Australian National Botanic Gardens

Lesson Plan

Module 2

Plant Structure

We acknowledge the Traditional Owners of Country throughout Australia and recognise their continuing connection to land, waters and culture. We pay our respects to their Elders past, present and emerging.

Plant Science Learning Hub

Students need a space to learn that is fun and rewarding. The Australian National Botanic Gardens has developed a Plant Science Learning Hub that aims to inspire and engage students in plant science and the stories surrounding Australian flora. With clear links to the Australian Curriculum for school years four to six, the Plant Science Learning Hub will provide a valuable resource for students and educators.

- Plant Life Cycles
- **Plant Structure**
- Pollination
- Seeds

This series provides educators with authoritative plant science content that has a uniquely Australian perspective. The Gardens manages globally significant scientific collections of living plants and herbarium specimens of Australian native flora. We provide educational experiences for students from pre-primary to tertiary levels, leveraging our scientific collections, participation in national and international conservation projects and outreach programs to engage the community in valuing, conserving, and appreciating Australia's diverse plant heritage.

Module learning objectives

The following learning objectives apply to the Plant Structure module.

1. Identify the basic structural elements of a generalised flowering plant.
2. Identify the structural elements of several specific Australian native plants.
3. Understand the functions and parts of a flowering plant.
4. Explore links between plant structure and the physical environment.

Each lesson within the lesson plans and the field kits has individual learning intentions appropriate to the activity.

Contents

Lesson One: Plant parts detectives

LEARNING INTENTIONS

Students will be able to:

- Identify and label the parts of a flowering plant.
- Discuss the functions of the parts of a flowering plant.
- Identify and label the parts of some common Australian native plants.
- Design a plant with specific features that will help it survive in a given environment.

CURRICULUM LINKS

This material provides opportunities for students to engage in the following Australian Curriculum **(Version 9.0)** content descriptions:

Science understanding

AC9S5U01 examine how particular structural features and behaviours of living things enable their survival in specific habitats (Year 5)

AC9S6U01 investigate the physical conditions of a habitat and analyse how the growth and survival of living things is affected by changing physical conditions (Year 6)

Science Inquiry

AC9S3I01 pose questions to explore observed patterns and relationships and make predictions based on observations (Year 3)

AC9S3I04 construct and use representations, including tables, simple column graphs and visual or physical models, to organise data and information, show simple relationships and identify patterns (Year 3)

AC9S3I06 write and create texts to communicate findings and ideas for identified purposes and audiences, using scientific vocabulary and digital tools as appropriate (Year 3)

AC9S4I01 pose questions to explore observed patterns and relationships and make predictions based on observations (Year 4)

AC9S4I04 construct and use representations, including tables, simple column graphs and visual or physical models, to organise data and information, show simple relationships and identify patterns (Year 4)

AC9S4I06 write and create texts to communicate findings and ideas for identified purposes and audiences, using scientific vocabulary and digital tools as appropriate (Year 4)

AC9S5I01 pose investigable questions to identify patterns and test relationships and make reasoned predictions (Year 5)

AC9S5I04 construct and use appropriate representations, including tables, graphs and visual or physical models, to organise and process data and information and describe patterns, trends and relationships (Year 5)

AC9S5I06 write and create texts to communicate ideas and findings for specific purposes and audiences, including selection of language features, using digital tools as appropriate (Year 5)

AC9S6I01 pose investigable questions to identify patterns and test relationships and make reasoned predictions (Year 6)

AC9S6I04 construct and use appropriate representations, including tables, graphs and visual or physical models, to organise and process data and information and describe patterns, trends and relationships (Year 6)

AC9S6I06 write and create texts to communicate ideas and findings for specific purposes and audiences, including selection of language features, using digital tools as appropriate (Year 6)

INQUIRY QUESTIONS (ENGAGE)

Explain the learning intentions for the lesson and introduce the topic to the students.

