Level

F	1	2	**3**	**4**	**5**	6	B6

*L*iving things reproduce

Strand
Life and Living

Key concept
Evolutionary processes have given rise to a diversity of living things which can be grouped according to their characteristics.

Purpose

Activities in this module are designed to help students to:

- understand that all living things reproduce;
- investigate similarities and differences in reproductive strategies.

Students have opportunities to:

- investigate the reproductive organs of plants and animals;
- design and perform investigations of plant pollination and growth;
- collect information and draw conclusions about reproductive strategies used by plants and animals;
- create graphs comparing reproductive strategies used by specific animals.

Overview of activities

The following table shows the activities in this module and the way in which these are organised in **introductory**, **developmental** and **culminating** phases.

Introductory ►	Developmental ►	Culminating
Reproduction	Pollinating a flower	Comparing reproduction
Parts of a flower	Seed dispersal and germination	
	Asexual (vegetative) reproduction	
	Courtship	
	External and internal fertilisation	
	Puberty	

QUEENSLAND SCHOOL CURRICULUM COUNCIL

Core learning outcomes

This module focuses on the following core learning outcomes from the Years 1 to 10 Science Syllabus:

Life and Living

3.2 Students present information which illustrates stages in different types of life cycles (including metamorphosis) of familiar living things.

4.2 Students identify and analyse similarities and differences in the ways that different living things reproduce.

5.2 Students evaluate different processes and strategies of reproduction (including asexual reproduction and care of young) in terms of their relative efficiency in ensuring survival of offspring.

Core content

This module incorporates the following core content from the syllabus:

Life and Living

Life cycles

- plant and animal

Reproductive processes

- sexual, asexual

Reproductive strategies

- parental care, numbers of offspring, eggs, courtship

Assessment strategy

Suggestions for gathering information about student learning are provided in each of the activities in this module. Once sufficient information has been collected, judgments can be made about students' demonstrations of outcomes. Typical demonstrations of this module's intended outcomes are provided here to indicate the pattern of behaviour to look for when making judgments.

Life and Living

3.2 Students present information which illustrates stages in different types of life cycles (including metamorphosis) of familiar living things.

Students may:

- demonstrate how pollination takes place;
- demonstrate how a plant reproduces asexually;
- identify the changes that take place in males and females at puberty.

Life and Living

4.2 Students identify and analyse similarities and differences in the ways that different living things reproduce.

Students may:

- discuss and describe methods of pollen transfer and seed dispersal in various plants;
- identify differences between sexual and asexual reproduction;
- compare external and internal fertilisation;
- create presentations on the reproductive behaviours of specific animals;
- compare reproductive strategies in various animals.

Life and Living

5.2 Students evaluate different processes and strategies of reproduction (including asexual reproduction and care of young) in terms of their relative efficiency in ensuring survival of offspring.

Students may:

- compare survival of offspring resulting from external and internal fertilisation;
- compare the number of offspring produced by various animals and relate this to how they care for their young.

Background information

Current scientific conceptions

All living things reproduce. Sexual reproduction involves a female sex cell and a male sex cell. Fertilisation is the process in which the male and female sex cells unite to create a new organism with characteristics from both parents. This process is common to both plant and animal groups.

Sexual reproduction leads to genetic variability. Genetic variability maximises the survival of populations of species in various environments. Animals are able to move around to find mates and thus maintain genetic variation within populations. They are also able to leave areas where conditions are no longer suitable for survival. Individual plants cannot move around as animals do. As a group, however, they have many different processes and strategies to maximise opportunities for reproduction and species survival. These include:

- cross-pollination, which maintains genetic variability in species;
- effective seed dispersal, which leads to species colonising a wide variety of environments.

Plants

This module mostly deals with reproductive strategies in angiosperms (flowering plants), but even this group alone is too diverse for all the reproductive strategies to be covered. An angiosperm's reproductive organs are in the flower. The central stalk of the flower is called the **pistil** and is made up of the **stigma** at the top and the **ovary** at the bottom. The ovary contains **ovules**, each of which contains a **female cell** (egg or ovum). When fertilisation occurs, the ovules become the seeds and the ovary develops into the fruit containing the seeds. Thin, stalk-like structures called **stamens** surround the pistil. These are the male parts of the flower. The top part of the stamen, which is called the **anther**, produces **pollen**. Pollen contains the **male cells** of the flower.

Pollination is the act of transferring pollen from the anther to the stigma. Pollination is assisted by wind, water, insects, birds and small mammals.

Flowers pollinated by the wind have feathery stigmas that trap pollen from the air. Grasses are examples of plants pollinated by wind. Plants that people are allergic to are often wind pollinated. Pollens from these plants are in the air and cause reactions in people's respiratory and immune systems.

Aquatic plants usually release their pollen into water. The water then carries the pollen to another plant.

Some flowers have certain features that attract birds, insects and various mammals such as bats, small gliders and small possums. These features include colourful or patterned petals, enticing scents and/or nectar (a sweet liquid secreted by special glands in the flowers). Pollen attaches to the bodies of animals as they feed on the nectar and is carried to other plants when they move on to feed elsewhere. Flowers pollinated by animals often have sticky stigmas. Pollen carried on the bodies of the animals adheres to the sticky stigmas.

Fertilisation occurs when the male cell from the pollen grain reaches the female cell. A seed is a fertilised ovule and contains the embryo (the young organism) and a food store for the developing embryo. Plants have many different methods of dispersing seeds (see p. 12). Germination is when the seed begins to develop. This process is usually not visible because the seeds are embedded in soil.

Plants also reproduce asexually or vegetatively (see pp. 15–16). Suckers, tubers, bulbs and runners are natural forms of asexual reproduction. People also reproduce plants using cuttings.

Animals

In animals, fertilisation occurs either externally or internally. External fertilisation takes place when the **female cells** (**eggs** or **ova**) are released into the environment and the **male cells** (**sperm**) are released onto them. This occurs with many aquatic organisms such as fish and frogs. Internal fertilisation occurs inside the female, with the male delivering the sperm into the female.

Students' prior understandings

Students may have varying ideas about reproduction. Some students may know nothing about the topic, some may be well informed and others misinformed.

Students' prior understandings may differ from current scientific conceptions in a range of ways.

Plants

Some students may think that:

- plants are boring because they do not 'do' anything;
- plants reproduce only by seed;
- seeds are just a part of the plant and not the result of sexual reproduction;
- all flowers are big, bright and showy;
- tomatoes, cucumbers and pumpkins are vegetables (they are in fact fruits of the plants);
- flowers are produced only to make the plant look attractive.

