Australian National Botanic Gardens

Field Activities

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.

1. Plant Life Cycles
2. **Plant Structure**
3. Pollination
4. 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 Module 2 Plant Structure.

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

The objectives in bold are addressed in this Field Kit.

Each Field Kit activity has individual learning intentions appropriate to the activity.

Contents of this kit

Each Field Kit contains the following sections relevant to all field activities:

Description: A brief overview of the field activity and the relevant Australian Curriculum content description, along with the learning intentions.

Content information relevant to all field activities: A story is often used to introduce the content, and key information for teachers to support the activity.

Equipment list: A list of the materials needed to support all listed field activities. Students are encouraged to participate in gathering the equipment using a checklist. There may be some items that need to be prepared by the teacher prior to the field activity. This section also contains guidelines for personal safety.

Each activity within the Field Kit contains the following sections relevant to the individual activity:

Content information: This section contains content information specific to the activity that may not have been included in the kit instructions.

Equipment list: A list of the materials needed to support the specific field activity.

Activity instructions: The steps for completing the field activity. Multiple activities may be presented and each may have an equipment list. The activities use experiential learning, are hands-on and are designed to encourage a sense of curiosity amongst students.

Learning and reflecting: Discussion questions to help students reflect on and summarise their learning.

Further exploration: Extension activities for greater depth.

Methodology

These materials aim to inspire and educate students nationwide about the science and stories of Australian native plants. The resources aim to support educators in providing students with creative and engaging learning experiences.

Where relevant, we provide a **story** to pique students' interest in the content and motivate them to discover more.

Activities provided in the Field Kits are **experiential** and **tactile**, moving beyond the classroom and into nature. Using the five senses is a powerful pedagogical tool in environmental education. Students are more likely to remember immersive learning experiences such as examining leaves using a microscope, smelling flowers in the field, feeling the humid air in a rainforest against their skin and hearing the sound of leaves crunching in their hands.

Inquiry-based learning approaches are used throughout the activities. We provide a focus question or questions, exploration activities, suggestions for further inquiry, and questions to support evaluation and reflection in line with the '5E's' model of science education (Engage, Explore, Explain, Extend/Elaborate and Evaluate).

Field Kit activities

It is not intended that the field activities are a continuous course of learning that must be completed in a linear manner. It is not essential that they are all completed.

We know from consulting with teachers that the preferred approach is to provide a selection of learning activities and resources from which they can choose, enabling them to curate a program of learning appropriate to their student group. Teachers might be guided by availability of resources (including time), the natural environment around them and the interests of their students.

There are four field activities to select from in the Plant Structure Field Kit:

1. Specimen Collection
2. Plant Pressing
3. Botanical Drawing
4. Flower Dissection

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Content information

WHAT IS AN HERBARIUM?

It's not a place to store your cooking herbs!

Herbaria are collections of preserved plant and fungal specimens and the data associated with them. The preserved plant specimens are used for scientific research.

The Australian National Herbarium (ANH) is located on two neighbouring sites in Canberra: the CSIRO Black Mountain site and the Australian National Botanic Gardens. The ANH stores approximately 1.2 million specimens including flowering plants, ferns and more. Larger plants are usually pressed, dried and mounted on sheets of light cardboard about 30 cm wide x 45 cm high. The sheets are then filed according to their classification in moveable shelving units called 'compactus'.

Cryptogams (a word for mosses, lichens, fungi etc.) are usually stored in folded paper envelopes.

Herbarium specimens can be stored for hundreds of years! The Australian National Herbarium has specimens collected by Joseph Banks on Captain Cook's voyage to Australia in 1770.

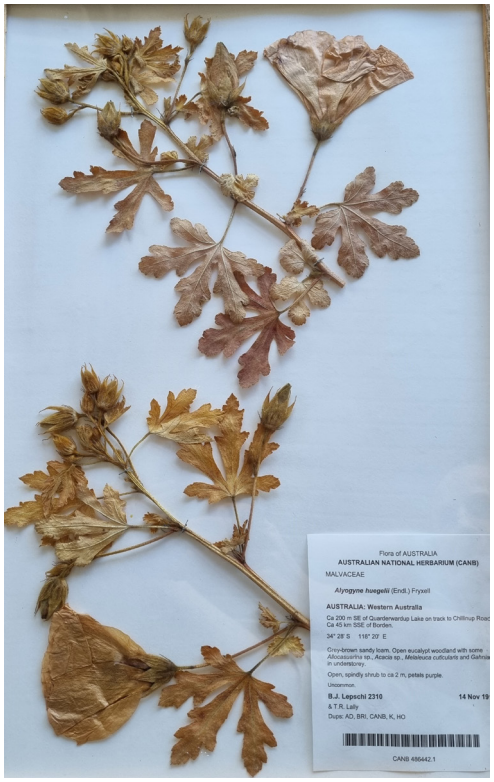
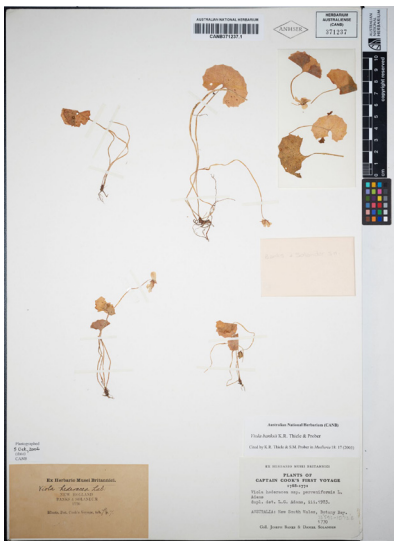
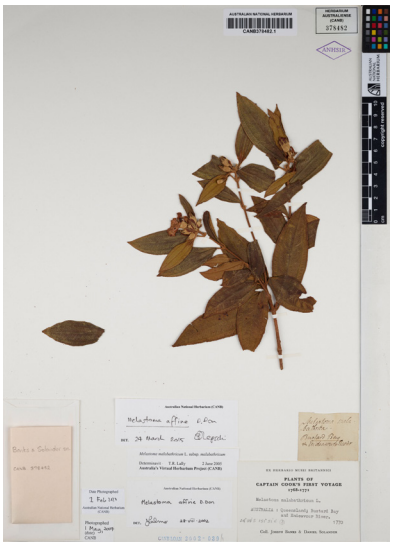


Image: ©Australian National Herbarium

Image: Brown,G©ANBG,1998



These herbarium specimens were collected by Joseph Banks on Captain Cook's voyage to Australia in 1770. You may wish to print these images and display for the students.

Images: ©Australian National Herbarium

COLLECTING AND IDENTIFYING AUSTRALIAN NATIVE PLANTS

The tasks in this Field Kit ask students to collect Australian native plant specimens from the field. The 'field' can be a location of your choice: the school premises, a local park, a plant nursery or even a botanic gardens in your state or territory. See the section 'General Guidance for Collecting and Exploring our Natural Environment' regarding permits required for plant collection.

Some types of Australian plants are easily identifiable. These include:

- eucalypts (genera Eucalyptus, Angophora and Corymbia)
- wattles (genus Acacia)
- bottlebrushes (genus Callistemon)
- banksias (genus Banksia)
- grevilleas or spider flowers (genus Grevillea)
- kangaroo paws (genus Anigozanthos)
- waratahs (genus Telopea)
- paper daisies (genus Xerochrysum, Rhodanthe, Helichrysum, Leucochrysum and others)
- mat rushes (genus Lomandra)
- native rosemary (genus Westringia)

There are plant cards contained within Lesson 1 of the Plant Life Cycles module that can be used to familiarise students with a variety of Australian plants. These can be found by searching for Lesson 1 of Plant Life Cycles on the Plant Science Learning Hub.

We encourage students to find plants that are native to Australia but that won't be possible in every field location.

PREPARING FOR THE FIELD

A Field Kit contains all the equipment and items scientists need to stay safe and conduct their research when working in the field. A Field Kit generally contains the following items:

Field Kit essentials:

- A field notebook/journal for each researcher (or student), ideally a hard cover book with blank or lined pages, but an exercise book will work just as well. Keep the book small so it is easy to carry. A waterproof pocket-sized notebook and pencil are ideal (but not required). You can also make your own journal with the instructions provided in the Life Cycles Field Kit: Making your field journals. This is available using the search feature of the Plant Science Learning Hub
- Pencils and pens
- Specimen collection equipment if you are collecting samples (see below)
- Digital camera if collecting electronically (can be on a smartphone or tablet)
- Field lens/magnifying glass
- Topographic maps and GPS (Global Positioning System) unit. These are necessary for locating your position and determining altitude. A GPS unit makes fixing an accurate latitude and longitude easy, often a mobile phone can be used for this purpose
- Field identification manuals or keys
- Safety equipment – see below

Equipment for specimen collection (Activity 1):

- Collecting bags:plastic bags, in a couple of sizes, and rubber bands to close them. Small paper bags for collecting fruits and seeds (a printable paper envelope is available in the Resource section of this document, if required)
- Scissors or secateurs for collection of specimens
- A digging implement, such as a small spade/trowel, to remove small plants from the soil and keep the roots intact
- Damp newspaper to wrap cuttings
- A field press (see Activity 2 for details on how to make)
- Tie-on tags large enough to write your name (or initials) and collection number, to attach to the specimen and label collecting bags
- Pencils, pens and waterproof markers for labelling specimens

Equipment for pressing specimens (Activity 2):

- Field press (Activity 2 provides details on how to make)
- Sheets of clean dry newspaper
- Corrugated cardboard sheets
- Tissue or toilet paper if pressing delicate plants and petals
- A3 card and sticky tape for mounting specimens

STAYING SAFE

Science education should be fun and often involves exciting experiments and activities that involve the use of equipment, materials, chemicals and products either in the classroom or outdoors.

