
Plants as living things

Introduction

Key concepts of plants as living things

The activities in this topic are designed to explore the following key concepts:

Broad concepts of living things

- There is no absolute definition of what we count as a living organism. The definition has changed over time. A living organism generally has a cellular structure, but viruses are currently counted amongst living things, and they do not.
- Living things have a variety of characteristics that will be displayed to different degrees: they respire, move, respond to stimuli, reproduce and grow, and are adapted within a complex of living things within an environment.
- When a plant is picked or cut, or an animal dies, some basic life process will continue to occur. There is no universally agreed answer to the question 'Is it alive?'.
- The way living things are classified has changed over time. Animals and plants are the main 'kingdoms', but fungi, mosses and viruses have their own separate kingdoms.
- Animals are 'consumers' in that they ingest food to survive. Food provides the energy for life processes.
- Plants are 'producers' and grow through the photosynthetic process by which carbon dioxide and water are used to produce starches (of which the plant material is made). Sunlight provides the energy to drive this process.
- Animals and plants are further divided. A major category of plants is 'flowering plants' or angiosperms. These differ from conifers and ferns, for instance, in the way they reproduce. Animals include a multitude of organisms, from microscopic creatures, through insects, reptiles, mammals, and so on. These different organisms are all interconnected through an evolutionary history.

Structure, function, adaptation of living things

- Living things have various 'structures' that enable them to survive: transport structures in plants by which water and trace elements move; digestive structures and respiratory structures in animals; and reproductive structures.

- Organism structures and behaviours should be seen in terms of their survival purposes.
- Each organism is adapted to a particular ecological niche involving interdependence with other living organisms as well as dependence on non-biotic factors.

Flowering plants, seeds

- The majority of plants on earth are flowering plants (this includes trees, grasses, cacti and other small plants, as well as the more obvious examples).
- All flowering plants have a similar reproductive cycle.
- The reproductive cycle is an important adaptation, and the formation and dispersal mechanisms for seeds (contained in fruit, pods or nuts) are varied.
- Fruits are the outcome of a fertilised flower and contain seeds.
- Conifers do not have flowers but produce seeds in cones.
- Seeds:
 - need water to germinate
 - need the right temperature to germinate
 - vary in their rate of germination
 - form a significant part of the world's food supply
 - are living.

Students' alternative conceptions of plants as living things

Research into students' ideas about this topic has identified the following non-scientific conceptions:

- Students associate life with movement or action, so that a bicycle may be alive when it is being ridden.
- Students associate life with power or effectiveness, including such things as the sun, fire, lightning, etcetera.
- Students think that the purpose of flowers is to please or support other organisms, for instance bees, or humans (to make them look pretty).
- Students do not understand the different reproductive (flowers, fruit, seeds), respiration (roots, leaves, stalk) or other structures of plants and can think of parts of the plant as the plant itself (e.g. a carrot is not thought of as the root of a carrot plant that may be flowering).
- Students have a restricted view of which plants are flowering plants.
- Students believe that plants take in food through their roots.
- Students have a narrow concept of plants as things in pots, that may not include trees or grass.

Activities

ACTIVITY:
IS IT ALIVE?

Probing conceptions of ‘alive’ and ‘plant’ using ‘instances’

Teaching note: As a group, attempt to establish a definition of what it is to be alive. What are some of the necessary criteria for saying something is alive? This activity can be done using drawings of the things above, or cutting photos and drawings out of magazines. A variation on the exercise involves having two hoops on the floor, one labelled ‘alive’ and one ‘not alive’, into which children place their pictures. It may be interesting to explore having a third hoop, or the crossover between hoops, labelled ‘once alive’. This could contain things like wood, or lemon juice. Note that children will sometimes juxtapose ‘alive’ against ‘dead’, and this can cause confusion.

Key idea: What is a ‘living thing’ has a particular meaning in science.

Which of the following are ‘alive’:

- a cow munching grass
- a bushfire
- a tree growing in your garden
- a plank of wood
- the sun
- a seed in a packet in a shop
- a picked carrot
- a river
- bacteria
- a battery-operated doll?

Why have you made these choices?

ACTIVITY:
WHAT IS A
PLANT?

Key idea: Exploring students’ understandings of what a plant is.

Which of the following are plants?

- grass
- a carrot
- a gum tree.

