of exam-style questions. This gives you the opportunity to gain valuable experience applying your knowledge and understanding to exam-style questions.


EXAM-STYLE QUESTIONS

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Biology toolkit

This toolkit provides support for developing the skills required to undertake research and practical investigations. It also covers examination techniques and study skills. The toolkit can serve as a reference tool to be consulted as needed throughout the year.

Scientific method

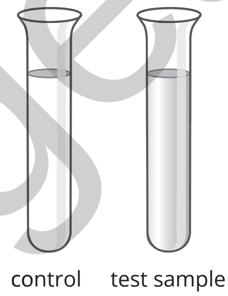
Biologists make observations and construct hypotheses to account for their observations. A **hypothesis** is a possible explanation, an educated guess, made to explain observations.

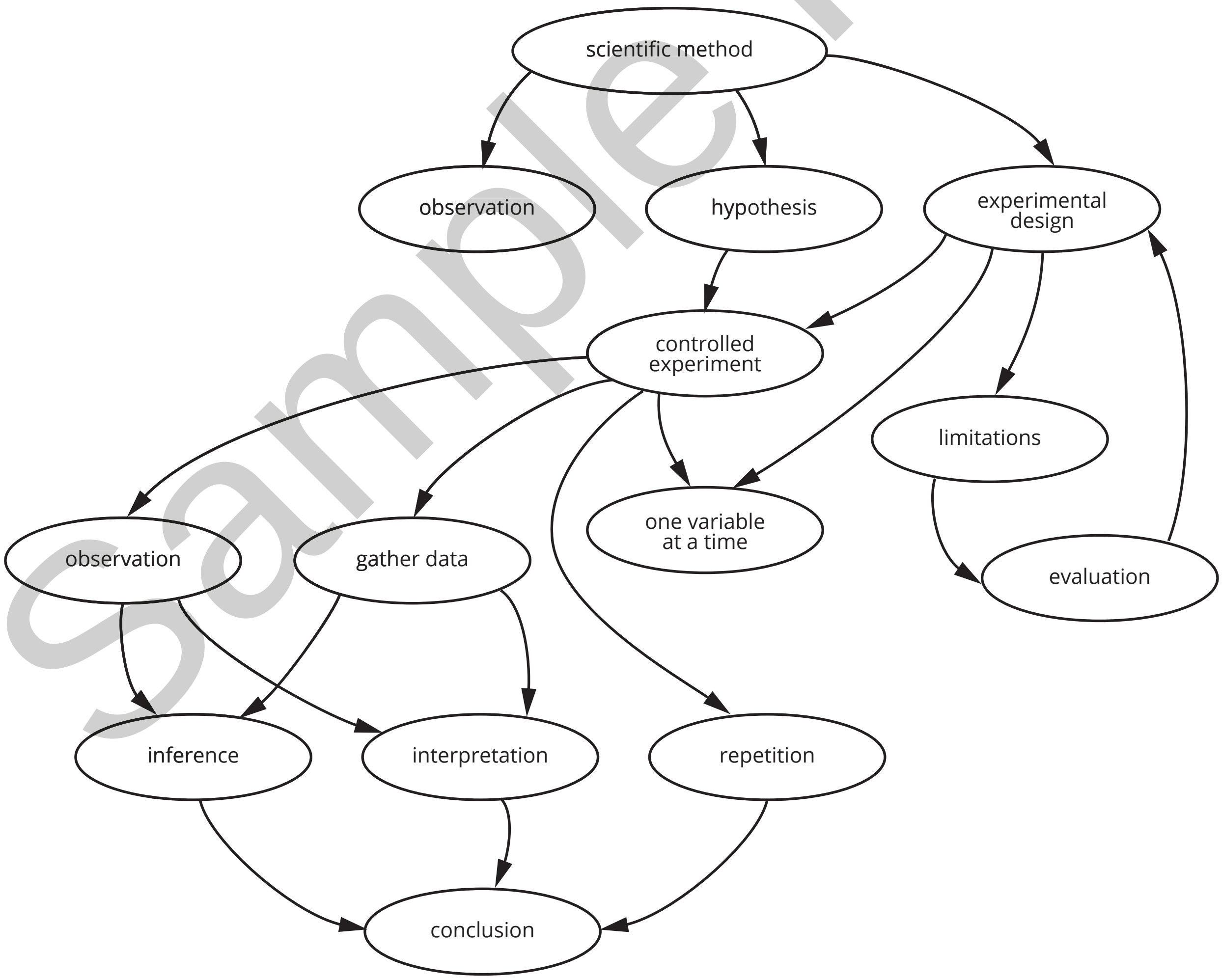
Hypotheses are tested following the principles of the **scientific method**. These include:

- asking relevant questions; that is, questions that can be tested
- making careful observations
- designing and conducting **controlled experiments**; in controlled experiments all **variables** are kept constant, except the one under investigation
- keeping an accurate record of experimental results
- logical interpretation of experimental data and observations
- drawing logical **conclusions** from the experimental results.