Teachers can help students to expand their conceptual understandings by highlighting the different adaptations evident in flowering plants.

Animals

Some students may think that:

- animals other than humans do not have courtship behaviours or take care of their young;
- there is no proper way to discuss the reproductive system.

Teachers can enhance students' understandings by raising their awareness of different types of animals and reproductive behaviours. Encouraging students to use correct terminology will also help them to clarify concepts and ideas about reproduction.

Supportive environment

Teachers need to provide a safe and supportive learning environment so that students feel comfortable dealing with this topic. As developing such an environment takes time, this module should not be undertaken early in the school year.

Terminology

Terms associated with reproduction are essential to the activities in this module — for example:

anther	nectar	sexual reproduction
asexual reproduction	ovary	sperm
courtship	ovule	stamen
fertilisation	ovum	stigma
filament	pistil	style
germination	pollination	vegetative reproduction
gestation period	puberty	
menstruation	seed	

Students may already be familiar with some of these terms and understand their meanings and use in scientific contexts. If so, the activities in this module will provide opportunities for them to evaluate current usage. If not, these activities will provide opportunities for students to develop their understandings.

School authority policies

Teachers need to be aware of and observe school authority policies that may be relevant to this module.

Safety policies are of particular relevance to some activities that follow. It is essential that demonstrations and student activities are conducted according to procedures developed through appropriate risk assessments at the school.

In this module, teachers need to consider safety issues relating to:

- the use of knives for dissecting flowers and taking cuttings from plants;
- the use of potting mix;
- allergies students may have to plants, pollens and insects attracted to some plants.

It may be advisable to send a letter to parents/carers informing them of the content of this module. They may wish to discuss some of the topics studied during activities with their children at home.

Support materials and references

Personal Development 1997, kit (video, activity cards, booklets, samples and teacher's notes), Johnson & Johnson, Professional and Educational Services, Sydney.

Queensland Department of Education 1983, *Primary Science Sourcebook: Activities for Teaching Science in Year 7*, Brisbane.

Sexual Encounters of the Floral Kind: An Investigation into the Extraordinary Sex Life of Plants, video (48 min), Oxford Scientific Films, Great Britain. (Distributed by Educational Media Australia.)

The Wonder of Living 1989, kit (three videos, information sheets and a teacher's manual; includes a video on puberty titled *I'm Stepping Out*), P. A. C. Educational Services, Ringwood, Vic. Available from the Film and Video Library, Education Queensland, telephone: (07) 3406 2455, email: oau.fvlinfo@qed.qld.gov.au, reference no. A10811877.

ACTIVITY

Reproduction

Introductory

Focus

This activity provides opportunities for students to clarify basic ideas about reproduction.

Materials

No particular materials are required.

Teaching consideration

Consider having a question box in the classroom. Students can submit anonymous questions and avoid possible embarrassment. Questions could be answered during the module when relevant to concepts being studied or at specific times during activities.

Working scientifically

Time: 20 minutes

Clarifying and challenging
Exploring phenomena
Discussing thinking
Exploring and elaborating ideas
Listening and questioning

▶ Students discuss the meaning of the word 'reproduce'. Questions to guide discussion could include:

- What does it mean to reproduce a page of writing or a painting?
- What smaller word is part of the word 'reproduce'? (produce) What does this mean?
- What does the prefix 're' mean?

▶ Students discuss the meaning of sexual reproduction. Terms that could be introduced during discussion include:

- male and female sex cells;
- egg;
- sperm;
- pollen;
- fertilisation.

Gathering information about student learning

Sources of information could include:

- students' contributions to discussions.

ACTIVITY

Parts of a flower

Introductory

Focus

This activity provides opportunities for students to identify the reproductive parts of a flower.

Materials

For each group:

- large simple flower that shows all the reproductive parts (e.g. lily, hibiscus)
- selection of flowers with different characteristics (e.g. grasses, *Callistemon*)
- craft knife
- hand lens
- coloured pencils (to match the colours of chosen flowers)

For each student:

- Resource Sheet 1, 'Diagram of a flower'

Teaching considerations

Assistance with observations

Students find it difficult to 'see' things through hand lenses and need to be taught how to make observations using these tools. A large diagram representing the pollen on the anther will help them make the observations required for this activity.

Some students with vision impairment may need assistance for this activity. Seek advice from their support teacher.

Safety

Students should identify any flowers or plants to which they might have an allergic reaction.

Inform students about safe practices for using knives — for example:

- Cut on mats or thick wads of newspaper.
- Always carry the knives in sheaths.

Working scientifically

Time: 45 minutes

Handling materials
Identifying
Making observations
Dealing in an orderly manner with the parts of a complex whole

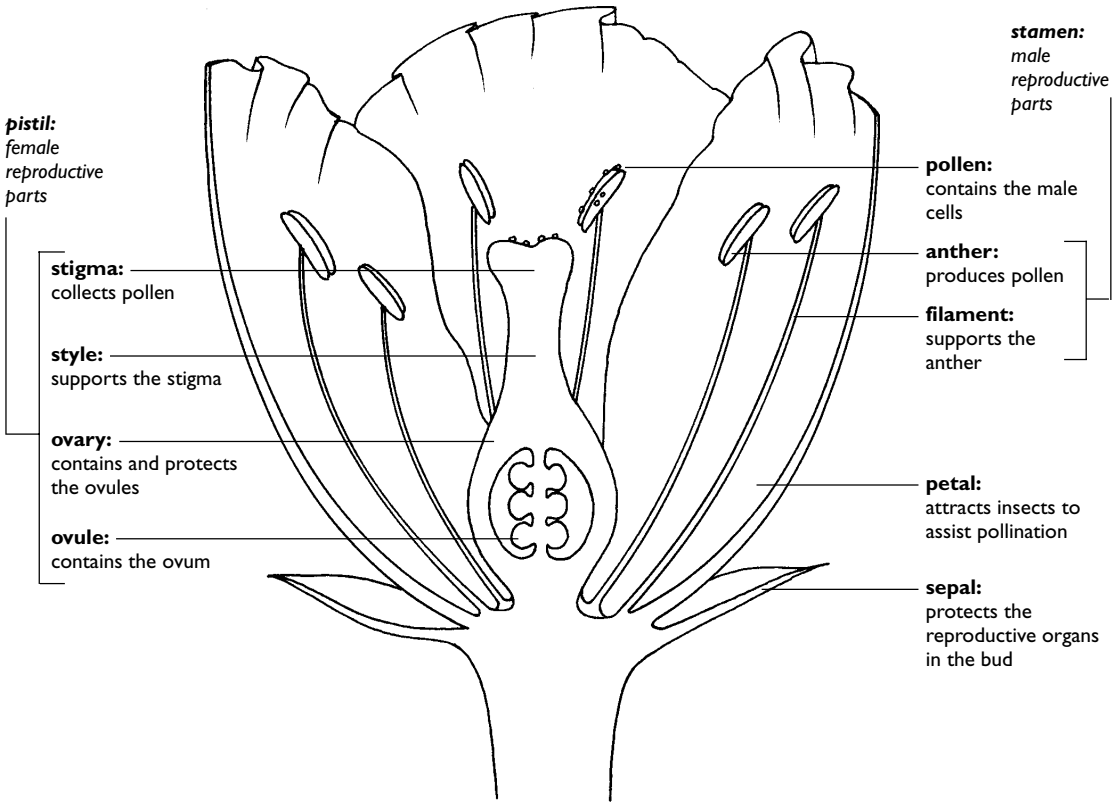
▶ Students form small groups and with teacher guidance examine the large simple flower:

- The teacher points out the stamen, which is the male part of the flower, with the anther at the top. Students discuss their observations of the anther (they should recognise the loose powder as pollen). The teacher explains that the pollen contains the male cells.
- The teacher points out the pistil and explains that this is the female part of the flower. Students discuss their observations of the pistil. They may notice that the tip (stigma) is a little sticky or wet (they may be able to infer that it is sticky to allow the pollen to stick to it) and that the base of the pistil is swollen (this part is the ovary).

▶ Students remove the pistil from the rest of the flower and cut it lengthwise. They should be able to see the ovules inside the ovary (when fertilised, the ovules will turn into the seeds).

Resource Sheet 1

▶ Students label and describe the functions of the reproductive parts on the flower diagram (Resource Sheet 1), colour the parts realistically and indicate whether these are male or female.



▶ Using the same approach, students investigate the reproductive parts of other types of flowers. Possibilities include:

- wind-pollinated flowers — for example, grasses;
- flowers in which the stamens rather than the petals are the dominant feature — for example, *Callistemon* and *Eucalyptus*.

Gathering information about student learning

Sources of information could include:

- students' contributions to discussions;
- students' labelled diagrams of flowers.

ACTIVITY

Pollinating a flower

Developmental

Focus

This activity provides opportunities for students to design and perform an investigation of plant pollination.

Materials

For each group:

- 2 potted plants with flowers that have easily visible pistils and stamens (e.g. hibiscus, lily, pumpkin, squash)
- cotton swab and small paint brush
- labels
- hand lens

For each student:

- Resource Sheet 2, 'Planning and reporting worksheet'

Teaching considerations

The investigation

Each group will pollinate only one of the flowers supplied; the other flower will act as the control. Students could use cotton swabs or paint brushes to transfer the pollen or simply cut off an anther and touch it to the stigma. They may devise other methods if they wish.

After pollination, students need to remove the anthers from both the pollinated flower and the control flower. This will prevent the control flower from being pollinated after the investigation begins.

In some species, the petals and stamen of the flower wilt and die very soon after pollination (and successful fertilisation). Flowers that have not been pollinated survive longer. This is not the case with hibiscuses and some lilies. Flowers of these plants last only one day.

It may take a week or more before the ovary of the pollinated plant swells, indicating that the seeds are developing.

Safety

Students should identify any flowers or plants to which they might have an allergic reaction.

Working scientifically

Time: 45 minutes to set up the investigation; 5–10 minutes per recording session at regular intervals

Designing and performing investigations

Handling materials

Dealing in an orderly manner with the parts of a complex whole

Using scientific report genres

► In groups, students design an investigation to study changes that take place in a flower following pollination. As they discuss their design, students may need to be reminded of the following:

- only one of the flowers should be pollinated — the other flower is the control;
- only the pollen is transferred to the stigma.

Resource Sheet 2

▶ Students complete the first sections of the planning and reporting worksheet on Resource Sheet 2 up to the observation chart. They then pollinate the flowers and label the pots to indicate which flower was pollinated and which was not.

▶ Students observe changes in their flowers during the next few days or weeks and record these in the observation chart on the planning and reporting worksheet.

▶ When the fruit has formed, students cut it open and observe the seeds inside. They then report on and evaluate their investigations by completing the worksheet.

Gathering information about student learning

Sources of information could include:

- students' planning and reporting worksheets.

ACTIVITY

Seed dispersal and germination

Developmental

Focus

This activity provides opportunities for students to make links between:

- characteristics of fruits and seeds and the way seeds are dispersed;
- parts of the seed and structures that appear during germination.

Materials

Part 1

For each learning centre:

- a variety of seeds and fruits from known plants (pictures may be used if fresh specimens are not available)
- hand lens or magnifier

Part 2

For each group of students:

- 4 bean seeds (1 for examination; 3 for planting)
- a beaker or clear, straight-sided jar
- sand (enough to fill the beaker or jar)
- paper towels
- water
- labels

Teaching considerations

Part 1: Seed dispersal

Encourage students to collect seeds or fruits for Part 1 of this activity and set up learning centres where they can observe each of the specimens. Try to provide a variety of types to broaden students' perceptions of seeds. Also ensure that some of the seeds are large or textured to enable students with vision impairment to participate in the activity.

Following are examples of seeds that could be used:

- water-dispersed seeds — mangrove species, coconut, pandanus, sea hibiscus (*Hibiscus tiliaceus*, coast cottonwood);
- wind-dispersed seeds — pine, jacaranda, dandelion, flowers with thistle-like heads, she-oak (*Casuarina*), coastal banksia (*Banksia integrifolia*);
- mechanically dispersed seeds — acacia, bean, milkweed, bauhinia;
- seeds dispersed by animals — fig, apple, strawberry, capsicum, pear, orange, tomato, watermelon, mulberry, cobblers' pegs, spinifex.

Water-dispersed seeds are able to float. Wind-dispersed seeds have 'wings' or 'parachutes'. Mechanically dispersed seeds are often in pods that dry out and 'explode'. When this happens, the seeds are scattered a considerable distance.

Seeds dispersed by animals may have burrs or hooks. These attach to the fur of passing animals and are carried and later deposited some distance from the parent plant.