Develop a definition of a plant that the class agrees upon.

ACTIVITY:
IS IT A PLANT?

Key idea: Plants are a definite and important category of living thing. They can have a variety of forms.

You will need:

- a set of cards with examples of plants and non-plants (e.g. a tree, a fire, a carrot, a lion, etc).

Look at the cards showing a range of objects. Which ones are plants? What tells you something is a plant?

Come to an agreement in your group about the characteristics that define what a plant is, in a way that other students can understand. You could start two lists of characteristics: 'Most plants ...' and 'All plants ...'.

Plant structures and function

ACTIVITY:
THINKING
ABOUT PLANT
PARTS

Teaching note: In this activity, praise the student who:

- makes the most observations
- makes the most counts (e.g. of petals, stamen, leaves, etc.)
- formulates the most questions
- makes the most accurate drawings
- attempts to indicate scale
- cuts up the most types of flowers
- attempts generalisations based on findings
- modifies generalisations in light of new findings.

Key idea: Raising questions about the different reproductive and other structures of plants.

You will need:

- a variety of native seeds and fruits (banksia, eucalypt, cones)
- a dandelion
- flowers
- magnifying glasses—mainly to illustrate the variety of reproductive structures.

Look at the plant parts supplied, and discuss them. As a group, write down ten observations and/or insights. Write down five questions about plants that the discussion raised in your minds.

What variation in reproductive strategies can you identify? (e.g. seed dispersal mechanisms).

ACTIVITY:
LOOKING AT
FLOWERS

Key idea: Flowers have a recognisable structure related to their reproductive function.

You will need:

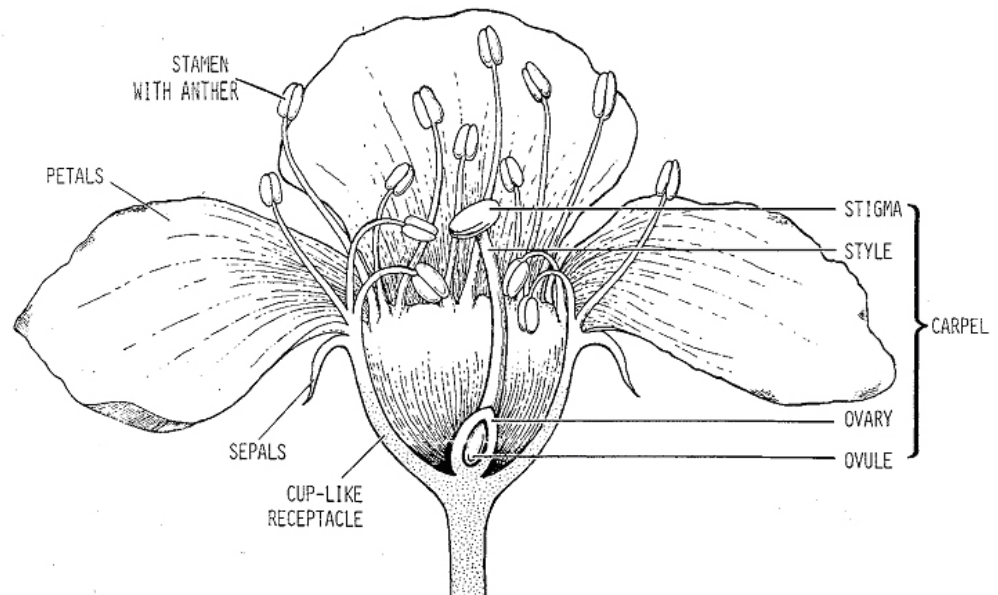
- a variety of flowers to cut up
- scissors
- razor blades
- tweezers
- magnifying glasses
- tiles for cutting on
- pencils for drawing.

Cut up a variety of flowers, including some Australian natives such as grevillea and eucalyptus, and some complex flowers such as a daisy or dandelion. You should use a razor blade, scissors and tweezers and work on tiles. A magnifying glass can be useful for identifying parts in a small flower.

Identify the ovules in the ovary. Where is the stigma found compared to the stamens? Decide which flowers have a structure to assist cross-pollination. Carefully draw and label three of the flowers, to illustrate the reproductive structures.

What is the function of flowers? Discuss as a group.