Ask the students a series of questions such as:

> *What existing knowledge do you have about plant parts and their functions? Can you explain why each part of the plant is important to plant growth?*
>
> *How could you apply that knowledge to Australian native plants? Could you create and label a drawing or a 3D model to show and describe the plant parts?*
>
> *How does that knowledge compare with what you know about the parts and functions of other living things, like humans and other animals, bacteria or fungi?*
>
> *Why is it important to know about the structure of a plant? How does it impact you and your life? How can you use this knowledge to solve problems?*
>
> *Do all plants have the same parts? Can you think of a plant that doesn't have a stem, a plant that doesn't have roots or a plant with no leaves?*

Strategies to facilitate questioning and discussion could include:

- Talk with a partner (turn and talk).
- Think, Pair, Share. (Project Zero Thinking Routine)[1]
- KWL Chart to track what a student knows (K), wants to know (W) and has learned (L) about a topic, can be used before, during and after research projects.
- Write in journal and share with others.
- Individual student writing.
- Drawing.

Record students' answers and wonderings on the board or a flipchart.

[1] The Think, Pair Share thinking routine was developed by Project Zero, a research center at the Harvard Graduate School of Education. Project Zero adapted this routine from Frank Lyman: Lyman, F. T. (1981). The Responsive Classroom Discussion: The Inclusion of All Students. In A. Anderson (Ed.), Mainstreaming Digest (pp. 109-113). College Park: University of Maryland Press.

LESSON SEQUENCE (EXPLORE)

There are two activities in this lesson:

In Activity 1, students will watch a video about plant parts and start building their technical vocabulary and understanding by creating a word wall and anchor chart.

In Activity 2, students will apply their knowledge of plant parts and the functions of these to build their own plant.

ACTIVITY 1 – PLANT PARTS KNOWLEDGE BUILDING

This activity is designed to capture students' interest, find out what they already know about plant structure and elicit their questions on this topic.

To do this, you will need:

Teacher preparation:

- A real plant with roots, stem, leaves and flowers visible or Resource: Images of Plant Parts printed or displayed on a screen (available in the Resources section of this document)
- Australian National Botanic Gardens' Plant Structure video (available in the Plant Structure area of the Plant Science Learning Hub)
- Prepared layout for the anchor chart (butcher's paper, sticky notes and pens)
- Students' science journals

Part 1 - Create a class word wall

1. Introduce the learning intentions and inquiry questions to students. Show the class a real plant (or use the images provided in the Resource: Images of Plant Parts) where each of the plant parts are clearly visible (roots, leaves, stem and flower/s).

   Look at each plant part individually. *What do you see? What is this part?*

   Discuss the function of the part. *What does this part do? How does it perform that function? How does it help the plant live?*

   Allow students some time to create a mind map in their science journals of their existing knowledge on this topic. You might like to put some headings on the board to guide their thinking (e.g. roots, stems, leaves and flowers).

2. Watch the video produced by the Australian National Botanic Gardens on Plant Structure. You will find this video in the Plant Structure section of the Plant Science Learning Hub. The video explores the Gardens' plant collections and introduces the term 'plant morphology': the different shapes, sizes and structures of plants.

3. Start a word wall in your preferred format using key vocabulary from the video and suggested by students. This can be added to throughout the Plant Structure Module as new words come up. The word wall should be displayed in the classroom for students to refer to as needed.

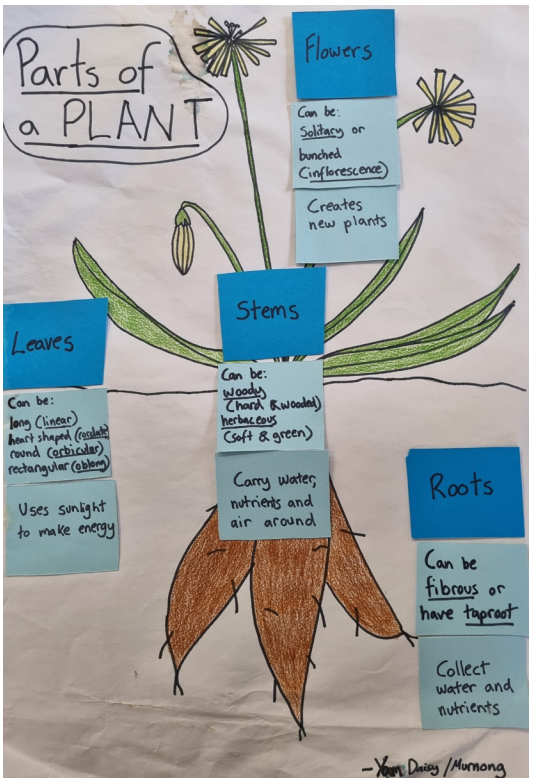
To make this activity more interactive students could be split into groups and given a few words (e.g. root, leaf, flower, stem, sepal, tepal) to write a definition for and share with the class.