The results of a scientific investigation may negate or refute the hypothesis being tested. In this case the hypothesis must be re-evaluated and modified. Such results are useful in redirecting scientific investigation. When experimental results repetitively support a hypothesis, it may become a **theory** or **principle**; that is, the hypothesis is accepted as a scientific truth.

The scientific method recognises that there are limitations in investigations. For example, some factors cannot be measured, a sample size may be too small to be representative, or unknown factors may influence investigations.





The scientific method is the process scientists use to conduct experiments and test hypotheses.

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EXAMPLES OF SCIENTIFIC REPORTS

It can be difficult to gauge whether you have attained a high standard in your completed scientific report. Looking at sample scientific reports can help you identify what is required. Two sample scientific reports are provided here as a reference: one is prepared to a high standard, while the second has room for improvement. The annotations draw your attention to key points to note on each scientific report. These points are also reflected in the checklist, so you are able to use this as a tool to evaluate whether all requirements of the scientific investigation have been met.

High standard scientific report

Place the heading at the top of the text on page 1 of the report. Heading should be clear and short.

State the reason for doing the investigation.

The hypothesis is based on the aim of the investigation.

Identify the different variables.

List all materials, including numbers of specific items.

Warn of potential hazards and how these can be reduced or eliminated.

Describe the overall approach undertaken in the scientific investigation and the reasons for taking this approach.

Provide clear instructions about each step of the experiment. These should be written in recipe style, with easy-to-follow detailed instructions written in the third person.

The effect of sunlight on seed germination

Aim

To investigate whether wheat seeds need sunlight to trigger germination.

Hypothesis

If wheat seeds need sunlight to germinate, then they will not germinate in the dark.

Variables

Independent variable: sunlight

Dependent variable: seed germination

Controlled variables:

- type of container used for seeds
- type of substrate used to support seeds
- temperature
- number and density of seeds

Materials

- 40 wheat seeds
- 2 × Petri dishes
- cotton wool
- 50 mL measuring cylinder
- spray bottle containing water

Risk assessment

If you are using glass Petri dishes, breakage is a potential risk. Wear disposable gloves to protect your hands. All breakages should be reported to the teacher immediately. The teacher or laboratory technician will dispose of broken glass.

Methodology

A controlled experiment was conducted to determine if sunlight is required for germination to occur.

Method

1. Place 1 cm thick bed of cotton wool in base of each Petri dish.
2. Measure 20 mL of water in the measuring cylinder. Pour over the cotton wool in the first Petri dish until uniformly wet. Repeat this for the second Petri dish.
3. Spread 20 wheat seeds evenly on the cotton wool bed of each Petri dish.
4. Place one Petri dish on the windowsill where it will receive sunlight. Place the second in a dark cupboard nearby.
5. Leave the Petri dishes for seven days. Use the water spray bottle to spray the two Petri dishes every second day to ensure they do not dry out.
6. Compare the seeds of the two set-ups after seven days.

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Results

Wheat seeds placed in light and dark conditions did not show a difference in the mean number of seeds germinated over a period of seven days (Table 1).

This is a record of all observations and measurements taken during the investigation.

TABLE 1 Number of wheat seeds germinated in light and dark conditions over seven days

Record your results in an appropriate format. Tables are useful for recording experimental data. Graphs, diagrams and photographs are also useful approaches for recording data.

Group	Number of seeds germinated	
	Light	Dark
1	18	17
2	17	19
3	18	16
4	17	17
5	12	14
Mean	16.4	16.6

If you take multiple measurements, calculating the mean (or average) gives a single representative value and can provide a clearer understanding of the data.

Discussion

The data from each set of experiments follows a similar pattern. The majority of wheat seeds germinated, regardless of exposure to light or dark.

The light and dark treatments for Group 5 both have a lower number of germinating seeds than the other groups. As the Group 5 seeds came from the same source as the other groups' seeds, variables other than the seeds need to be considered when accounting for the difference in germination rates between groups. There are several possibilities that might account for the lower rate of germination. For example, the seeds might not have received adequate water. Another reason could be the handling of the seeds by contaminated hands. Such variables should be controlled in future experiments by ensuring all seeds receive equal quantities of water and by wearing disposable gloves when handling the seeds.