FIGURE:
FLOWER OF A
PLUM



Studying plants in the local environment

Teaching note—student’s observation skills: The distinction between observations, inferences (where an interpretation is added to the ‘pure’ observation) and experiments is often not easy to make. What is a good observation?

Criteria by which we might assess observation skills

Does the child:

- use senses other than sight?
- observe detail, rather than gross features only?
- make statements that incorporate information other than that observed?
- note unexpected occurrences rather than always confirm preconceived notions?
- in comparing situations, note similarities as well as differences?
- in making sense of a set of observations, rank them in some priority order?
- use observation as part of a process of testing ideas?
- plan observations as a sequence that focuses on the most relevant issues?

Developing the skill of observation

- Draw the object (or event), to encourage closer attention to detail.
- Describe the object and develop a vocabulary of description.

- Children play in pairs; one child identifies the object from the other's description.
- Children have to identify their particular object from a drawing they have made of it, from a container full of similar objects.
- Encourage children to make as many observations as possible, using as many senses as possible.
- Go around the class asking each child to make one more observation of, say, a tree.
- Structure the observations by providing definite categories, for example, look at a leaf and describe
 - its edges (smooth or rough)
 - the type of veins
 - texture of surface (shiny or rough).
- Give enough background knowledge for students to base their observations on (e.g. the basic parts of a flower).
- Provide a purpose for the observations (e.g. give them a question they must use the observations to answer).
- Ask for five questions about the object or process being observed.

Teaching note—environmental activities/trails: The following is presented courtesy of the Gould League of Victoria.

Environmental trailing is one way in which we can develop a child's awareness of the human-modified and natural environment. 'Trails' are simply a series of planned walks along certain set routes that highlight certain aspects of the local environment. They have the advantage of:

- taking students out of the classroom into their local environment to focus on things that may otherwise go unnoticed; it may also develop a respect and pride in their local environment
- enabling records to be kept of what has been seen at points along the trail
- giving flexibility in planning to cater for the broadest ranges of interest and levels of achievements
- making a change to the surrogate experiences of the classroom and covering most subjects of the curriculum: art, language, science, mathematics.

Environmental trails fall under two categories:

1 Joined location trails.

- A joined location trail can be developed in a number of ways. It can be used simply as a series of observation points with similar characteristics, to reinforce a certain theme or concept. It can be used as a developmental trail with each location point becoming more complex as the trail progresses, in other words, a series of graded lessons at each observation station. Each station reinforces and extends the previous station. At the end of the trail the child should emerge with a specific field skill and concept.
- Alternatively, the trail location could be used as a monitoring station to enable children to observe and measure changes over time.

2 Continuous experience trails

- The continuous experience trail is one that emphasises a particular topic along the whole trail walk. It need not have a series of observation stations, but rather the possibilities for incidental experiences related to one particular idea or theme.

If you devise a trail, these four elements should be incorporated on a trail card:

- method—the way of doing the projected activities
- identity of things to be observed
- map of trail
- data table to record observations.

These elements apply particularly to joined location trails.

Some examples of trails:

- a ‘look under things’ trail
- a ‘feeling’ trail
- a pollution trail
- a ‘moving things’ trail.

The success of an environmental trail depends upon the teacher’s awareness of possibilities that the local area offers.

ACTIVITY: PLANT TRAIL

Key idea: Plants have many structures that help them survive.

You will need:

- manila folders
- small plastic bags
- a stapler
- specimens of plants.

Construct a means of collecting specimens of plants in an orderly array. This might consist of, for instance, a manila folder with small plastic bags stapled into it. Each manila folder could be dedicated to a particular plant, for instance.

Walk around the local environment with the aim of setting a trail for students. Identify plants with interesting features and select one feature to place in the folder. The features might include new and old leaf, bark, fruit, seed or flowers in different stages.

Swap your folders with another group.

As a group, use the folder supplied to locate each plant, and collect (if appropriate ... keep in mind the need to preserve the environment) parts that build a profile of the plant (e.g. bark, old leaf, bud, flower, fruit, seed).

Discuss the adaptive characteristics of the plants you found on the trail.

ACTIVITY:
WORKING
WITH PLANT
PARTS

Key idea: Plants have a variety of structures, each with a purpose.

You will need:

- a variety of native plant parts, or a strategy for collecting them
- pencils for drawing.