Part 2 – Create a class anchor chart

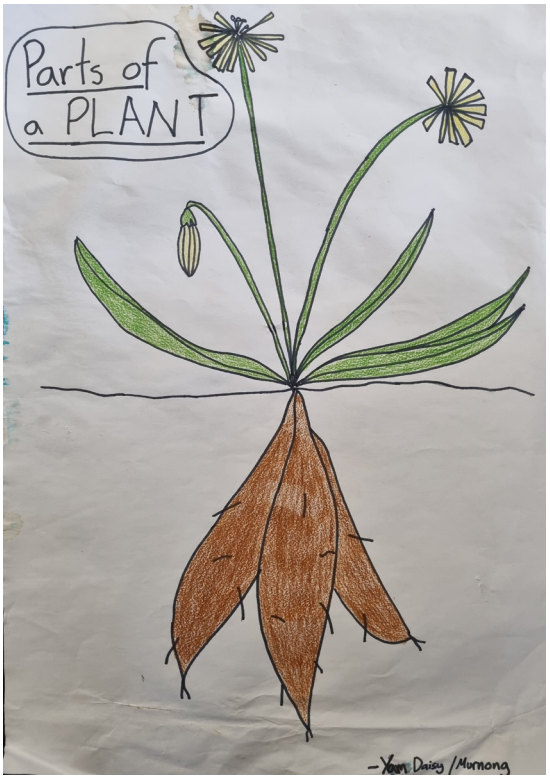
1. An anchor chart holds ideas, thoughts and processes in place (like an anchor) throughout a learning journey. It provides a visual scaffold for students to refer to and can be added to as more learning takes place.

   Prepare the central idea, headers, graphics and questions for students in advance. The image below is a prepared and completed example.

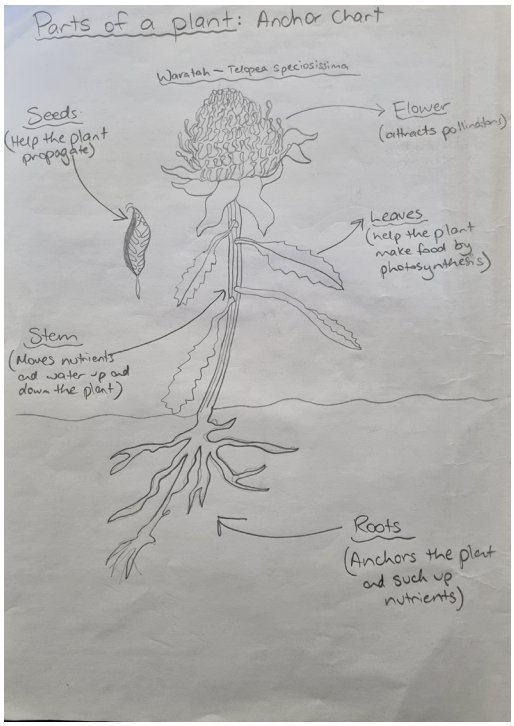
   TIP: Use a projector, smartboard or tablet (underneath the paper) to trace the central image. In this example, the central idea is the structure of a plant, so draw a picture of a plant.



Completed anchor chart



Prepared anchor chart



Completed anchor chart

2. As a class group, create the anchor chart. The chart should include:
    - Central diagram
    - Labels (roots, stem, leaves and flowers)
    - Functions
    - Space for additional facts (if desired)

Example plant for central diagram:

Discussion points:

What words were you not familiar with or were new to you?

What questions do you have about the parts of a plant?

How could you answer these questions?

What questions do you have about the functions of the parts of a plant?

Were the plants you saw familiar to you? Where have you seen them?

Were the botanical drawings new to you? Why do you think botanical artists draw plants?

ACTIVITY 2 – CREATE A PLANT

This activity allows students to apply their knowledge of plant parts and the functions of these and to create their own plant. A summary game of 'heads up' and 'What am I' will help students to consolidate their learning.