The discussion focuses on the interpretation of the experimental data. What do the results show? Are there any unexpected results? How can we account for this? Evaluation of the procedure is also included here.

Conclusion

This investigation demonstrated that wheat seeds do not require sunlight to germinate. The hypothesis is not supported. The experimental evidence shows that in every instance, wheat seeds germinated when placed in the dark for seven days.

The conclusion relates back to the purpose and states whether the hypothesis was supported or not supported. It also outlines the experimental evidence to support this.

Avoid terms such as 'always' and 'never' in scientific writing. Refer to what the data shows—all claims must be supported by the evidence.

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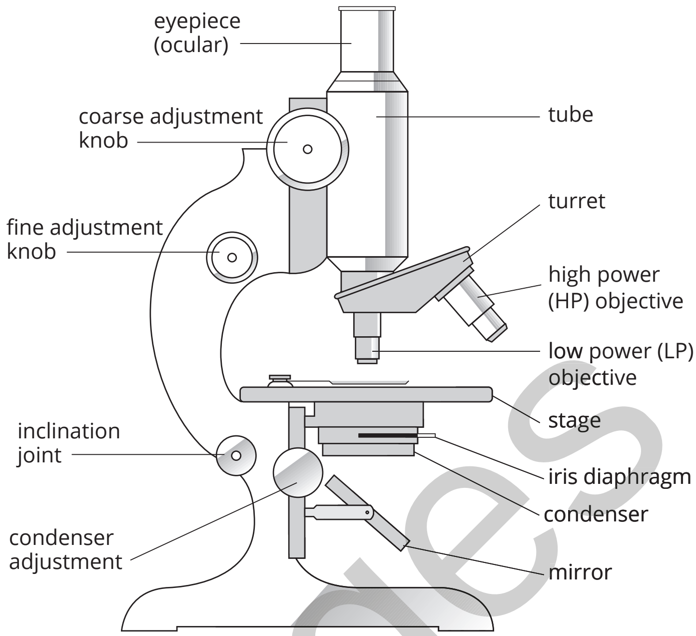
User-friendly microscope hints

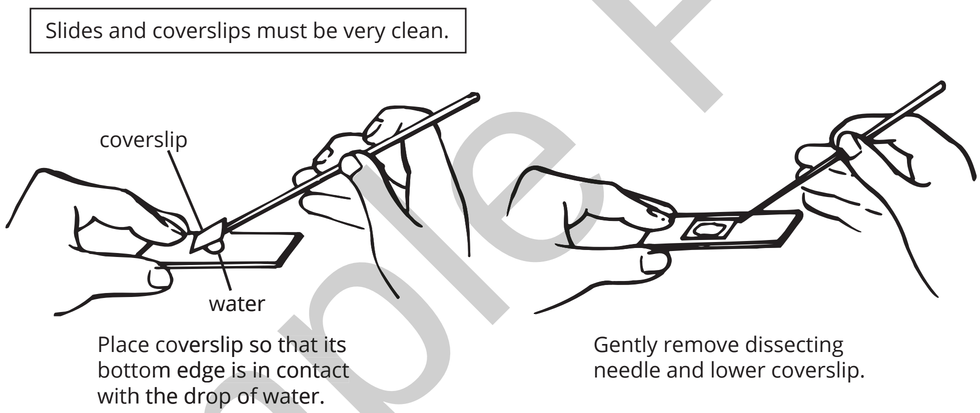
- Look down the eyepiece lens and adjust the light source (mirror, condenser lens and iris diaphragm) so the field of view is uniformly illuminated.
- Place your prepared slide on the microscope stage and centre the object to be viewed. Use the clips to secure the slide in position.
- When setting up the microscope always view the object under low power (LP) first.
- Checking from the side, wind the coarse adjustment until the LP objective lens is as close as it can go towards the slide. (It should be no closer than 2 mm.)
- Looking down through the eyepiece lens, use the coarse adjustment knob to slowly move the LP objective lens away from the slide. When the object is in focus, use the fine adjustment knob to bring the image into even sharper focus.
- Rotate the turret to set a high power (HP) objective lens in place. Only use the fine adjustment knob when using HP.



A light microscope

Preparing a wet mount slide

The following figure illustrates the best technique for making a wet mount slide.



Making a wet mount slide

BIOLOGICAL DRAWINGS

The following guidelines should help you to make simple and effective biological drawings.