Collect, or work with, a variety of parts from native plants from the local environment, including leaves, gumnuts or banksia fruit, tea-tree seed, a variety of seed pods, cones, flowers, bark and buds.

Identify the function of each plant. What is its role in the plant's survival?

Draw carefully the details of selected plant parts.

Generate a set of questions that arise from the activity.

ACTIVITY:
INVESTIGATING
LEAVES

Key ideas: Observation of adaptive structures of trees. Investigative design.

Work out a strategy to find answers to the following questions:

- Are the leaves that fall from an evergreen tree all at the same stage of development?
- Do younger or older leaves release more water to the air during the day?
- Do leaves continue to release water to the air after sunset?

ACTIVITY:
BARK
RUBBINGS

Key idea: Observation of adaptive structures of trees.

You will need:

- 'Dura' crayons
- paper
- trees.

Make a bark rubbing of selected trees.

ACTIVITY:
PLANT TABLE





Key idea: Supporting close observation of adaptive structures of a tree.

You will need:

- a plant table (see the figure *Plant table* below)
- pencils
- trees.

Build up a profile, by sketching, of a number of trees in the local environment.

FIGURE:
PLANT TABLE

Drawing of leaf	Sketch shape of tree	Describe bark	Comment on bud/flowers/ fruit
			Close clusters of pink flowers (4 cm across) with five petals. Unscented.
			
			
			

ACTIVITY:
CHANGE IN
PLANTS

Key idea: Methods of representing growth and change in plants.

You will need:

- a tree displaying new leaf growth
- a plant showing different stages of development of flowers and fruit
- pencils and paper
- something to mark leaves on a tree (e.g. an overhead marker pen, or texta).

Locate a tree that displays new leaf growth. Arrange a display showing new, old, dead and dried leaves from the one tree. Where does the new growth occur?

Find a plant that shows different stages of development of the flowers or fruit on its branches. Sketch the stages.

Mark fifty leaves on an accessible tree. Follow the history of these leaves over a period of two months.

ACTIVITY:
LONG-TERM
STUDY OF A
TREE



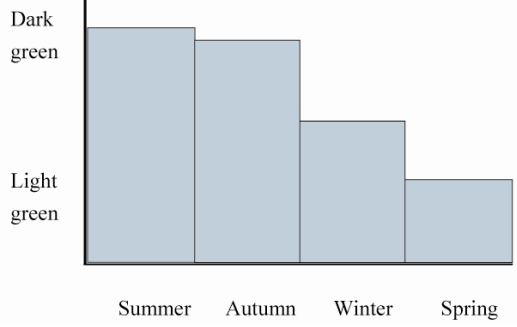
(This study was developed by David Symington of Deakin University.)

Objectives:

- That students become aware of the changes which occur in the tree as the seasons change
- That students realise that to discover patterns in the natural world often requires persistence.

Some important decisions:

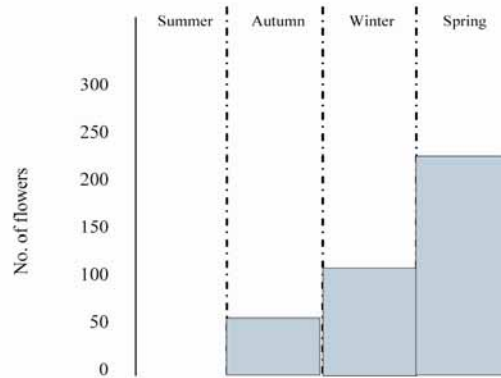
1 Evergreen or deciduous

<p>Summer Autumn Winter Spring</p> 	<p>Deciduous</p> <p>Over the year there are obvious and dramatic changes in deciduous trees such as oaks, elms, apples and plums.</p>
 <p>Bud Flower Fruit</p>	<p>Evergreen</p> <p>1. Bud–flower–fruit</p> <p>Evergreen trees undergo changes too, but they are not always so obvious. Students can discover changes related to reproductive function</p> <p>The shape and size of flower buds change considerably as the bud develops and produces the flower, which in turn yields the fruit.</p>
 <p>Dark green</p> <p>Light green</p> <p>Summer Autumn Winter Spring</p>	<p>Evergreen</p> <p>2. Leaf observations</p> <p>In some trees (for example, the lemon) students can detect changes in the number of leaves, the average size of the leaves, the colour of leaves, and the feel of the leaves over the seasons.</p>

2 Quantitative or qualitative

Sometimes students are involved in measuring.