To do this, you will need:

- 4 stations set up around the classroom with plant part images, or real plants, and plant part function. Stations are explained below.
- Printed copies of Resource: Plant station images at each station
- Printed copies of Resource: Plant station fact sheets at each station
- Printed copies of Resource: Create a plant worksheet for each student
- Printed copies of Resource: Heads up and what am I cards, or ability to display them on a tablet or phone
- Access to word wall and anchor chart
- Students' science journals

Part 1 – Stations

1. Split students into four groups that will rotate through the stations set up around the room. Each station should have:
    - Cut up images from Resource: Plant station images. Alternative you may like to source living examples.
    - Resource: Plant station fact sheet (one plant part per station)
      There will be four separate stations:

      Station 1. Roots

      Station 2. Stems

      Station 3. Leaves

      Station 4. Flowers.
2. Give each student a copy of the Resource: Create a plant worksheet and explain that they will be creating a plant using parts they find at each station.

    Station 1: Roots

    For example:

    - Yam Daisy (*Microseris lanceolata*), carrot, radish, beetroot (taproot)
    - Native or non-native grass, alfalfa sprouts, onions including spring onions (fibrous roots)

    Station 2: Stems

    For example:

    - Any herbs such as Warrigal Greens (*Tetragonia tetragonoides*), parsley (soft, herbaceous stem)
    - Hakea, rosemary (hard, woody stem)

- Banksia, tomato plant (branched stem)
- Gymea Lily (*Doryanthes excelsa*), asparagus (unbranched stem)

Station 3: Leaves

For example:

- Grass tree (*Xanthorrhoea species*), chives or spinach (simple leaves)
- Ferns, clover, parsley (compound leaves)

Station 4: Flowers

For example:

- Daisy, rose, chrysanthemum, gerbera (regular flower)
- Orchid, iris, violet, pea, snapdragon (irregular flower)
- Hibiscus, petunia, nasturtium (Single-flowered inflorescence)
- Banksia, callistemon, sunflower, dandelion (compound inflorescence)

FLOWERS

3. Allow 15 minutes at each station. Students choose one plant part from each station and draw it on page 1 of their worksheet and answer the questions on page 2. Encourage students to draw their plant parts in a way that forms a whole plant picture, i.e. Flower at the top, roots at the bottom etc. Encourage them to extend their thinking and questioning while working at the stations.
   How do the plant parts undertake these functions?
   Do other living things (like people, insects, bacteria, fungi) have similar parts?
4. After all groups have visited each station and created their own plant, allow time for sharing. Ask each group to talk about the plant part and function/s at the last station they visited.
   Did other groups notice anything different?

   Explain that there were different examples of stems, roots, leaves and flowers shown at each of the stations.

   - Tap root
   - Fibrous root
   - Soft herbaceous stem
   - Hard woody stem
   - Simple leaves
   - Compound leaves
   - Monocot flowers
   - Dicot flowers
5. As students to present their plant to the class and discuss the different plant parts.

Part 2 – 'Heads up' and what am I game review

1. Review and summarise by playing heads up with plant parts and their functions. You can use the heads up cards on paper, a phone or tablet. One player holds the card against their forehead while their teammates provide clues for them to guess which plant part or function they have. The team can use charades or verbal clues but cannot say the word/s on the card.

   Heads up can be played as a class group or in smaller groups.

   What am I can similarly be played using the prompt cards. One student reads out the clues and other students guess the answer.
2. Add words to the word wall.

Discussion points:

What words were you not familiar with or were new to you?

What questions do you have about the parts of a plant?

How could you answer these questions?

Did any of the plant parts surprise you?

Does your plant have a root, stem, leaf and flower?

Does your plant need a root, stem, leaf and flower?

What would happen if you removed a plant part, for example, the leaf?

Have you seen any interesting looking plant parts anywhere?

CONCEPTS EXPLAINED AND VOCABULARY DEFINED (EXPLAIN)

The following resources are provided to assist teachers to facilitate a class session to explain concepts and terms that have been introduced to students through the activities.