There are also seeds that are encased in a soft, sweet, fleshy fruit that animals eat. The animals eat the seed along with the rest of the plant but cannot digest it because of its hard coat. The seed is eventually deposited in the nutrient-rich droppings of the animal, far away from the parent plant.

Part 2: Seed germination

Bean seeds are available from plant nurseries and supermarkets. Large seeds like these are best for examination of the parts. However, other seeds (for example, tomato seeds or capsicum seeds) could be used to illustrate germination. If different seeds are used in the two parts of this activity, explain that most seeds have similar parts.

Soak the bean seeds for 12 hours before the lesson.

Safety

Students should identify any flowers or plants to which they might have an allergic reaction.

Working scientifically

Time: Part 1, 45 minutes; Part 2, 20 minutes for examination and planting plus 5–10 minutes for observation over a 2-week period

Handling materials
Making observations
Looking for patterns
Constructing meaning
Generalising
Suggesting
Creating presentations
Predicting

Part 1: Seed dispersal

▶ In the class group, students discuss the purpose of seeds and the advantage of a species having strategies or mechanisms for seed dispersal. Questions to guide discussion could include:

- What are the functions of seeds?
- What do you think would happen if all the seeds from a plant landed on the ground beside the parent plant?
- What advantages for the plant would there be if the seeds could be dispersed widely?
- Individual plants are not able to move. How, then, are they able to disperse their seeds?

▶ In groups of two or three, students move round the learning centres and, at each one, do the following:

- examine the seed or fruit;
- draw a diagram of the seed or of the fruit with its seeds;
- name the plant from which the fruit/seed was collected;
- describe the characteristics of the fruit/seed;
- suggest ways in which the seeds could be dispersed.

▶ Each group prepares and presents a report about one of the seeds or fruits identifying its characteristics and explaining how these characteristics could be seen as adaptations. Students discuss these adaptations and how they relate to seed dispersal.

▶ Students compile a list of adaptations that plants have to ensure their seeds are dispersed. Questions to guide thinking could include:

- Which seeds do you think are dispersed by water/wind/mechanical means/animals?
- Which characteristics of the seeds made you think this?

Part 2: Seed germination

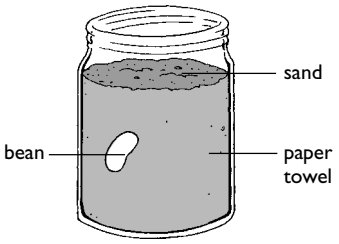
▶ In groups, students examine and describe the parts of one of the presoaked bean seeds. They make suggestions about the function of each part and predict what will happen to each part as the seed germinates. Questions to stimulate discussion could include:

- Is the seed the same throughout?
- What do different sections look like?
- What do you think the skin on the outside is for?
- Is there a part that looks a little like a mini-plant?
- From where will the seed get energy to grow?

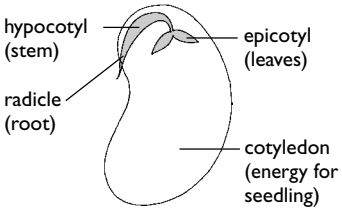
▶ Each student draws a picture of the bean seed and labels it to show the functions of the various parts (for example, energy source, protection) or what the parts might turn into (for example, leaves, stem, roots).

▶ In groups, students plant the other three seeds to determine if they were correct in their predictions about what would happen to the various parts. Following are directions for planting:

1. Place a paper towel around the inside edge of a beaker or jar and fill it with sand. (This will keep the paper towel and the seeds in place.)
2. Place the beans between the paper towel and the beaker so that they are visible through the glass.
3. Water the seeds so that the sand is completely wet. Label the beaker and put it in a safe place.



▶ Students examine the seeds every second day until the leaves and roots are obvious. They then discuss whether their predictions were correct and either revise their earlier drawings of a seed and its parts or draw a new diagram.



Gathering information about student learning

Sources of information could include:

- students' reports about seeds/fruits;
- students' contributions to group work;
- students' contributions to discussions;
- students' drawings of parts of the seeds.

ACTIVITY

Asexual (vegetative) reproduction

Developmental

Focus

This activity provides opportunities for students to observe and gather information about plants with different techniques of asexual (vegetative) reproduction.

Materials

- variety of plants that can reproduce asexually (vegetatively)
- Resource Sheet 3, 'Vegetative reproduction' (for each student)

For each planting station:

- plants with the same technique of asexual reproduction
- small pots (at least 1 per student)
- knives (for cuttings)
- potting soil
- growth hormone to stimulate root growth
- water
- labels
- Resource Sheet 4, 'Planting stations: Sample instruction cards'

Teaching considerations

Planting stations

Set up a planting station for each type of vegetative reproduction chosen for investigation. Not all the techniques need to be covered, but each student should have the opportunity to plant one specimen. Consider using an outside area for the planting stations or arrange an area indoors that can be easily cleaned.

Resource Sheet 4

Have an instruction card at each planting station showing the name of the plant, the technique of asexual (vegetative) reproduction and instructions for planting. Examples are provided on Resource Sheet 4.

Asexual (vegetative) reproduction

Asexual reproduction is reproduction that does not involve the fusing of male and female sex cells (gametes). This type of reproduction occurs in many plants and some animal groups. The term 'vegetative reproduction' is used to describe asexual reproduction in plants.

The following are various means of vegetative reproduction:

- **bulb:** specialised underground reproductive organ consisting of a short stem bearing a number of swollen, fleshy leaf bases enclosing the next year's bud — for example, lilies, onions, chives;
- **rhizome:** thick horizontal stem usually underground, sending shoots above and roots below — for example, flax lily (*Dianella*), cunjevoi lily (*Alocasia*), native ginger (*Alpinia coerulea*), bracken fern (*Pteridium*), *Lomandra*;
- **stolon:** creeping plant stem capable of developing rootlets and a stem — for example, spider plant (*Chlorophytum*), native violet (*Viola hederacea*);
- **runner:** specialised stolon consisting of a prostrate stem rooting at the node and forming a new plant that eventually becomes detached from the parent — for example, strawberry plants, some grasses such as spinifex;
- **sucker:** branch of a stem, at first running underground and then emerging, which may eventually form an independent plant — for example, mint, *Dampiera*, *Scaveola*, *Helichrysum*;

- **tuber:** thickened, fleshy, food-storing, underground root or stem with surface buds — for example, potato, dahlia;
- **cuttings:** parts of leaves or stems that have been cut from the parent plant to reproduce an entire new plant. Nurseries frequently use this method of vegetative reproduction to propagate large numbers of a plant quickly. Many different plants can be propagated by cuttings — for example, impatiens, hibiscus and African violet.