This graph shows changes to the number of flowers on a lemon tree



At other times students describe the nature of the changes they observe:

‘The colour of the leaves changed through the year from a dark shade of green in summer to a gradually lighter shade of green in winter and spring.’

‘During summer, autumn and winter the leaves were quite rough, while in the spring observation they felt smoother. No growth or markings on the leaves were observed in summer, but these were most obvious in autumn. From autumn to spring these markings were fewer.’

3 Methods of recording

Sketches

Of trees at different times of the year.



Summer

Autumn

Winter

Spring

Samples

Of trees at different times of the year.



Leaf



Bud



Shoots

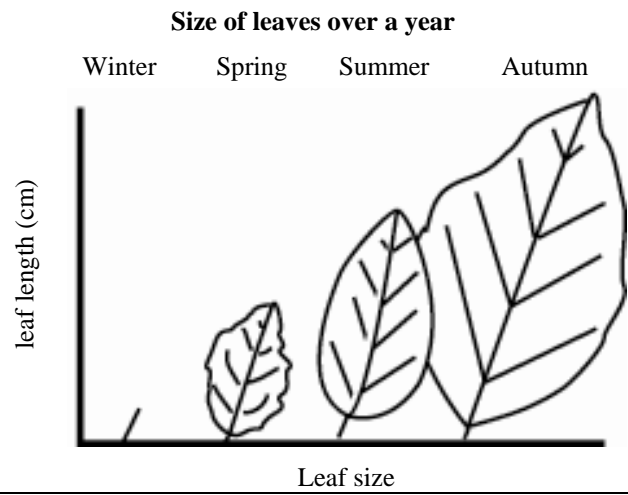
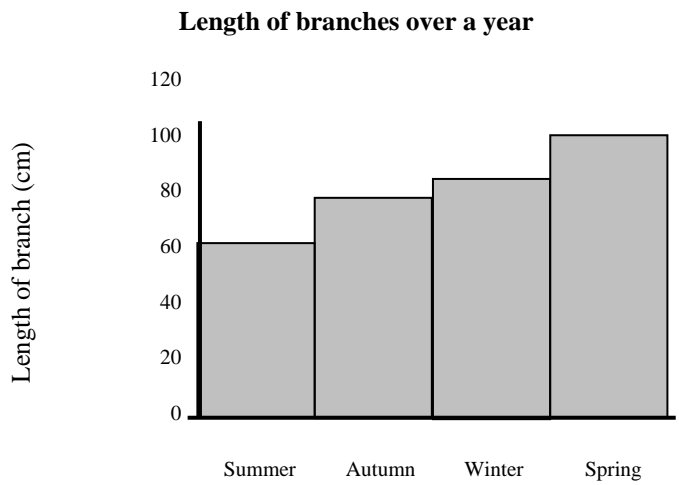
Tables

Showing times of the year when changes occur.

SEASONS		leaves	flower buds	flowers	fruit	seeds
	Sum					
Aut						
Win						
Spr						