- Plant Structure Teachers' Notes (these can be found in the Plant Structure area of the Plant Science Learning Hub).
- Plant Structure Video. If you have not already shown the video produced by the Australian National Botanic Gardens in a previous lesson, you could use this to engage students. The Plant Structure video uses botanical illustration, along with a visit to the National Herbarium and the Australian National Botanic Gardens to engage students.
  The videos are appropriate for use through any of the Plant Structure Module and can be used to engage students at the beginning of a lesson, or to summarise key information and show some real-world applications at the end of a lesson.
  This video can be found in the Plant Structure Resources section of the Plant Science Learning Hub.
- Word wall
- Discussion questions

APPLYING AND EXTENDING THE LEARNING (ELABORATE)

Applying the Learning

Supermarket challenge. Head into your local supermarket and look at the fruit and vegetable section. See if you can identify which items are roots, leaves, stems and flowers (or fruits and seeds). Some can be tricky to work out! Although celery looks like a stem it is part of the leaf of the plant; the part we eat is the leaf stalk called the petiole. A sweet potato is an edible tuber, an underground stem. Broccoli is a flower but is a cauliflower really a flower? What stems do we eat? What roots do we eat? What flowers do we eat?

Nature walk. Take a walk around the school grounds and identify different leaves. Collect examples of different shaped leaves. How are they arranged? How many leaves are there? Do a leaf rubbing to show the venation. Research simple and compound leaves.

Write a leaf, stem, root or flower poem. Write a poem using your five senses to describe what a leaf, stem, root or flower looks, sounds, feels and smells like.

Leaf art. Gather examples of simple and compound leaves. Use paint to make leaf prints that show the leaf arrangement or highlight the beauty of the leaves you collected.

Alternatively, stick leaves to clear contact paper and press against a window.

Extension ideas for further research

Sunflower and other daisy inflorescences. Although it looks like a regular flower, the sunflower's 'flower' is actually made up of many individual flowers. This is also true of other daisy flowers. Take a closer look at an actual sunflower or source some close up photographs from a website such as the Atlas of Living Australia. Can you see the individual flowers? How are they arranged? What do you notice?

Plant creation. Investigate whether the plant you created in Activity 4: Create a plant would survive in the wild. Consider the environmental conditions each of its parts are suited to and whether these could work together to allow it to survive, e.g. if it has roots suited to a dry environment and leaves suited to a wet environment, do you think it would survive in either of these environments? Write about your plant's ability to survive in a news article or persuasive piece or scientific reporting and include a labelled diagram of your plant explaining the functions and suitable environmental conditions of each part.

Research leaf parts. Find out more about the parts of a leaf: the blade, tip, petiole, midrib, veins, margin and stipules. Draw a labelled diagram.

QUESTIONS AND ACTIVITIES FOR REFLECTION (EVALUATE)

Students review and reflect on their learning journey by:

- Revisiting the learning intentions and original inquiry questions:

  What existing knowledge do you have about plant parts and their functions? Can you explain why each part of the plant is important to plant growth?

  How could you apply that knowledge to Australian native plants? Could you create and label a drawing or a 3D model to show and describe the plant parts?

  How does that knowledge compare with what you know about the parts and functions of other living things, like humans and other animals, bacteria or fungi?

  Why is it important to know about the structure of a plant? How does it impact you and your life? How can you use this knowledge to solve problems?

  Do all plants have the same parts? Can you think of a plant that doesn't have a stem, a plant that doesn't have roots or a plant with no leaves?

- Identifying further questions.

  What questions haven't I had answered yet?

- Identifying what they learned from others and their own research.

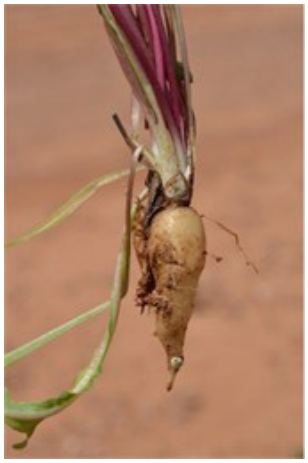
  What new knowledge do I have about plant parts and their functions that I didn't have before?

RESOURCE – WORD BANK

morphology	**root**	**stem**	**leaf**
flower	**classification**	**vascular**	**herbaceous plant**
inflorescence	**fibrous roots**	**taproot**	**reproductive structure**

RESOURCE – PLANT STATION IMAGES

ROOTS



LEAVES

STEMS

FLOWERS

RESOURCE – PLANT STATION FACT SHEETS

Root System

Roots are usually under the soil so we can't see them, but they have very important jobs to do!