Safety

Students should identify any flowers or plants to which they might have an allergic reaction.

Inform students about safe practices for handling commercial potting mix — for example:

- Check warnings on the packaging.
- Avoid breathing in dust and spores.
- Wash hands after using the mix.

Inform students about safe practices for using knives — for example:

- Cut on mats or thick wads of newspaper.
- Always carry the knives in sheaths.

Working scientifically

Time: 40–60 minutes

Exploring phenomena
Handling materials
Making observations
Applying ideas and concepts
Drawing conclusions
Making comparisons
Creating presentations
Using scientific terminology

Resource Sheets 3, 4

▶ In the class group, students brainstorm a list of ways they have seen new plants start, other than from seeds. They observe specimens of the different methods and classify these using the pictures on Resource Sheet 3.

▶ The teacher introduces the terms 'vegetative reproduction' and 'asexual reproduction' and explains that in the context of plants, these have the same meaning. Guided by the teacher, students discuss differences between asexual and sexual reproduction.

▶ In small groups, students visit at least two planting stations. They should follow the instructions for planting at each one and record details of what they planted (see Resource Sheet 4).

▶ Students discuss ideas about their investigation of asexual reproduction and devise a plan that includes:

- how to care for their plants;
- how to compare the different types of vegetative reproduction;
- the length of time for observation;
- methods of recording observations.

▶ After the agreed observation period, students collate their results and create presentations that illustrate differences between the two types of vegetative reproduction. They then record what they have learnt from the investigation.

Gathering information about student learning

Sources of information could include:

- students' contribution to discussions;
- students' presentations;
- students' statements about the investigation.

ACTIVITY

Courtship

Developmental

Focus

This activity provides opportunities for students to collect information about courtship behaviours and other aspects of the reproductive process in animals.

Materials

- a selection of print and electronic resources about reproduction

Teaching considerations

Preparation

Compile a list of animals that have interesting courtship behaviours and/or unusual ways of caring for their young. Base the list on resources available in the school and try to make it extensive enough to allow each student to research a different animal. Include a variety of animals including birds, placental mammals, marsupials, monotremes, insects, reptiles, amphibians and fish. Some examples are:

- **birds:** bird of paradise, cuckoo, bowerbird, megapodes (mound builders like the brush turkey), red phalarope, penguin, crane, lyrebird, apostle bird, babbler;
- **insects:** antler fly (*Phytalmia*) (bird of paradise of the insect world), bessbug, praying mantis, dung beetle, bed bug (traumatic insemination), dragonfly (mate protection, removal of spermatophores from other males);
- **other:** funnel-web spider, scorpion, crocodile, stickleback (fish).

Using resources

Ensure that students are aware of and know how to use all resources available. A lesson on how to use and reference various resources may be beneficial.

Working scientifically

Time: 3–5 hours of class time for research sessions; 1–2 hours for presentations

Accessing resources
Collecting information
Exploring phenomena
Creating presentations
Describing
Summarising and reporting
Using scientific report genres
Using scientific terminology

▶ Students discuss their observations of courtship behaviours in animals and/or pictures they have seen of such behaviours. They suggest how these behaviours benefit the species.

▶ Students discuss how various animals take care of:

- the female of the species during pregnancy;
- the young after birth.

▶ Students each select an animal to study from the list prepared by the teacher. They could negotiate their selections or draw them from a container holding the names on slips of paper. Students collect information from a range of resources about the reproductive strategies of their chosen animals. Questions and directions to guide research could include:

- What is the name of your animal?
- What is the scientific classification of this animal? (class, order, family, genus, species)
- What size is the animal when it is a full-grown adult? (This may be different for males and females.)
- How old is the animal before it is ready to mate — that is, when is it sexually mature? How is sexual maturity recognised?

- Describe the courtship behaviours of the animal before mating. For example, are there dances, special movements, gift giving?
- How long do the courtship rituals last?
- Describe the animal's nesting (home-making) behaviour.
- Describe any territorial behaviour the animal exhibits.
- Describe any hierarchy within the animal group and/or differences in the behaviour of young and old adults.
- How do members of the same species recognise each other? How do males of the species recognise the females?
- What is the animal's gestation period — that is, for how long is the female pregnant?
- How many offspring are born at one time?
- How long do the parents care for the young and what care do they provide?

▶ Students prepare and present individual reports about the animals studied using information from at least three different types of sources. These could be in various formats — for example, information report, video, PowerPoint presentation, poster. Presentations could be judged by peers as well as the teacher. Criteria could include:

- information collected;
- application of ideas and concepts related to the reproductive process and care of the young;
- synthesis of information from a variety of sources;
- presentation of information in a manner that clarifies relevant ideas and concepts;
- correct and appropriate use of scientific terminology.

Additional learning

▶ This module could be linked to a visit to a zoo or the young animal section of the local agricultural show.

Gathering information about student learning

Sources of information could include:

- students' contributions to discussions;
- students' collection, analysis and synthesis of information;
- students' presentations;
- students' evaluations of their peers' presentations.

ACTIVITY

External and internal fertilisation

Developmental

Focus

This activity provides opportunities for students to observe and compare external and internal fertilisation.

Materials

- videos showing internal and external fertilisation
- aquarium with frogs or toads (optional)

Teaching considerations

Ensure that correct terminology is used during class discussions.

Videos could be used for students' observation of both methods of fertilisation. It may also be possible for students to observe external fertilisation among frogs or toads in an aquarium in the classroom. Putting a male and female frog or toad together should lead quickly to amplexus (mate holding). If conditions are appropriate and the female is ready, eggs may then be laid and fertilised. However, breeding in captivity is often difficult.