Like any science classroom, teachers facilitating lessons and field activities sourced from the Australian National Botanic Gardens education materials should ensure they and their students are aware of potential hazards, carry out a risk assessment and take precautions to prevent accidents.

A list of recommended safety gear is as follows:

- A hat, long-sleeved shirt and long trousers to provide protection from the sun and sharp vegetation
- A jumper and water-proof raincoat to provide protection from the rain and cold
- Close-toed sturdy shoes
- A first-aid kit
- Plenty of water for drinking as well as for washing your hands.
- Gloves - you may like to wear these when collecting specimens as some plants have caustic sap or other irritants and toxins. Always make sure you know what plants you are touching and wash your hands after handling
- Food
- A trip plan outlining your intended destination/s and expected time of return left with someone who will call for help if necessary

Classroom and field activities may include:

- Use of potting mix
- Use of ovens and boiling water
- Knife or scalpel use
- Exposure to plants that may have caustic sap or other irritants and toxins

Where Material Safety Data Sheets (MSDS) are available (such as for potting mix), ensure you are aware of the directions for using the product safely.

Undertake risk assessments and take actions to mitigate identified risks.

GENERAL GUIDANCE FOR COLLECTING AND EXPLORING OUR NATURAL ENVIRONMENT

The general principle of 'leave no trace' applies any time we are in our natural environment. Respect the environment, take your rubbish with you, stick to paths, don't make campfires unless permitted to do so, respect wildlife by not feeding or otherwise interacting or interfering and leave what you find as you found it (unless permitted to take plant material).

Many of our activities ask students to use real specimens or examples they have collected from the field. In some places you will need to seek permission or apply for a permit to collect material from the environment.

- For private property, contact the landowner.
- For government managed property, contact the managing authority.

You will not need a permit to collect material from the school grounds. However, the area around your school is still an environment that provides habitat for many plant and animal species. To limit the impact of your collecting on the organisms that live there, do not take material unnecessarily and only take a sample equivalent to about 5% of the plant.

In addition, do not remove plants from an area without permission and do not replant any plant anywhere (outside the school grounds or permitted area) without permission.

Activity 1 – Collect flowering plant specimens for pressing, botanical art or dissection

LEARNING INTENTIONS

Students will be able to:

- Look for Australian native plants in their local area.
- Identify one or more appropriate plants for specimen collection.
- Take a cutting to use as a specimen.
- Create a specimen label.

CURRICULUM LINKS

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

Science understanding

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

Science inquiry

AC9S3I02 use provided scaffolds to plan and conduct investigations to answer questions or test predictions, including identifying the elements of fair tests, and considering the safe use of materials and equipment (Year 3)

AC9S3I03 follow procedures to make and record observations, including making formal measurements using familiar scaled instruments and using digital tools as appropriate (Year 3)

AC9S4I02 use provided scaffolds to plan and conduct investigations to answer questions or test predictions, including identifying the elements of fair tests, and considering the safe use of materials and equipment (Year 4)

AC9S4I03 follow procedures to make and record observations, including making formal measurements using familiar scaled instruments and using digital tools as appropriate (Year 4)

AC9S5I02 plan and conduct repeatable investigations to answer questions, including, as appropriate, deciding the variables to be changed, measured and controlled in fair tests; describing potential risks; planning for the safe use of equipment and materials; and identifying required permissions to conduct investigations on Country/Place (Year 5)

AC9S5I03 use equipment to observe, measure and record data with reasonable precision, using digital tools as appropriate (Year 5)

AC9S6I02 plan and conduct repeatable investigations to answer questions, including, as appropriate, deciding the variables to be changed, measured and controlled in fair tests; describing potential risks; planning for the safe use of equipment and materials; and identifying required permissions to conduct investigations on Country/Place (Year 6)

AC9S6I03 use equipment to observe, measure and record data with reasonable precision, using digital tools as appropriate (Year 6)

INQUIRY QUESTIONS

What kinds of plants do we see around us?

What are the names of some plants that we know?

What is a plant specimen?

What is an herbarium?

Are there right and wrong ways to collect specimens?

What do we need to consider when preparing to take plant specimens from our local area?

What do scientists use specimens for?

What risks do we need to consider and how do we use equipment safely?

CONTENT INFORMATION

IDENTIFYING SPECIMENS FOR COLLECTION

There are many reasons that scientists might collect plant specimens, for example to identify plants or find new plant species. Plant specimens can also be used for botanical drawing or for dissection in the laboratory.

It is important to collect information at the same time you collect the specimen itself. Once you cut a piece of the plant (or take a photograph) and move away from the site, a lot of information can be lost. When you are collecting plant specimens it is important not to rely on your memory. You may have taken a leaf but not have any information about the flower, the bark, the root system or the fruit. All this information is needed to help you identify the plant. Once you are back in your laboratory or classroom, you may forget what the environment was like, or confuse the specimens you have collected. If you can't identify a plant on the spot, you need to take the time to record your observations and data.

It is much easier to identify a whole plant or a fresh plant specimen than a single leaf or plant you collected a few days ago that has wilted. If you can't collect a fresh specimen, recording accurate data about all the parts of the plant (bark texture, tree size, leaf shape etc.) can be the best way to identify a dried and pressed specimen.

Scientists identify specimens by using things like:

- Taxonomic keys – identification tools for particular groups of plants, usually using their physical features.

- Comparing plants — to descriptions in books, to photographs or to collections of known specimens.
- Expert determination – asking someone who knows a lot about plants.

The more information you have the better!

Questions to ask:

- **Stem** – is it soft ('herbaceous') or hard ('woody')? Is there just one stem (or trunk) or many? How thick is it? Is there bark? If so, what does it look like (colour, texture, thickness) and does the bark cover the entire plant or certain parts?
- **Size** – how tall is it? How far out do the leaves spread?
- Shape – is it an upright tree, a rounded shrub, or a creeping vine or something else? Is it growing on something else or straight out of the ground?
- **Roots** – can you see any above the ground are they all hidden? Are they fibrous like a bundle of hair or is there a thick taproot growing deep into the ground?
- **Flowers** – what size and shape are they? What colour and texture? What do they smell like? Are they growing as one flower or clustered together?
- **Fruits** — what size and shape are they? What colour and texture? What do they smell like? Are they growing as one fruit or clustered together?
- **Leaves** – How long and wide are they and where on the leaf is the widest point? What shape are the tip and base of the leaf? What patterns do the veins make? What does the edge of the leaf look like? If you crush a leaf is there a scent? When you look at how the leaves are growing along the branch do they alternate like a zipper ('alternate'), grow opposite each other in pairs ('opposite'), grow in different directions making a spiral shape ('spiral') or come out in different directions from the same point ('whorl').
- **Location and surrounding environment (habitat)** – where is the plant growing? What does the soil look like? Are there other plants growing in this area? How many other plants?

COLLECTING SPECIMENS – WHAT MAKES A GOOD SPECIMEN?

Remember to ALWAYS seek permission from the relevant place before cutting or digging up specimens. In some places (such as national parks and some botanic gardens) it is against the law to remove plant material unless you have a permit, see section above 'General guidance for collecting and exploring our natural environment'.

- Don't cut off a piece of the plant without thinking about whether it is necessary.
- Photograph the plant if you have a camera. Take multiple pictures of different parts of the plant, close-up and at a distance. Photograph the leaves, the flowers, the roots etc.
- Make sure the plant is healthy. If the plant looks sick or looks like it has any insect damage, find another plant.
- Minimise damage to the plant and the plant population. A good rule to follow is to take no more than 5% of a population, no more than 5% of the flowers and no more than 20% of the seed on an individual plant. Avoid removing whole plants – take a small cutting or just photographs where possible.
- Samples about 30 cm long are usually adequate. If the plant is small and you can't collect 30

cm, usually several plant specimens are collected (where possible).

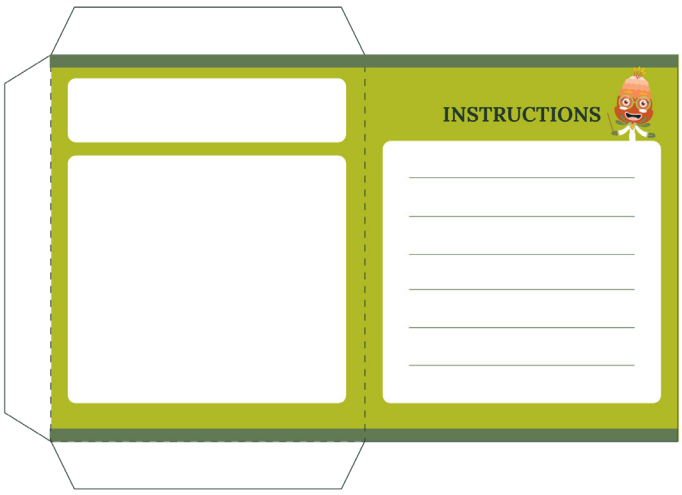
- Samples should be as complete as possible, i.e., they should include buds, flowers and/or fruits as well as a piece of stem with typical leaves. Some plants have different juvenile (young) and adult leaves – if you see more than one leaf type on the same plant, collect samples of both. You may also like to take bark and wood samples. Some plants need specific information for identification – for example, a eucalypt sample should include (where possible) both mature and juvenile leaves, buds, fruit and bark.
- You must collect the specimen yourself. It's fine for a couple of people to use the same plant, but don't record something a friend gave you if you didn't see the plant and make your own observations.