The main functions of roots are:

- to help a plant stay in one place
- to help a plant stay stable in the wind
- to store some of the plant's food
- to give the plant water, nutrients, minerals and fungi from the soil to help it grow.

There are two types of roots: taproots and fibrous roots.

Taproots

- A taproot is a main root that is often straight, thick, points downwards and is shaped like a carrot (tapered).
- Small roots growing from the sides of a taproot are called lateral roots.
- Scientists think taproots evolved to allow plants to live in dry environments.
- Taproots grow downwards so they can help plants in dry areas to reach deeper water.
- Taproots can also store food and nutrients for the plant to use during a drought.

Fibrous roots

- Fibrous roots make 'mats' of lots of thin roots packed closely together.
- Fibrous roots generally spread sideways and stay in shallow soil so do not reach deep water.
- Fibrous roots grow best in wet environments.
- Fibrous root 'mats' can help to hold soil together (and prevent erosion).
- Fibrous roots are common in grasses.

Yam Daisy

Native Grass

Kitchen plants with taproots: • Carrots • Radishes • Beetroot **Native plant with taproot:** • Yam Daisy (*Microseris lanceolata*) • Gum Trees (Eucalyptus species)	**Kitchen plants with fibrous roots:** • Bananas • Asparagus • Onions • Alfalfa sprouts • Rice • Wheat **Native plant with fibrous roots:** • Blue Tussock Grass (*Poa sieberiana*) • Many other native grasses

Stems

Stems connect all the parts of a plant together. Some stems are soft (herbaceous) and others are hard and woody. Stems can have a single stem (unbranched) or have more than one stem (branched). The stem of a tree is called a trunk and can be over 100m tall!

The main functions of stems are:

- to support the leaves, flowers and fruits
- to allow nutrients, minerals and water to travel around the plant.

Soft, herbaceous, stems

Warrigal Greens

Hard, woody, stems

Gum Tree

Kitchen plants with different stem types:

- Parsley and coriander (soft herbaceous stem)
- Rosemary (hard woody stem)
- Tomato plant (branched stem)
- Asparagus (unbranched stem)
- Interestingly, celery is not a stem: each 'stick' is the petiole (leaf stalk) of a compound leaf

Native plants with different stem types:

- Warrigal Greens (*Tetragonia tetragonoides*) (soft herbaceous stem)
- Hakea (hard woody stem)
- Banksia (branched stem)
- Gymea Lily (*Doryanthes excelsa*) (unbranched stem)

Leaves

Leaves are attached to a stem with a 'leaf stalk' called a petiole. The veins in the leaf help it to keep its shape and allow water and nutrients to move through it.

Leaves help plants in many ways.

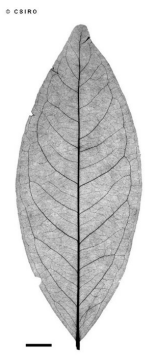
The main functions of a leaf are:

- to make food using light from the sun (photosynthesis)
- to take in carbon dioxide (CO_2) and release oxygen (O_2) and water (H_2O)
- to defend the plant
- to store food for the plant.

The green part of a leaf makes food (sugar) with help from the sun. This is called photosynthesis. During photosynthesis a plant loses water through small openings in its leaves (stomata). Plants living in dry places have ways to help them lose less water during photosynthesis:

- hairy, thick or waxy leaf surfaces (cuticles)
- being a light colour
- having small leaves
- having cladodes instead of leaves.

There are two types of leaves: simple and compound.

Simple leaf	**Compound leaf**
• A single leaf blade.	• Many leaflets making up one 'leaf'.
Simple leaf 	Compound leaf 
Kitchen plants with simple leaves: • Chives • Rosemary • Basil • Mint • Spinach **Native plants with simple leaves:** • Grass trees (*Xanthorrhoea* species) • Lilly pillies (*Syzygium* species)	**Kitchen plants with compound leaves:** • Parsley • Dill • Coriander **Native plants with compound leaves:** • Tree ferns (*Dicksonia* species) • Many wattles (*Acacia* species)

Flowers

Flowers can have many different shapes, sizes, colours, arrangements and smells. Flowers can have different numbers of petals and stamens. Some 'flowers' are made up of many, many tiny flowers together, such as a daisy or a banksia. This is called an inflorescence.