Working scientifically

Time: 45 minutes (depending on lengths of videos)

Making comparisons
Suggesting
Using scientific terminology
Exploring phenomena
Looking for patterns and meanings
Seeking reasons
Drawing conclusions
Clarifying ideas and concepts
Discussing thinking

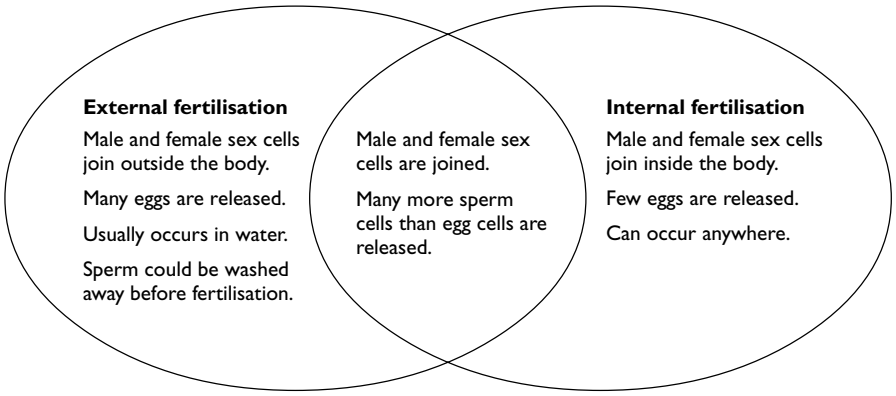
► Students view a video showing external fertilisation — for example, frogs or coral spawning. Alternatively, students may be able to observe frogs or toads spawning in an aquarium. Questions to guide the subsequent discussion could include:

- How do the male cells get to the female cells?
- What are the possible problems of external fertilisation?
- How do the animals you observed overcome these problems?
- What are the benefits of external fertilisation?
- What other animals have external fertilisation? (fish, many insects, scorpions)
- What do many of these animals have in common? (aquatic environment) Why?
- How might these animals overcome the problems of external fertilisation?

► Students view and discuss a video showing internal fertilisation — for example, insects or birds mating. The above set of questions (adapted as necessary) could be used to guide discussion.

► Students make a list of points about external fertilisation and a comparable list about internal fertilisation and use these to create a Venn diagram. Students may need to be reminded that the centre section of the diagram is for overlapping information — that is, information relevant to both types of fertilisation. The sample diagram on the next page shows some of the points that could be included.

External and internal fertilisation



Gathering information about student learning

Sources of information could include:

- students' contributions to discussions;
- students' Venn diagrams.

ACTIVITY

Puberty

Developmental

Focus

This activity provides opportunities for students to collect information on puberty.

Materials

- video(s) on puberty (see 'Support materials and references', p. 6)
- Resource Sheet 5, 'Menstrual cycle' (for each student)

Teaching considerations

Ensure that correct terminology is used during class discussions.

Some students with hearing impairment may need assistance for this activity. Seek advice from their support teacher. Videos with captions are available from the Film and Video Library, Education Queensland (telephone: (07) 3406 2455; email: oau.fvlinfo@qed.qld.gov.au).

Working scientifically

Time: 45 minutes

Identifying
Examining and evaluating
Making comparisons
Relating

▶ Students view a video about changes that occur during puberty. They discuss the changes noted while viewing and compile these in a table like the one below.

Changes during puberty

Boys	Girls

▶ If the video contains a section on stages of the menstrual cycle, students can make notes about this and complete Resource Sheet 5.

Gathering information about student learning

Sources of information could include:

- students' tables showing changes during puberty;
- students' worksheets on the menstrual cycle.

ACTIVITY

Comparing reproduction

Culminating

Focus

This activity provides opportunities for students to compare features of reproduction in different mammals and to identify relationships between these features.

Materials

- a selection of print and electronic resources about reproduction in mammals

Teaching considerations

Collecting information

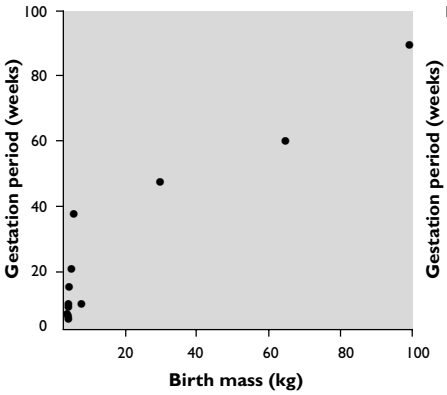
Each student should collect information about a different mammal so that comparisons can be based on a reasonably large sample.

Presenting information

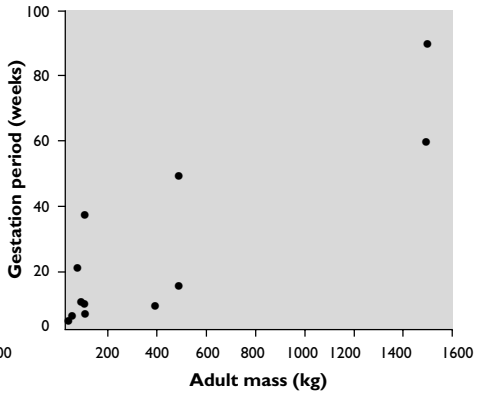
The following table and scattergrams (graphs) are examples of ways that students could collate and present information:

Features of reproduction in mammals

Animal	Mass at birth (kg)	Mass of adult (kg)	Gestation period (weeks)
Mouse	0.05	0.5	3.0
Red kangaroo	<0.001	70.0	5.0
Grey wolf	0.5	45.0	9.0
Grizzly bear	0.5	400.0	8.0
Rabbit	0.5	5.0	3.5
Tiger	1.0	500.0	14.0
Sheep	2.0	50.0	21.0
Human	3.0	70.0	38.0
Lion	6.0	40.0	9.0
Horse	30.0	500.0	48.0
Giraffe	65.0	1500.0	60.0
Elephant	100.0	1500.0	90.0



Relationship between birth mass and gestation period



Relationship between adult mass and gestation period

These scattergrams show the relationship between the gestation period of an animal and its birth mass and adult mass. Students could also identify relationships between:

- length of courtship and period of parental care;
- mass of an animal and its age of sexual maturity;
- mass of an animal and the number of offspring it has.

Interpreting information

It is important for students to understand that although their scattergrams may show certain relationships, these may not apply to all animals. Using more animals would give a better indication of the range of the relationships. It is also important for students to realise that the relationships are not necessarily cause-and-effect relationships. For example, just because an animal is large, it does not necessarily have a long gestation period.

Working scientifically

Time: 2 hours

Accessing resources
Collecting information
Constructing meaning
Drawing conclusions
Creating tables and graphs

▶ Students discuss ways in which reproduction in mammals varies. They list features that may be related — for example:

- mass;
- gestation period;
- length of courtship;
- length of parental care after birth;
- number of offspring;
- age of sexual maturity;
- environment in which the animals live (land, water, air);
- environmental conditions (food availability, temperature, need for water).