- Drawings should be:
  – made in grey lead pencil
  – large
  – fully labelled with the name of the specimen, the type of preparation and the magnification
  – given a size perspective so that comparison between specimen sizes can be made—draw each specimen in relation to the size of the field of view observed.

- Lines to labels should be ruled—they should not have 'arrowheads' and should not cross over.
- Drawings of low power images do not show the detail of cells, just the 'area of cell types' (Figure 1).
- Drawings of images made under high power show detail of a few cells only of each type (Figure 2).

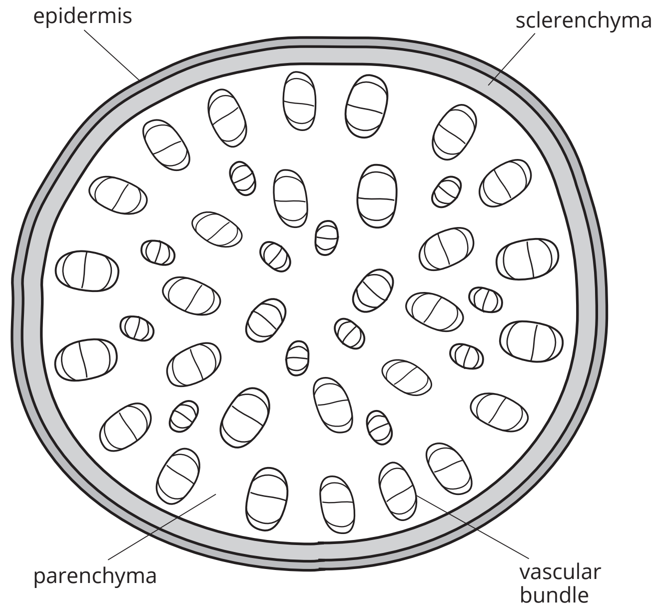


Figure 1 A low power view of zea maize cells (30×)

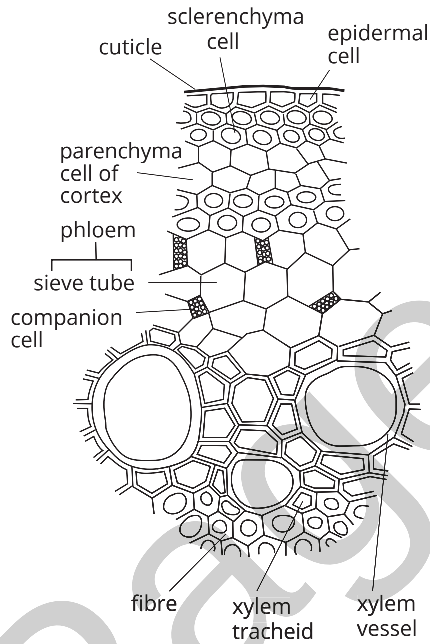


Figure 2 A high power drawing of zea maize cells (600×)

Techniques of monitoring and maintaining ecosystems

When studying ecosystems, it may be necessary to determine the type and number of living organisms in an area. For example, your investigation may look at the population of a particular species in two different areas. There are many different ways to do this, including using quadrats and transects.

QUADRATS AND TRANSECTS

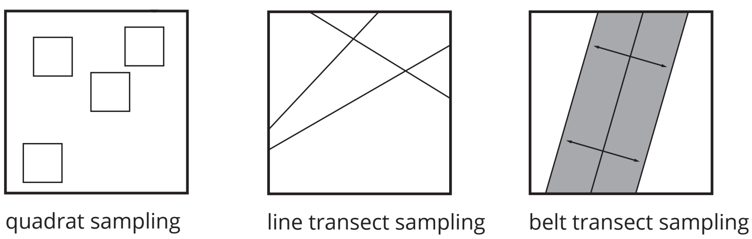
A **quadrat** is an area marked out with a frame for the purpose of gathering data related to populations of organisms in a given area.

- It is usually 1 m^2 but can be adapted to suit the specific ecosystem.
- A number of quadrats placed randomly around the habitat can provide a useful estimate of the presence, density and abundance of different species within the area.

A **transect** is a line marked out randomly through a habitat.

- Every organism on the line at regular intervals or within the transect is recorded.
- Variations in community composition throughout the habitat can be assessed.
- Line transects are time-efficient and can minimise disturbance to the environment. However, species of low density can be missed.
- Belt transects extend out a specific distance to either side of the line. They are time-intensive but can provide more accurate estimates of community populations.

Permanent quadrats and transects can be used to measure, estimate and predict changes in the diversity and abundance of populations over time.



Sampling methods: quadrat sampling, line transect sampling and belt transect sampling

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