TAKING CUTTINGS

- Use secateurs or scissors to minimise the damage to the plant, and don't take more than you need. If the specimen is difficult to cut (e.g. a tough woody branch) students may need adult assistance.
- Take cuttings from one part of the plant and if you are taking flowers, fruit and/or leaves, take them from the same plant.
- If possible, try to take cuttings during the cooler part of the day to reduce wilting.
- Cuttings will last longer if they are kept cool and moist.
- Wrap cuttings loosely in damp (not wet) newspaper or paper and place in a plastic bag. If you don't have newspaper, you could use a spray bottle to spray some water into the plastic bag (but not too much, or the cutting could go mouldy). Remember to label each specimen – you may need to use a permanent or waterproof marker on the bag.
- Cuttings can be stored for a few days in an ice box or refrigerator.

COLLECTING SEEDS

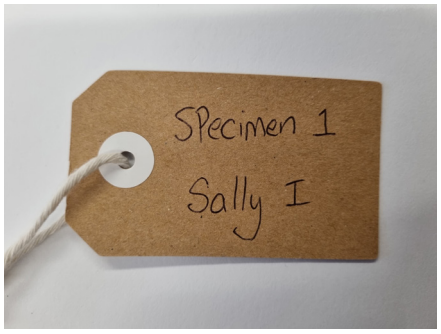
Fruit and seeds should be stored in cotton or paper bags. Glass jars or plastic containers should only be used if seeds are very dry, as they can go mouldy if they are stored incorrectly. Store bags containing seeds in a well-ventilated location to avoid fungal contamination and keep away from direct sunlight and heat. There is a printable paper bag available in the Resource section of this document.



CREATING SPECIMEN LABELS

Once you have collected your specimen you will need to create a label with the specimen number and tie it onto the specimen. The best system to use is simple and consecutive numbering - i.e. begin at 1 and go up. Avoid anything elaborate so it is easy to understand when you are looking at your specimens again (which could be a week later!). Each number should refer to a specific collection and should never be repeated. All samples taken from the same plant should have the same number.

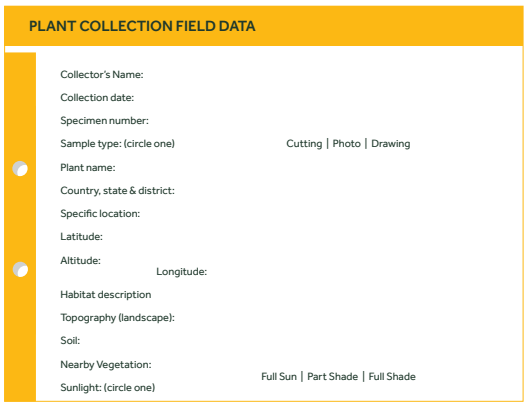
Students should include their name (or at least their initials) on specimen labels so that their specimens can be identified after pressing.



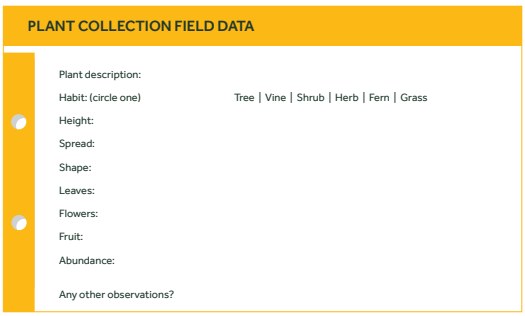
The collection of the specimen should be recorded in your field journal together with information about the collection location. As much as possible of the following data should be included:

- Plant name (including family where possible)
- Date
- Collector
- Collection number (same as specimen label)
- GPS coordinates of collection location and description of the location
- Habitat
- Distinguishing characteristics of the plant

A template for collection field data can be found in the Resources section of this document.


PLANT COLLECTION FIELD DATA

Collector's Name:
Collection date:
Specimen number:
Sample type: (circle one) Cutting | Photo | Drawing
Plant name:
Country, state & district:
Specific location:
Latitude:
Altitude: Longitude:
Habitat description
Topography (landscape):
Soil:
Nearby Vegetation:
Sunlight: (circle one) Full Sun | Part Shade | Full Shade


PLANT COLLECTION FIELD DATA

Plant description:
Habit: (circle one) Tree | Vine | Shrub | Herb | Fern | Grass
Height:
Spread:
Shape:
Leaves:
Flowers:
Fruit:
Abundance:
Any other observations?

Field data collection sheet provided in the Resource section of this document.

ACTIVITY INSTRUCTIONS

!! Remember !!
A specimen without field data (at least location and date) is of very little scientific value

Head into the field with a field journal. The 'field' can be a location of your choice: the school premises, a local park, a plant nursery or even a botanic gardens in your state or territory. For this activity, keep in mind that you may not be permitted to collect physical specimens in certain locations, e.g. botanic gardens and national parks. Always ask permission before taking physical specimens. Allow advance time to contact the managers of your 'field' site and to complete any paperwork they may require as discussed in the section above 'General Guidance for collecting and exploring our natural environment'.

Working in small groups, pairs or individually, students look for Australian native plants and record their observations in their field journal. Where there are not many Australian native plants other plants can be used.

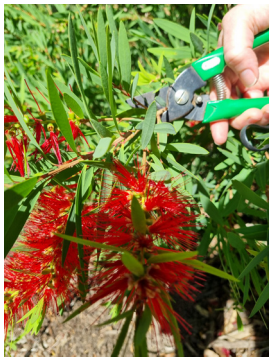
Equipment

Refer to 'Preparing for the field' and 'Staying safe' in the content information. In addition, each student (or group) will need the following:

- Secateurs or scissors
- Plastic and paper bags, printable seed bag available in the Resources section of this document
- Damp newspaper or dry newspaper (normal paper can be used in place of newspaper) and a spray bottle filled with water
- Tags to label specimens
- Field journal
- Pen/pencil
- Waterproof marker

Method

1. Using scissors or secateurs, cleanly cut through the stem to take a 30 cm cutting (if possible, make sure the specimen includes flowers and/or fruits). If the plant is too small to collect a 30 cm cutting, you may need to collect multiple specimens. See above content information for further instruction on taking cuttings.
2. Collect extra flowers, seeds and fruit for identification purposes (students may also like to collect bark and wood samples).



3. Wrap specimen loosely in damp newspaper and place in plastic bag (place seeds and fruit directly in a dry paper bag, such as the template provided in the Resources section of this document).

4. Label the bag with the collector's name and a collection number (either use tags or write on the bag with a waterproof marker).

Make a record in your field journal, including the following information: specimen number; date collected; name of the plant; name of person who collected the plant; habitat; and distinguishing features of the plant. The Plant Collection Field Data sheet found in the Resources section of this document can be used.

LEARNING AND REFLECTING

Discussion questions to help students reflect on and summarise their learning.

What did you discover?

Where did we find the plants?

What did you notice about the habitat that the plants were growing in?

Which plants did you see most/least? Why do you think this was?

What did you find interesting about collecting your specimens?

What did you find challenging about collecting your specimens?

Did you consider all the possible risks before you started?

What will you do with your specimens now? (Note that the following activities can be done using your collected specimens).

Activity 2 - Pressing specimens

LEARNING INTENTIONS

Students will be able to:

- Build a simple field press.
- Position specimens in the press.
- Mount dried specimens and label the parts.

CURRICULUM LINKS

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

Science understanding

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

Science inquiry

AC9S3I02 use provided scaffolds to plan and conduct investigations to answer questions or test predictions, including identifying the elements of fair tests, and considering the safe use of materials and equipment (Year 3)

AC9S4I02 use provided scaffolds to plan and conduct investigations to answer questions or test predictions, including identifying the elements of fair tests, and considering the safe use of materials and equipment (Year 4)

AC9S5I02 plan and conduct repeatable investigations to answer questions, including, as appropriate, deciding the variables to be changed, measured and controlled in fair tests; describing potential risks; planning for the safe use of equipment and materials; and identifying required permissions to conduct investigations on Country/Place (Year 5)

AC9S6I02 plan and conduct repeatable investigations to answer questions, including, as appropriate, deciding the variables to be changed, measured and controlled in fair tests; describing potential risks; planning for the safe use of equipment and materials; and identifying required permissions to conduct investigations on Country/Place (Year 6)

INQUIRY QUESTIONS

How can we best store specimens for scientific use?

Why is pressing plant specimens important to science?

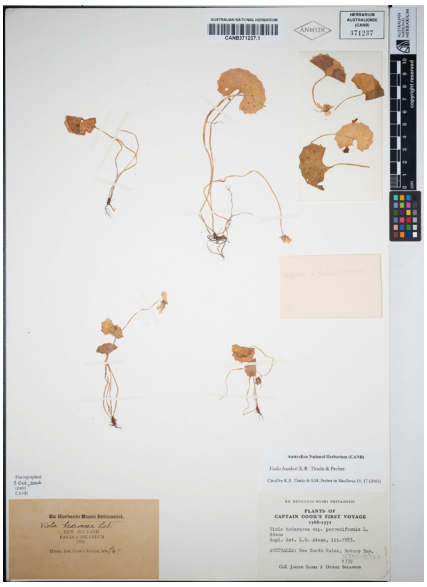
What are some methods we can use to press a plant?