▶ Students discuss ways of comparing these features and brainstorm a list of animals they wish to investigate. Each student researches one of the animals and completes the relevant section of a large table prepared for the collation of everyone's information. The following table shows examples of animals and features for research.

Features of reproduction in mammals

Animal	Mass	Gestation period	Length of courtship	Length of parental care	Number of offspring
Mouse					
Red kangaroo					
Elephant					

▶ Individually or in pairs, students use information from the table to create a scattergram (graph) about two features that they wish to compare.

▶ Students display their scattergrams and discuss the relationships these show. Discussion starters could include:

- What relationships are clearly evident in the scattergrams?
- Describe the characteristics of the scattergram that suggest there is a relationship between one feature and another feature.
- What evidence is there that not all animals fit this pattern?
- In what ways might the relationship between these features of reproduction be an advantage for the animals?

Additional learning

▶ Students could:

- compare reproductive processes and care of the young in different vertebrate groups;
- discuss ways that animals other than mammals (for example, insects) provide for their young to maximise chances of survival.

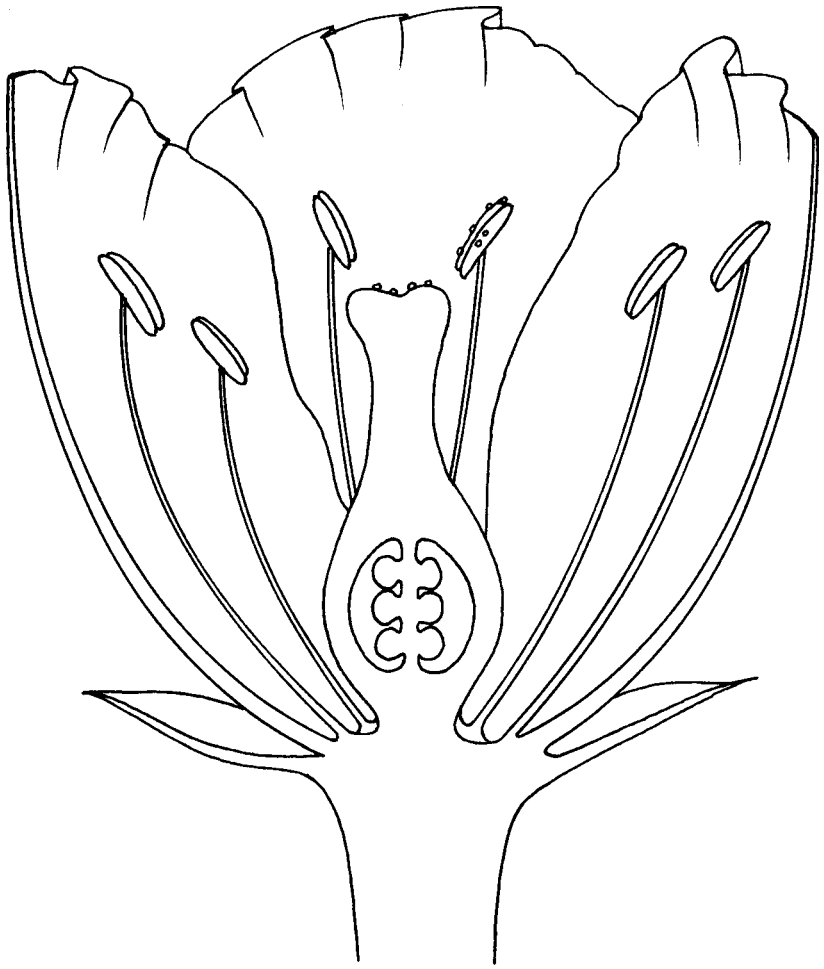
Gathering information about student learning

Sources of information could include:

- students' contributions to discussions;
- students' contributions to the table about features of reproduction;
- students' scattergrams (graphs).

Diagram of a flower

Label and describe the functions of the reproductive parts of the flower shown in this diagram. Colour the parts realistically and indicate whether these are male or female.



Planning and reporting worksheet

Resource Sheet 2

Name: _____ Class: _____

Other members of your group: _____

_____

What are you going to investigate?

_____

_____

_____

What do you think will happen?

_____

_____

_____

The flower that is to be left untouched is called the 'control'. Why is this flower left untouched?

_____

_____

_____

What equipment will you need?

_____

_____

_____

(continued)

Planning and reporting worksheet *(continued)*

Write in the date and describe what you see and any changes that occur in the two flowers.

Observation chart

Date	Control flower	Pollinated flower

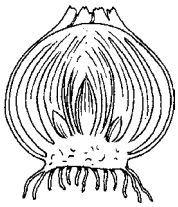
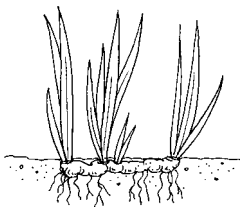
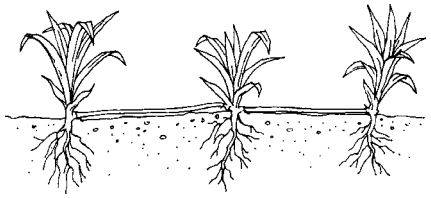
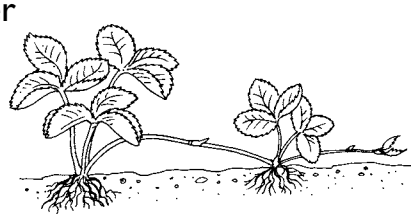
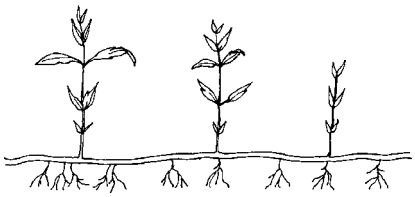
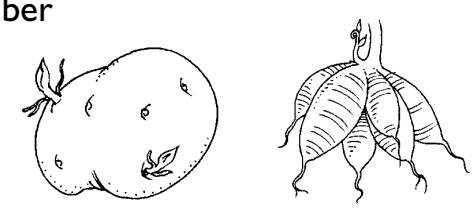
What do your observations tell you?

Was the outcome different from your prediction? Explain.

What difficulties did you experience doing this investigation?

How could you improve this investigation?

Vegetative reproduction

Techniques of vegetative reproduction	Plants that use the technique
Bulb 	
Rhizome 	
Stolon 	
Runner 	
Sucker 	
Tuber 	

Planting stations: Sample instruction cards

R4 Resource Sheet 4

LIVING THINGS REPRODUCE • UPPER PRIMARY

Station 1: Mint — sucker

- Gently clip off one of the small sucker plants that are growing from the mint.
- Take a pot of soil that is packed down and make a small hole in it.
- Place the sucker plant in the hole so its base is covered and pack the soil around it.
- Label and water your plant.