The main functions of flowers are:

- to attract pollinators (to pollen and nectar)
- to make fruits and seeds after pollination, in order to reproduce (make new plants)

Flowers of monocots (plants that sprout with one first leaf) and dicots (plants that sprout with two first leaves) are different.

Monocot flowers

- Monocot flowers usually have features in multiples of three (3, 6, 9, 12).
- The flowers of this lily have:
  - three sepals (that look like petals)
  - three petals (sometimes with Lilies, the sepals and petals together are known as tepals)
  - six stamens.

Slender Wire Lily

Dicot flowers

- Dicot flowers usually have features in multiples of four (4, 8, 12, 16) or five (5, 10, 15, 20).
- The flowers of this Teatree have:
  - five petals
  - five sepals (green)
  - five groups of stamens.

Leptospermum 'Rudolph'

RESOURCE – CREATE A PLANT WORKSHEET

Print this page and next page back to back.

Draw your plant parts so they form a whole plant.

Draw a flower
Draw a stem
Draw a leaf
Draw roots

RESOURCE – CREATE A PLANT WORKSHEET

Print this page and previous page back to back.

1. This part is called

It helps the plant to

-
-
-

2. This part is called

It helps the plant to

-
-
-

3. This part is called

It helps the plant to

-
-
-

4. This part is called

It helps the plant to

-
-
-

RESOURCE – HEADS UP AND WHAT AM I CARDS

Leaf

Stem

Flower

Root

I help a plant stay in one place

I help a plant stay stable in the wind

I store some of the plant's food

I give the plant water, nutrients, minerals and fungi from the soil to help it grow

I attract pollinators (to pollen and nectar)

I make fruits and seeds after pollination, in order to reproduce (make new plants)

I make food using light from the sun (photosynthesis)

I take in carbon dioxide (CO_2) and release oxygen (O_2) and water (H_2O)

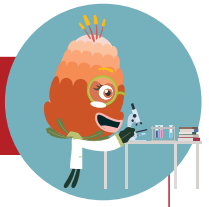
I defend the plant

I store food for the plant.

I support the leaves, flowers and fruits

I allow nutrients, minerals and water to travel around the plant.

RESOURCE: STUDENT REFLECTIONS



Consider displaying sentence starters or questions, such as below, in the classroom. Alternatively they could be turned into laminated thought bubbles that are directly passed to students. Students could choose two or three to complete in their journal then share their responses with the class.

End of lesson reflections	
Today I discovered ...	I am most proud of ...
I want to know more about ...	I feel confident about ...
Something new I found out was ...	I am enjoying ... because ...
I am excited about ...	I am confused by ...
Something I am finding interesting is ...	Today I asked ...
The most challenging thing was ...	A question I have is ...

Guiding students to reflect on their own thinking	
I am starting to think differently about ...	This idea is useful for ...
I got stuck when ... and I got back on track by ...	Some things I didn't understand are ...
I figured out that ...	To help me understand better I will ...
I solved a problem by ...	Before I didn't know ...
I first thought ... but then I realised that ...	Now I realise/know ...

Reflecting on stewardship and taking action	
This information can make a difference by ...	Something I will now help others understand is ...
It is important to know about this because ...	I can make a difference by ...
Something I will now do as a result of my learning is ...	An action I/we can take is ...
Something I want to do next is ...	If we don't ... the consequences could be ...
	It is important to ... because ...

End of unit reflections – where I was and where I am now	
I used to think ...	**Revisit** your first journal entry. What do you understand now that you didn't back then?
Now I know ...	
This causes me to (re)think/ wonder ...	**Review** your work so far. What has been the biggest discovery/learning/ challenge?
I didn't know how to ...	
Now I can ...	**Reconsider** your initial ideas. Have your ideas changed? If so how?
In the future I will ...	

Source: Adapted from the *Animal adaptations: year 5 Australian science curriculum focus, 2016, by the Great Barrier Reef Marine Park Authority, licenced under Creative Commons licence CC-BY-NC-SA from: http://hdl.handle.net/11017/2990'.*

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