What can we observe/learn from pressed plant specimens?

What risks do we need to consider and how do we use equipment safely?

CONTENT INFORMATION

Some botanists will preserve a plant for future study by pressing it until dry, then mounting it on archival card.
If properly prepared and stored, pressed plant specimens can last for hundreds of years. The Australian National Herbarium in Canberra has specimens collected by Joseph Banks when he arrived in Botany Bay in 1770.



Original herbarium specimen collected by Joseph Banks in 1770.

Image: ©Australian National Herbarium, 2023

Many botanists will press their samples straight away while they are still in the field. In humid environments, presses are sometimes strapped to the roof rack of a car or the side of a helicopter to help them dry! You should press your specimens as soon as possible before they wilt. If this is not possible, specimens may be stored in plastic bags, preferably wrapped in damp (but not wet) newspaper and kept in a cool place (ideally a refrigerator or ice box). Make sure that each bag is correctly labelled. This is outlined in Activity 1 - Collect flowering plant specimens for pressing, botanical art or dissection.

Plant presses on a camel during a plant specimen collecting trip in the Simpson Desert.

Image: ©R.W.Purdie, 2015

Australian National Herbarium staff collecting specimens on the back of a ute on Christmas Island.

Image: ©M.Fagg,2012

For best results, use a field press. You can build one using the instructions below. If you don't have a field press you can use alternating sheets of corrugated cardboard (e.g. from a packing box) and newspaper, placed on a flat surface with a weight on top. Make sure the weight is evenly distributed across the specimen and remember to label each sample with your name and the collection number. Don't just label the newspaper, because if the plant material falls out it can be difficult to match it up with your field records. Multiple specimens can be laid on top of each other, separated with layers of newspaper and corrugated cardboard.

Most plants will take a few days to dry. Succulents and plants with high moisture content will take longer.

Instructions on pressing plants are below.

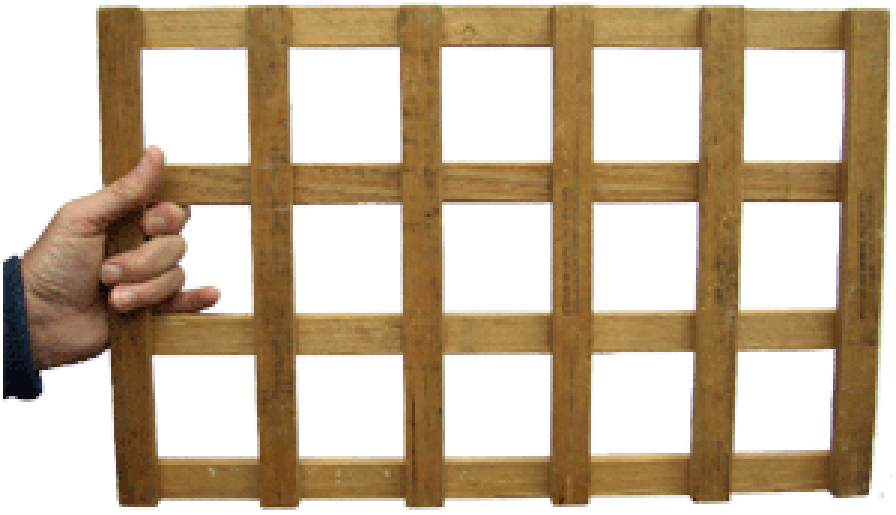
GATHERING YOUR SUPPLIES

To construct a field press you will need:

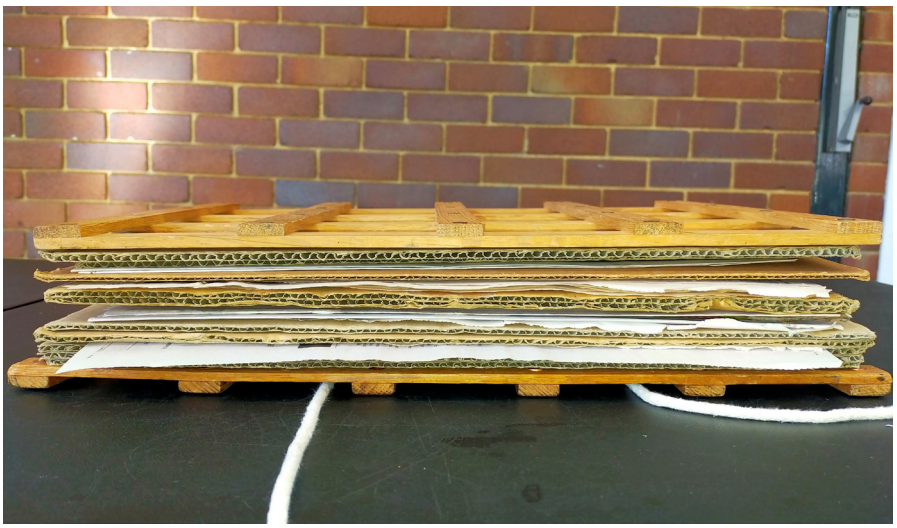
- 8 hardwood strips approx. 450 mm long x 20 mm wide x 12 mm thick
- 12 hardwood strips approx. 300 mm long x 20 mm wide x 12 mm thick
- 48 x nails, screws or rivets. These should be just long enough to connect two wooden strips without poking through the other side.
- 2 x 1.5 m strong webbing strap with buckle or sash cord
- Corrugated cardboard, newspaper and foam (approx. 10 mm thick).

Method:

1. On a flat surface, create a rectangular grid pattern using four long strips and six short strips (see image below).
2. Use nails, screws or rivets to attach wood strips at intersections.
3. Repeat to create a second grid. You have now made the top and base of your field press. Alternatively, you may also use 2 pieces of 12 mm plywood cut to 300 x 450 mm. If you use plywood, drill holes in each piece to allow for air circulation.



4. Cut several pieces of cardboard to the same dimensions as your press (300 x 450mm). These will be used to separate specimens and allow for air circulation.



ACTIVITY INSTRUCTIONS – USING THE FIELD PRESS

Pressing specimens

Equipment

- Plant specimens
- Plant field press
- Sheets of clean, dry newspaper
- Corrugated cardboard sheets
- Tissue or toilet paper if pressing delicate plants and petals

Method

1. **Position the specimen**

Place cardboard on top of the plant press lattice, followed by several sheets of newspaper.

2. **Lay the specimen on the paper**

Place the specimen on the newspaper with the specimen tag attached – see Activity 1. Try to arrange the specimen so that the leaves and flowers can be easily seen. This means moving the leaves into place, so they don't overlap, and so that some leaves face up and some face down. The whole specimen should fit your page so trim extra parts you don't need. Long specimens (e.g. grasses) can be bent into a 'V', 'N' or 'W' shape. If there are any flowers, try to open them out so that the details of their structure will be visible after pressing.

Delicate plants and petals are easily damaged and should be kept in tissue-paper or toilet paper.

3. **Cover**

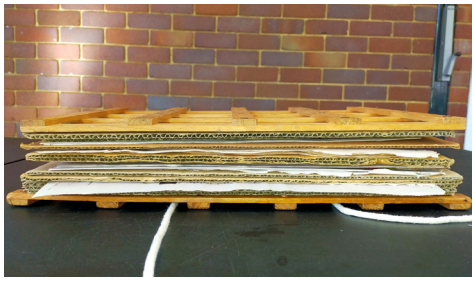
Place another piece of newspaper on top, or fold newspaper over the specimen, being careful not to move the leaves and flowers you positioned in the last step. Top with a few more layers of newspaper.

4. **Adjust for bulky specimens**

If your specimen is bulky, follow the newspaper with one or two pieces of corrugated cardboard. To achieve a good result the press needs to apply pressure evenly, so if the layers don't sit flat (as in this picture) use foam, more cardboard or even rolled up newspaper to ensure the cardboard sheets sit evenly over the specimens.

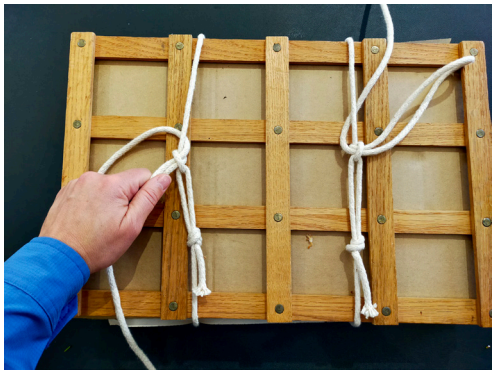
5. **Finish layering**

Continue layering cardboard, newspaper and specimens until all your specimens are in the press. Some plant presses can get quite tall. Place the second lattice on top.



6. **Secure the press**

Using the straps or cord, firmly secure the press. Don't use excessive pressure, as this can damage delicate samples. Alternately you can use weights placed on top of the press, but make sure the weight is evenly distributed to ensure even pressing.



Leave to dry

Leave the press in a warm, dry, well-ventilated location. Check the specimens daily for the first few days, changing out any damp paper (specimens will go mouldy if left in damp paper). Continue checking regularly until the specimens are dry. Handle carefully - a properly dried plant specimen is brittle.

Australian National Herbarium Staff creating a tall field press.

Image: ©M.Fagg,2012

ACTIVITY INSTRUCTIONS – MOUNTING DRIED SPECIMENS

Once specimens are dry they can be mounted for storage or display. To prolong the life of specimens in herbariums, scientists use acid free (archival) card and tape, but you can use whatever you have available.