✂-----------------------------------

Station 2: Spider plant — stolon

- Gently clip off one of the small plants that are growing from the stolons of the spider plant.
- Take a pot of soil that is packed down and make a 2 cm hole in it.
- Place the clipping in the hole so that its base is covered and pack the soil around it.
- Label and water your plant.

✂-----------------------------------

Station 3: Potato — tuber

- Select one of the potato pieces (it will have an 'eye' in it).
- Take a pot of soil that is packed down and make a 3 cm hole in it.
- Place the piece of potato in the hole. Fill in the hole with soil.
- Label and water your plant.

✂-----------------------------------

Station 4: Onion — bulb

- Select an onion.
- Take a pot of soil that is packed down and make a 3 cm hole in it.
- Place the onion in the hole with the pointed end up. Fill in the hole with soil.
- Label and water your plant.

✂-----------------------------------

(continued)

Planting stations: Sample instruction cards *(continued)*

Station 5: Impatiens — cutting

- Measure 10 cm from the tip of a branch of the impatiens plant.
- Find a node (or swelling) near the 10 cm mark.
- Cut the branch through the node at an angle.
- Place the branch in a container of water with your name on it.

✂– –

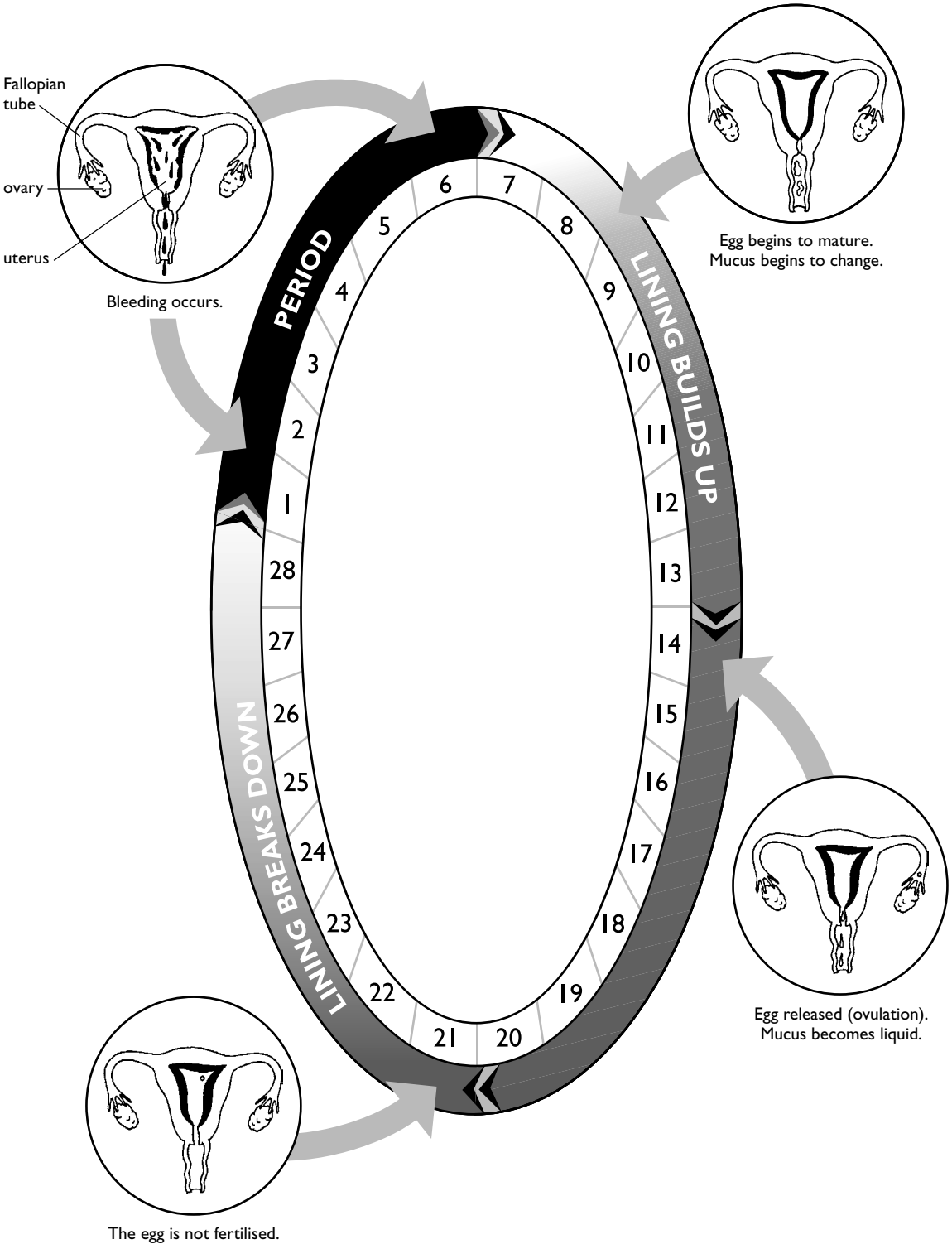
Station 6: Impatiens — cutting with growth hormone

- Measure 10 cm from the tip of a branch of the impatiens plant.
- Find a node (or swelling) near the 10 cm mark.
- Cut the branch through the node at an angle.
- Dip the end in the growth hormone.
- Take a pot of soil that is packed down and make a 3 cm hole in it.
- Place the branch in the hole and pack down the soil around it.
- Label and water your plant.

✂– –

Menstrual cycle

Study the diagram and answer the questions that follow.



(continued)

Menstrual cycle *(continued)*

Another name for menstruation is _____

The process where an ovum (egg) is released into the Fallopian tube is called _____

Why does the lining of the uterus thicken?

What happens in the uterus if the ovum is not fertilised?

What happens in the uterus if the ovum is fertilised?

Acknowledgments

This module is based on material developed by Angela Skevington who attended a module writing workshop organised by the Science Teachers' Association of Queensland and the Queensland School Curriculum Council.

This sourcebook module should be read in conjunction with the following Queensland School Curriculum Council materials:

Years 1 to 10 Science Syllabus
Years 1 to 10 Science Sourcebook: Guidelines
Science Initial In-service Materials

ISBN 0 7345 2099 9

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