Equipment

- A3 piece of card
- Sticky tape
- Pencil

Method

1. Open the press and remove dried specimens from the newspaper. Be careful, as dried specimens can be quite brittle.
2. Lay the specimen on the card and attach it with sticky tape. You only need a few pieces to hold the specimen in place.

3. Write some details about the specimen on the card using the information written in your field journal. You can use the Resource: Plant Collection Field Data found in the Resources section of this document.
4. Data should include:

- Identification
- Collector's name
- Collection date
- Collection location
- Original colour of flowers and leaves (if colours have changed through the drying process)

What to do with dried specimens?

Create a class herbarium

Many botanists throughout history have kept their own personal herbarium for research and reference purposes. Create an herbarium for your class by placing specimens in folders

(standard office folders work well). They should be kept away from sunlight and heat, in a dry environment and protected from insects. Specimens can be taken out to use as a reference for botanical art or further study (e.g. looking at plant parts under a microscope or magnifying glass).

Traditionally, specimens of the same genus are stored together in folders. What do you think would be the best way to organise your herbarium?

Specimens as art

Herbarium specimens can be beautiful in their own right – try framing your specimens and using them as wall decorations! You could also laminate them to create cards, bookmarks or book covers.

LEARNING AND REFLECTING

Discussion questions to help students reflect on and summarise their learning.

Why do botanists press plants?

What is the purpose of an herbarium?

What are some ways that pressed plant specimens can be used in science or art?

Why is it important to press plants straight away?

What determines how long it will take a plant to dry?

How long can a pressed plant specimen last?

Activity 3 – Introduction to botanical illustration

LEARNING INTENTIONS

Students will be able to:

- Understand what botanical illustration is and why it is important in plant science.
- Complete a botanical illustration with as much scientific accuracy as possible.
- Label their botanical illustration.

CURRICULUM LINKS

This material provides opportunities for students to engage in the following Australian Curriculum **(Version 9)** content descriptions:

Science understanding

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

Visual arts

AC9AVA4C01 use visual conventions, visual arts processes and materials to create artworks that communicate ideas, perspectives and/or meaning (Year 3/4)

AC9AVA6C01 use visual conventions, visual arts processes and materials to plan and create artworks that communicate ideas, perspectives and/or meaning (Year 5/6)

INQUIRY QUESTIONS

What are the parts of a plant? What does each part do?

What is botanical illustration?

Why do botanists and botanical artists draw or paint plants and flowers?

Is drawing going to be better than taking a photograph? Why or why not?

Why is it important to accurately draw parts of a plant/flower?

What risks do we need to consider and how do we use equipment safely?

CONTENT INFORMATION

WHAT IS BOTANICAL ILLUSTRATION?

A botanical illustration is a scientifically accurate representation of a plant. Botanical illustrations are designed to be beautiful and informative. This gives them a unique role both as a scientific tool and as a form of art that celebrates the natural world.

All flowering plants have structural features such as flowers, stems, leaves, fruits and seeds, however these features vary in shape, colour, size and texture. Unlike photographs, botanical illustrations can highlight all the important structural details on one page. They usually have plain backgrounds and high levels of contrast so that the viewer can see the detail quickly and easily. Botanical illustrations can be black and white, created as pen or pencil line drawings, or colour, created using watercolours, coloured pencils etc.

Botanical illustration of Kangaroo Paw (Anigozanthos manglesii) by botanical artist Jann Ollerenshaw.

Botanical illustration Kangaroo Grass (Themeda triandra) by botanical artist Jann Ollerenshaw.

Professional botanical artists go through a rigorous process to ensure that their illustrations are as scientifically accurate as possible. This usually includes:

- viewing living plant material, photographs and/or herbarium specimens
- inspecting plant features using a microscope
- accurately measuring the different parts of the plant
- observing and illustrating the different stages of growth throughout the plant's life cycle.

Botanical illustrations are used for scientific purposes including to describe new plant species, identifying plants and better understanding a plant's structure and life cycle. Botanical illustrations also share the beauty and unique nature of plants and are enjoyed as framed paintings, printed on tea towels and even shown on coffee mugs!

ELLIS ROWAN: FLOWER HUNTER

Since their arrival in Australia in the late 1700s, Europeans have studied and documented unique Australian environments. This created a huge demand for skilled artists to complete botanical illustrations of native flora across the country.

Up until World War I (1914-1918) women were mostly excluded from the workforce, instead engaging in domestic and social activities. The demand for botanical artists was so great, however, that in the 1800s several skilled women were recruited to fulfil this role, including the now-famous botanical artist, Ellis Rowan (1848-1922).

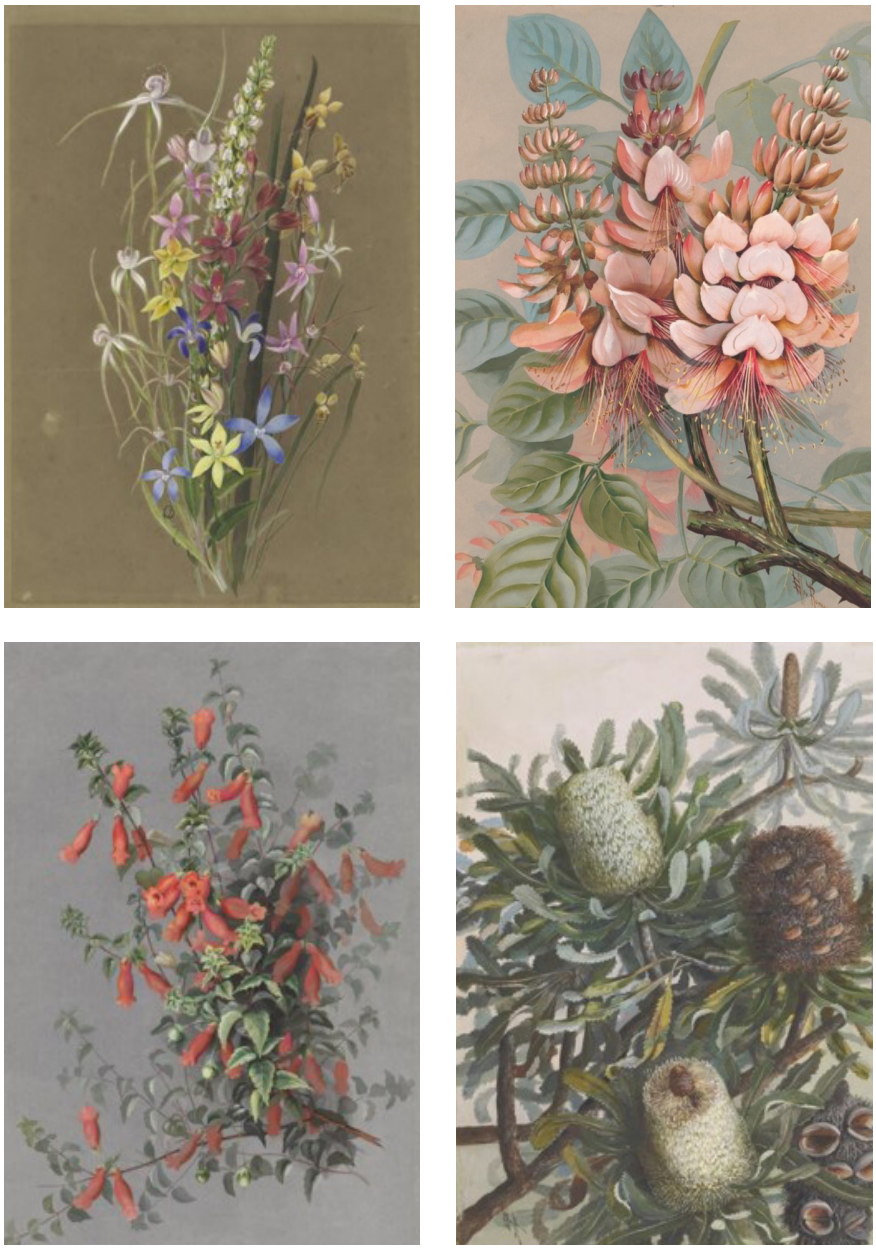
Ellis Rowan wearing traditional women's clothes whilst on a botanical art expedition in 1887. Source: National Library of Australia

Image: Peince, 1887. Source: Ellis Rowan sketching Mary Moule sitting on the ground [picture] / Peince - Catalogue | National Library of Australia (nla.gov.au)

Ellis Rowan, the self-described 'flower hunter', hiked great distances and travelled to remote islands and regions to capture plants and wildflowers in their habitat. In many of the areas she visited she was assisted by local First Nations people, as they often knew the best way to find the rare plants she was seeking. She was not interested in the domestic life generally expected of women at the time and instead focussed on developing her own unique artistic style and 'getting as good a collection of Australasian flora as I could.'

Ellis' work helped to document and identify many new plant species and became celebrated works of art. She won many awards and was even invited to London to present Queen Victoria herself with three of her artworks. Ellis then became one of the first European women to travel to Papua New Guinea, where she unfortunately contracted Malaria and never fully recovered.

Ellis Rowan was a pioneer in the field of botanical illustration in Australia. She is remembered through her thousands of artworks, now housed at the National Library of Australia, National Gallery of Victoria, Adelaide Botanic Gardens, Powerhouse Museum and Queensland Museum, and namesakes such as the Ellis Rowan Building at the Australian National Botanic Gardens.



Some of Ellis Rowan's botanical illustrations (clockwise from top left): Native orchids, watercolour (1880).

Source: https://catalogue.nla.gov.au/catalog/2843725; Erythrina variegata (pale form).
Source: https://catalogue.nla.gov.au/catalog/1317791; Banksia serrata, Old Man Banksia, watercolour (1782) .
Source: https://catalogue.nla.gov.au/catalog/542809; Nitraria sp., Nitre Bush, watercolour, Western Australia (circa 1885)
https://catalogue.nla.gov.au/catalog/1322635

GATHERING YOUR SUPPLIES

Botanical illustrators observe real plants. They can use:

- living plants in botanic gardens
- pressed plant specimens in an herbarium
- specimens from their own gardens or local area
- high quality photographs.

Equipment

- A sharp B pencil or a fine, felt tip pen
- A4 cartridge paper (regular paper will do)
- A botanical specimen (see A*ctivity 1 - Collect Flowering Plant Specimens for Pressing, Botanical Art or Dissection*)
- A magnifying lens
- A clipboard if doing the activity outdoors
- Resource: Botanical Drawing Worksheet for each student

ACTIVITY INSTRUCTIONS – INTRODUCTION TO BOTANICAL ILLUSTRATION

1. Practise your skills

The three-dimensional shape and texture of the different plant parts can be represented with different drawing techniques. Practise these skills on the Botanic Drawing Worksheet.

2. Position your specimen

Find a good position for drawing. You may need to try a few different angles before you get a 'pose' that works best to showcase your specimen. If you are indoors, you can position your specimen using a vase, plasticine or placing it on a piece of plain paper beside you.

3. Observe your specimen

Study your specimen closely (use a magnifying glass if you have one). Is it a whole specimen or is it dissected? Which plant parts can you see? How do they connect to each other? Which textures, colours and shapes can you see?

A plant specimen can show different plant parts such as leaves, stems and flowers.

4. Draw the specimen with as much detail as possible.

a. Decide whether you want your drawing to be portrait (long side vertical like this page) or landscape (long side horizontal). Which way suits the shape of your specimen?

b. Choose a starting point: maybe the bottom of the stem, the centre of one flower or the middle of the specimen? Concentrate on one small area of the plant instead of the whole.

c. Start with a light pencil line and where the plant gets darker, use a stronger pencil line. Focus on the main parts of the plant and their proportions to each other. How big are the anthers compared to the petals? Is each flower larger or smaller than the leaves? Are all the leaves the same size?

d. Allow your drawing to grow slowly. It is best to keep checking your plant every few minutes to make sure it looks like your specimen. Look, check and think one step ahead to see where you are going.

e. If things go wrong, go back. Look and find the mistake and change it. Remember that your drawing will not be perfect and botanical illustration takes many years of practise to master!

drawing by Patrick Clarke

Tip: A good botanical drawing should take at least 30 minutes, so take your time!

5. Label your work

Write the species name at the bottom of your artwork. You can also label the plant parts.

Learning and Reflecting

Discussion questions to help students reflect on and summarise their learning.

What did you learn about botanical illustration?

What did you enjoy about the process?

How did you focus on and explore the details of the plant/flower?

Did the process help you to appreciate nature?

How do you think botanical illustrations could be used by scientists?

Activity 4 - Collecting for dissection

LEARNING INTENTIONS

Students will be able to:

- Dissect a flower.
- Identify the structural elements of a flower.

CURRICULUM LINKS

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

Science understanding

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

Science inquiry

AC9S3I02 use provided scaffolds to plan and conduct investigations to answer questions or test predictions, including identifying the elements of fair tests, and considering the safe use of materials and equipment (Year 3)

AC9S3I03 follow procedures to make and record observations, including making formal measurements using familiar scaled instruments and using digital tools as appropriate (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)

AC9S4I02 use provided scaffolds to plan and conduct investigations to answer questions or test predictions, including identifying the elements of fair tests, and considering the safe use of materials and equipment (Year 4)

AC9S4I03 follow procedures to make and record observations, including making formal measurements using familiar scaled instruments and using digital tools as appropriate (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)

AC9S5I02 plan and conduct repeatable investigations to answer questions, including, as appropriate, deciding the variables to be changed, measured and controlled in fair tests; describing potential risks; planning for the safe use of equipment and materials; and identifying required permissions to conduct investigations on Country/Place (Year 5)

AC9S5I03 use equipment to observe, measure and record data with reasonable precision, using digital tools as appropriate (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)

AC9S6I02 plan and conduct repeatable investigations to answer questions, including, as appropriate, deciding the variables to be changed, measured and controlled in fair tests; describing potential risks; planning for the safe use of equipment and materials; and identifying required permissions to conduct investigations on Country/Place (Year 6)

AC9S6I03 use equipment to observe, measure and record data with reasonable precision, using digital tools as appropriate (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)

INQUIRY QUESTIONS

What is the function of a flower?

What are some of the main parts of a flower?

What are the functions of each plant part?

What parts of the flower do you think you will be able to see when you dissect it?

Why do botanists dissect flowers?

What risks do we need to consider and how do we use equipment safely?

CONTENT INFORMATION

WHY DO BOTANISTS DISSECT PLANTS?

There are many reasons we love flowers:

- they are interesting to look at and come in many wonderful colours
- their shapes are varied and amazing - some resemble animals, like a Bird of Paradise, and others have mathematically perfect symmetry
- some can be used for food
- some can be used to dye fabrics, e.g. Austral Indigo
- they can smell terrific and are used in aromatherapy and perfumes.

Not only are flowers stunning to look at, but they have a purpose for plants, and without them we would not have many of the fruits and vegetables we eat everyday. Many plants would not be able to reproduce if there were no flowers, so many species would die out and the animals that depend on the flowers for food or shelter would also eventually disappear.

Dissecting a flower is an interesting way to look further into the reproductive system of plants. Scientists use plant dissection to look closely at the structure of the plant to help identify it. Dissecting a plant can help us understand how a plant is pollinated and what its role is in the ecosystem. We can identify its female parts (ovary, style and stigma) and male parts (filament and anther) and see the structures that attract pollinators like birds, insects and mammals. In return for transferring pollen from one place to another for the plant, pollinators are often rewarded with food from the flower in the form of nectar. Other plants rely on wind or water to spread their pollen. When pollen reaches the stigma it grows a pollen tube through the style to reach the ovary. The male cells travel from the pollen down the pollen tube to reach the ovules (female cells) contained in the ovary. If fertilisation occurs, the ovary becomes a fruit and the ovules become seeds. More information on Pollination can be found in the pollination module of the Plant Science Learning Hub.

BOTANY AND THE BANK

Botanists dissect plants and their flowers to study their structure and form. Using a few scientific tools, such as a scalpel, tweezers, probe and dissecting microscope, you can describe the different parts of a flower, such as its sepals, petals and stamens. The position, number, shape and size of these parts, and the presence or absence of hairs or nectaries, can provide a lot of information about the flower. This can help botanists to identify plant species, investigate a plant's pollination strategy or even determine if they are looking at a new species!

But how does this relate to money? Australia's banknotes are produced by the Reserve Bank of Australia (RBA) and possess various security features to prevent counterfeiting. One of the recent security additions is a 'top-to-bottom' clear plastic window that is overlayed with images. In the latest series of notes the RBA has embraced Australia's native flora by each showing a different species of wattle (*Acacia* species) within this window. Some notes have wattle images in other places as well.

Dr Phillip Kodela is a botanist with the Australian Biological Resources Study at the Australian National Botanic Gardens who helped the RBA to create these abstract, but still accurate, wattle images. He used his knowledge of plant structure to advise on the position, size and shape of the flower heads (wattle 'flowers' are made up of many tiny flowers grouped together to form a

ball or rod shape) and leaves (mostly phyllodes that look like leaves) depicted on the banknotes. Accurately representing the number of veins on the phyllodes was also important.

The $100 note released in October 2020 features Australia's floral emblem, the iconic Golden Wattle (*Acacia pycnantha*). At the time, *The Canberra Times* reported, "All the features of the wattle have been checked for the leaf sizes and the number of flower heads and the dimensions, all that's botanically correct," said Dr Kodela. "Even though the flowers themselves are abstract, they are scientifically correct."

Banknote	**Release date**	**Wattle species shown**
$100	20 October 2020	Golden Wattle (*Acacia pycnantha*)
$50	18 October 2018	*Acacia humifusa* (without common name)
$20	9 October 2019	Box-leaf Wattle (*Acacia buxifolia*)
$10	20 September 2017	Bramble Wattle (*Acacia victoriae*)
$5	1 September 2016	Prickly Moses Wattle (*Acacia verticillata* subsp. *ovoidea*)

If you would like to know more about these wattle species, or any of our native flora, you can visit Flora of Australia at https://profiles.ala.org.au/opus/foa.

The $100 note released into circulation in October 2020 depicts scientifically accurate images of Australia's national floral emblem, the Golden Wattle (Acacia pycnantha).

The $50 note released into circulation in October 2018 depicts scientifically accurate images of Acacia humifusa.

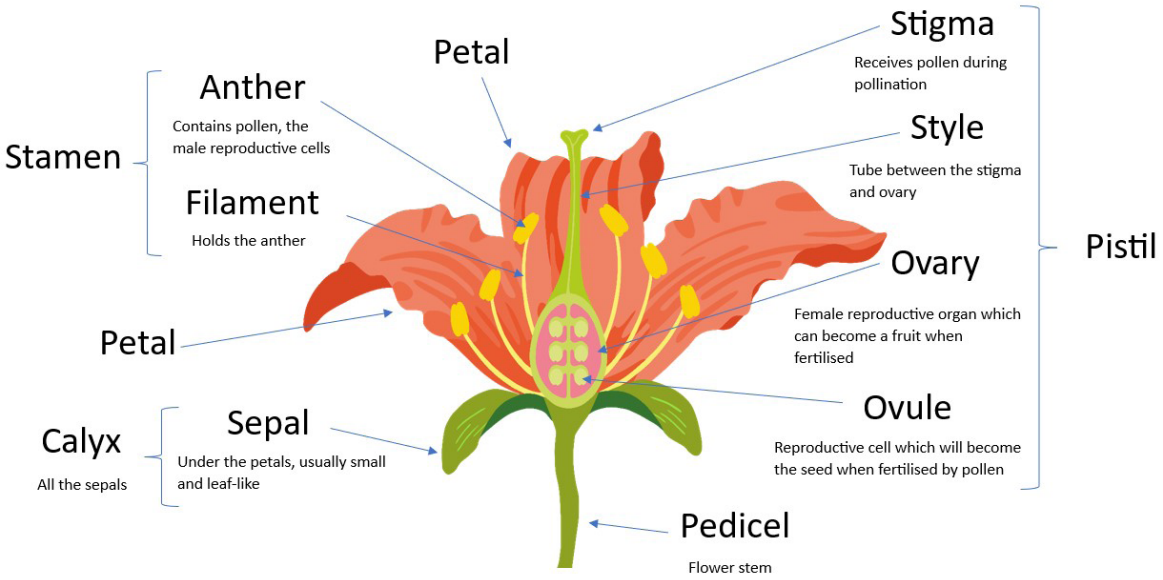
The $20 note released into circulation in October 2019 depicts scientifically accurate images of Box-leaf Wattle (Acacia buxifolia).

The $10 note released into circulation in September 2017 depicts scientifically accurate images of Bramble Wattle (Acacia victoriae).

The $5 note released into circulation in September 2016 depicts scientifically accurate images of Prickly Moses Wattle (Acacia verticillata subsp. ovoidea).

THE STRUCTURAL ELEMENTS AND FUNCTIONS OF A FLOWER

Before a flower opens it is called a bud. The outside of the bud is made up of sepals that protect the inner parts of the flower before it is ready to open. The sepals often remain attached after the flower has opened, and are visible at the base of the flower. Once the bud opens and a flower forms, you will be able to identify its main parts (as seen in the diagram below).



Petal — Petals help to attract pollinators to the flower. The colours, markings and shape of the petals will attract specific pollinator types. Petals also help to protect the inner reproductive parts of the flower.

Sepal — Sepals are usually green and protect the inner parts of the flower in the bud. The sepals open with the petals and usually remain attached at the base of the flower.

Tepal — Tepal is a term used instead of sepal and petal when it is not possible to distinguish between them, such as when the sepals are enlarged and coloured.

Pedicel — This is also known as the flower stem. The purpose of the pedicel is to hold the flower up, giving it support. It also helps to elevate the flower and make it visible to pollinators.

The **male parts** of a flower:

Stamen — The stamen is the male reproductive organ of the flower. It has two main parts, the pollen-producing anther and the supporting filament.

- **Anther** — The anthers are the pollen-producing organ of the flower. Pollen contains the male gametes, or reproductive cells, of a flowering plant.
- **Filament** — The filament is the stalk that supports the anthers. The filament makes the anthers more accessible to pollinators. Depending on the flower shape they can be short, tall or absent.

The **female parts** of a flower:

Pistil — The pistil is the female reproductive part of a flower. It is usually made up of: the stigma, which often protrudes from the top of the flower to receive pollen; the ovary is located at the base of the pistil and contains ovules (future seeds); and the style, a stalk-like structure that connects the stigma and ovary.

- **Stigma** — Depending on their pollination strategy, stigmas receive pollen from air, water, insects or other animals. Pollen grains are tiny and difficult to catch, so stigmas have different adaptations to improve their chance of retaining pollen. Some stigmas are hairy or lobed, some have flaps, some are intricately shaped and many are sticky to help catch and trap the pollen.
- **Style** — The style is a stalk that connects the stigma and the ovary, providing a place for a pollen tube to form and for the male gametes to reach the ovary.
- **Ovary and ovules** — The ovary houses the ovules, which contain the female gametes. The flower is fertilised when the male sperm cells found in pollen travel from the stigma via a pollen tube through the style to the ovary. When fertilisation is successful the ovules grow into seeds and the ovary wall often expands into a fruit that encloses the seeds.

GATHERING YOUR SUPPLIES

- Flowers – at least three flowers each of three different varieties. These can be from Australian native plants. For a more general activity, Lillies are great for illustrating plant parts but watch out for pollen stains. Tulips, irises and daffodils can also work. Flowers should have easily distinguished male and female parts.

Many Australian native plants have modified floral structures (e.g. reduced or no petals) or composite flowers, so they are not ideal for an introductory dissection activity. Examples that have a more classic flower structure and may be found in garden and flower shops are listed below.

- *Leptospermum* (Tea Tree)
- *Alyogyne* (Native Hibiscus)
- *Crowea* (Waxflower)
- *Correa* (Native Fuchsia)
- *Westringia* (Native Rosemary)
- *Prostanthera* (Native Mint)
- A chopping board or strong piece of cardboard
- Something to cut with – scissors or scalpel, small kitchen knife or craft knife
- Tweezers
- Sticky tape or pins
- Resource: Plant Dissection Worksheet. Alternatively you can use trays or paper plates to hold dissected parts. If you are using paper plates you can divide the plate and label each section with a plant part, e.g. stem/pedicel, sepal, petal, stamen and pistil.
- Magnifying glass or microscope
- Bench or table space for dissection

A note about safety and allergy advice:

Pollen is a common allergen. If anyone experiences sneezing or other respiratory symptoms, do not continue with the and seek medical advice immediately.

Tip:

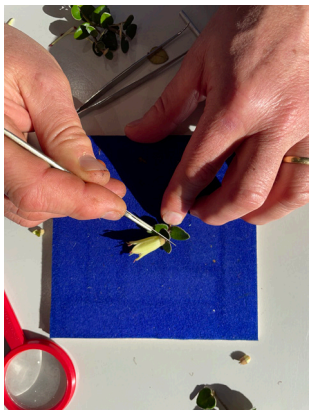
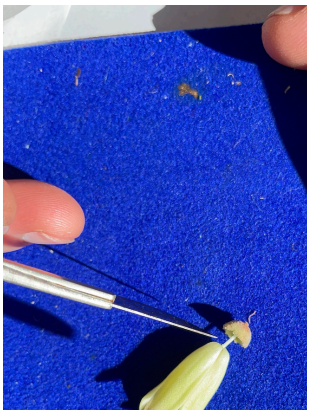
Ask your local florist to hold their broken or damaged flowers that are not suitable for sale. Flowers that are slightly bruised or otherwise not quite fit for sale are still fine for dissection.

ACTIVITY INSTRUCTIONS

Method

1. Remove the flower from the plant with scissors or your hands, being careful not to cut too close to the base of the flower. Leave a little bit of the stem so that you don't accidentally cut off an important part of the flower.

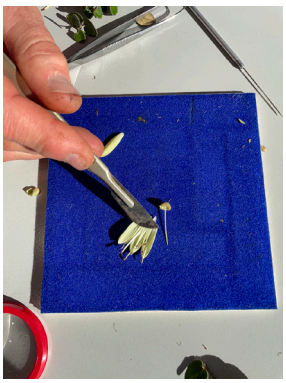
2. Take some time to look at the flower before starting to cut. Can you identify the parts of the flower already? Do you see the petals? The sepal? The pollen?
3. Draw a picture of your flower in the space provided on the worksheet or in your field journal. You could also take a photograph.
4. Place your flower on a board or a sheet of cardboard and start by carefully removing the sepals. Sepals are the small green structures at the base of the petals and next to the flower stem. You should be able to remove them by gently pulling them down towards the stem. Put them on the Plant Dissection Worksheet or labelled plate. Count the sepals and record how many there are.

5. Next, you need to remove the petals. Put these on the Plant Dissection Worksheet or labelled tray. How many petals are there? What colour are they?
6. Find the stamen, the male part of the flower, and separate the anthers and the filaments. The anthers are the yellow/brown tips that contain pollen and each is attached to a thin stem called the filament. They should come off easily with fingers or tweezers, or you can also use a knife or a scalpel to cut them off at the base. If you slice the stamens and anther in half with your knife and scalpel, inside you will find the small grains of pollen. This is the pollen that can fertilise the ovules of another flower.

   Put them on the Plant Dissection Worksheet or labelled plate. Count the anthers and record how many there are.

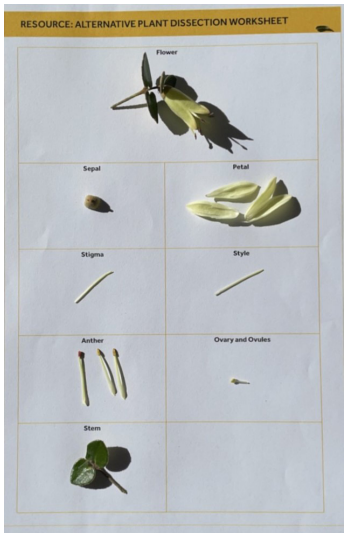
7. The long stalk remaining is the female part of the flower called the pistil. Pull this off and place it on the Plant Dissection Worksheet or plate. Can you identify the stigma, style and ovary?



If the stigma is large enough, using your scalpel or knife, slice down the length of the stigma. Start at the top and move down to the end of the stem. Only cut one side of the hollow stigma so that you can open it up with your fingers. Try not to cut the whole way through.

8. The ovaries are at the base of the pistil and, if large enough, you will be able to expose them by peeling the style away from the ovary with your fingers.
9. If large enough, slice open the ovary. Inside are tiny ovules and sometimes you will see developing seeds. Ovules are the plant's 'eggs' that, when pollinated, will grow into an embryo. Scrape them out carefully and place them on the Plant Dissection Worksheet or your labelled plate.
10. Repeat the process on two other flowers. Compare the same parts from each type of flower. How are they different and similar?

11. Repeat the process on two other flowers. Compare the same parts from each type of flower. How are they different and similar?



LEARNING AND REFLECTING

Discussion questions to help students reflect on and summarise their learning.

What did you discover?

Was it easy or difficult?

Discuss the parts of a flower. What is a stigma? What is an anther? What is the stamen?

Could you see all the parts?

Which kinds of animals do you think might be attracted to your flower and why?

Does the structure of your flower make it easy for pollinators to remove and transfer the pollen?

What is pollination? Why is it important?

What are the female parts of the flower?

What are the male parts of the flower?

What is the difference between pollination and fertilisation?

What is the difference between ovules and seeds?

Which types of plants develop fruits?

RESOURCE: PLANT COLLECTION FIELD DATA

Collector's name:

Collection date:

Specimen number:

Sample type: (circle one) Cutting | Photo | Drawing

Plant name:

Country, state & district:

Specific location:

Latitude:

Altitude: Longitude:

Habitat description:

Topography (landscape):

Soil:

Nearby vegetation:

Sunlight: (circle one) Full sun | Part shade | Full shade

Plant description:

Habit: (circle one) Tree | Vine | Shrub | Herb | Fern | Grass

Height:

Spread:

Shape:

Leaves:

Flowers:

Fruit:

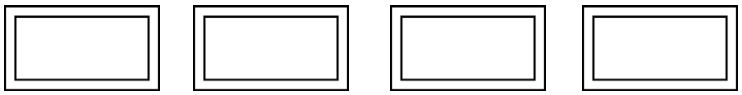
Abundance:

Any other observations?

RESOURCE: BOTANICAL DRAWING WORKSHEET

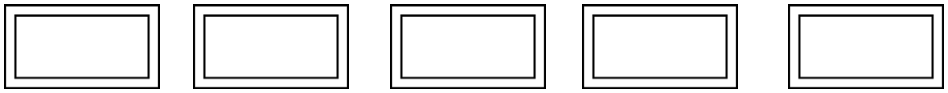
1. Practise your skills before you start.

Use stippling (dots) to shade these boxes in different tones.



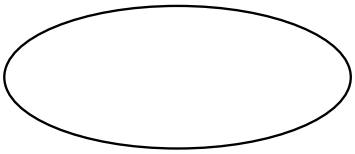
Very pale *Medium-light* *Medium-dark* *Almost black*

Use marks with different shapes to make similar shading effects.



Diagonal *Curvy* *Spiky* *Furry* *Scribbly*

Shade this oval from one end to the other, starting very dark and progressing to very light.



2. Position your specimen

Find a good position for drawing. You may need to try a few different angles before you get a 'pose' that works best to showcase your specimen. If you are indoors, you can position your specimen using a vase, plasticine or placing it on a piece of plain paper beside you.

3. Observe your specimen

Study your specimen closely (use a magnifying glass if you have one). Is it a whole specimen or is it dissected? Which plant parts can you see? How do they connect to each other? Which textures, colours and shapes can you see?

4. Draw the specimen with as much detail as possible.

a. Decide whether you want your drawing to be portrait (long side vertical like this page) or landscape (long side horizontal). Which way suits the shape of your specimen?

b. Choose a starting point: maybe the bottom of the stem, the centre of one flower or the middle of the specimen? Concentrate on one small area of the plant instead of the whole.

c. Start with a light pencil line and where the plant gets darker, use a stronger pencil line. Focus on the main parts of the plant and their proportions to each other. How big are the anthers compared to the petals? Is each flower larger or smaller than the leaves? Are all the leaves the same size?

d. Allow your drawing to grow slowly. Keep checking how the plant is put together. It is best to keep looking and checking every few minutes to make sure it looks like your specimen.

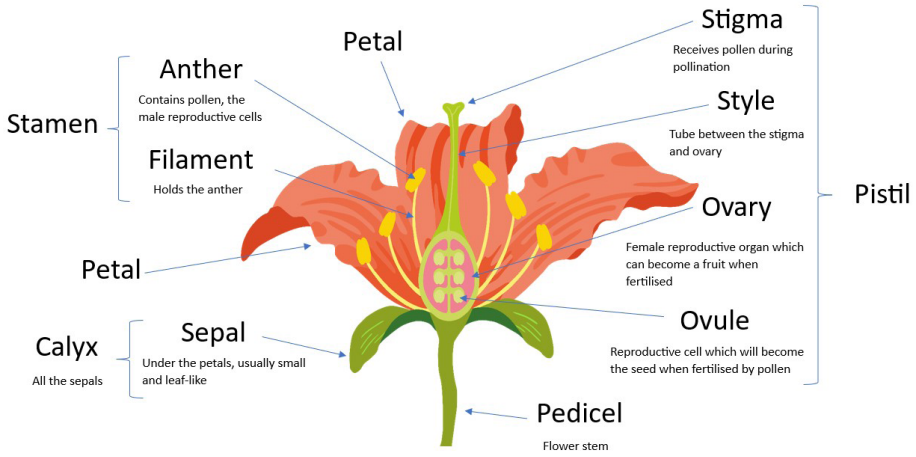
Look, check and think one step ahead to see where you are going.

e. If things go wrong, go back. Look and find the mistake and change it. Remember that your drawing will not be perfect and botanical illustration takes many years of practise to master!

Tip: A good botanical drawing should take at least 30 minutes, so take your time!

5. **Label your work**
   Write the species name at the bottom of your artwork. You can also label the plant parts that you know.

RESOURCE: PLANT DISSECTION WORKSHEET



Name(s)	How many?

Function

Name(s)	How many?

Function

Name(s)	How many?

Function

Name(s)	How many?

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Name(s)	How many?

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Name(s)	How many?

Function

Name(s)	How many?

Function

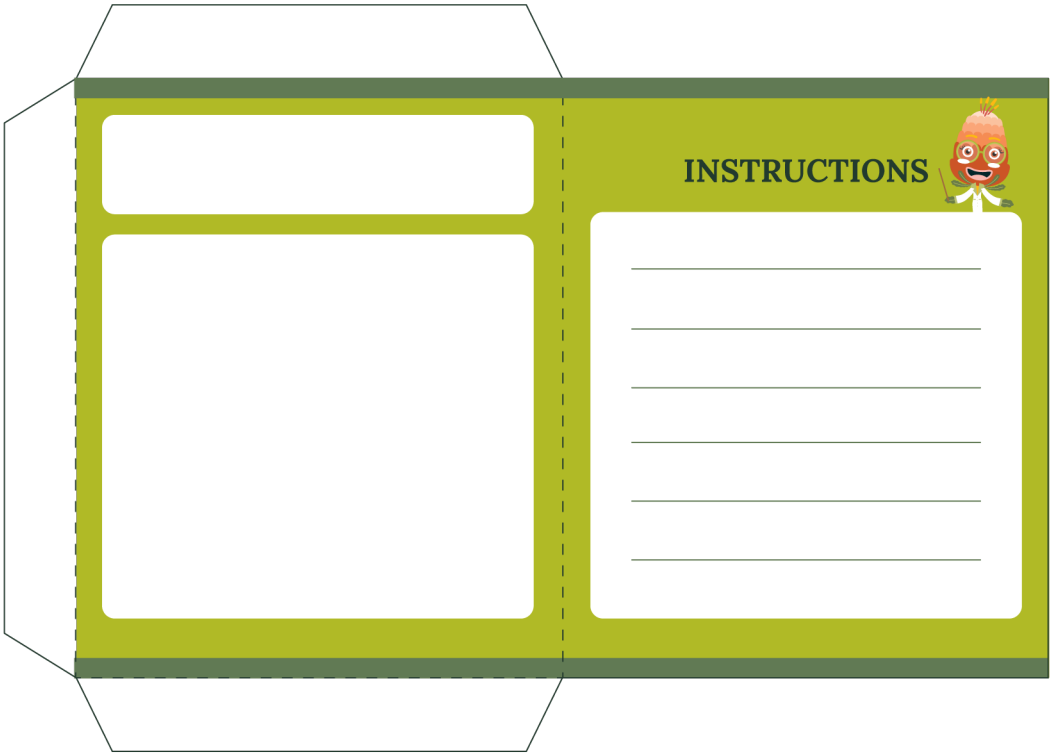
Name(s)	How many?

Function

RESOURCE: ALTERNATIVE PLANT DISSECTION WORKSHEET

Flower	
Sepal	**Petal**
Stigma	**Style**
Anther	**Ovary and ovules**
Stem	

RESOURCE – SEED PACKET WORKSHEET



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