4 Graphs

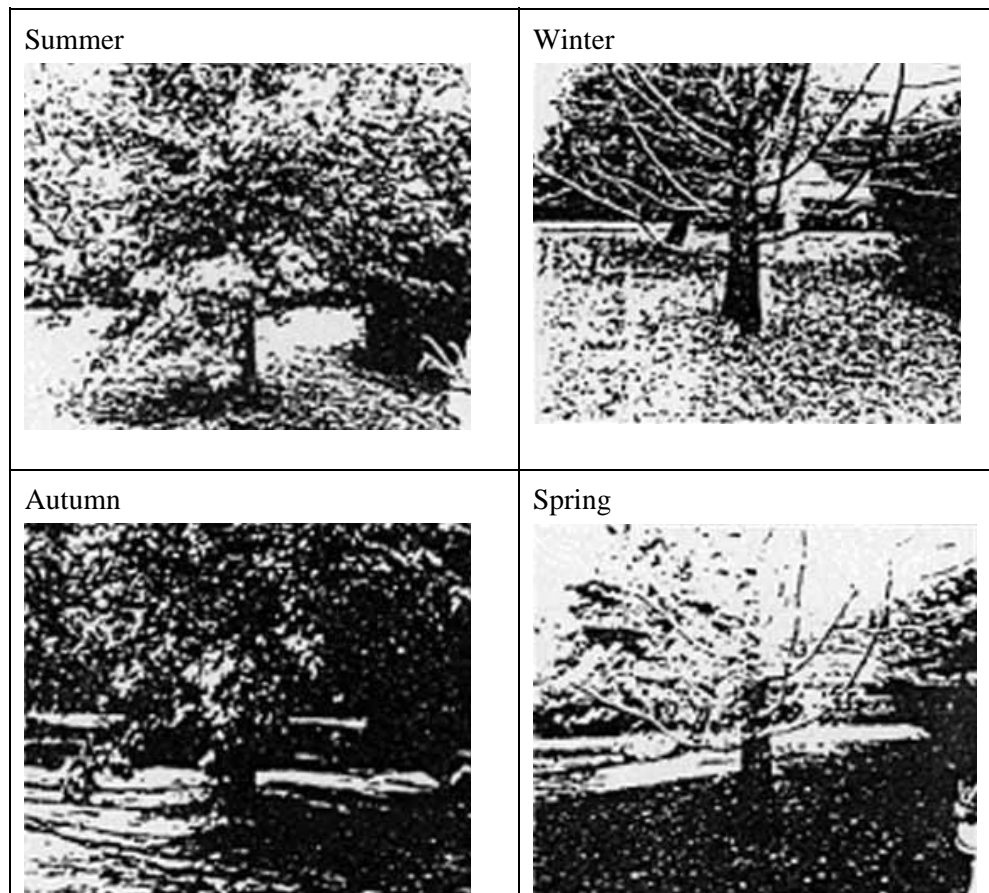
Of length of branches over a year, and size of leaves over a year.



5 Worksheets

What colour are the leaves?			
Summer	Autumn	Winter	Spring

6 Photographs of cycle



ACTIVITY: GROWING SEEDLINGS

Other plant investigations

Teaching note: You can investigate factors such as light, amount of water, open air or closed room, fertiliser. If you put seeds in a dark cupboard, they will grow quickly because energy is stored in the seed, but they will be pale, and not green like plants exposed to the sun. If you use a glass jar, with cotton wool or soil, and put the seed between the side of the jar and the cotton wool, the growth of shoots (initially down but they curve up) can be investigated in the initial stages.

Key idea: Seedling growth depends on light and water.

You will need:

- seeds (e.g. lentils)
- soil
- containers
- cotton wool
- water.

Grow seedlings by placing a seed in wet cotton wool or soil in a container.

Investigate the best methods and plants to use in growth experiments from seeds.

- What could be observed and measured in charting the growth?

- **What would be a relevant recording method?**
- **What factors that might affect growth could be investigated?**
- **What design considerations should be kept in mind?**

ACTIVITY:
TALKING TO
THE
GREENGROCER

Teaching note: Follow up the excursion to the market by putting together a book. Each child should decorate a page of the book, including writing a brief sentence or two about what they saw and liked best, relating this back to the parts of the plant.

It would be an advantage to take along a camera and take photographs of the produce and the children's responses to what they see. These photographs can then also be included in the class book.

Key idea: The plant parts we eat have a variety of functions.

You will need:

- **access to a local market**
- **paper**
- **materials and pens for decorating**
- **something to bind the book with**
- **a camera.**

Visit a market and look at the different vegetables and fruits on display. Identify which are seeds, flowers, fruits, roots or stems, etcetera.

Explanatory note: Examples of plant parts are:

- **Root:** carrot, beetroot, turnip
- **Stem:** celery
- **Leaf:** lettuce, parsley, bok choy, spinach
- **Fruit:** banana, apple, tomato, snow peas, beans, pineapple
- **Flower:** cauliflower, broccoli
- **Seeds:** peas, sunflower seeds.

Mushrooms are not classified as plants as they do not photosynthesise.

ACTIVITY:
DANDELION
STUDIES

Key idea: Structures in plants have an adaptive function.

Explore the following questions about the figure *Dandelion*.

Seeds

- **What is the average number of seeds per seed head?**
- **If all seeds produced plants and their seeds all produced plants, what would the population of dandelions be during the fourth generation?**
- **How long would it take a dandelion seed to germinate?**
- **Do they all germinate at the same time?**
- **Why is the seed so shaped?**
- **Can you find other plants with similar seeds?**

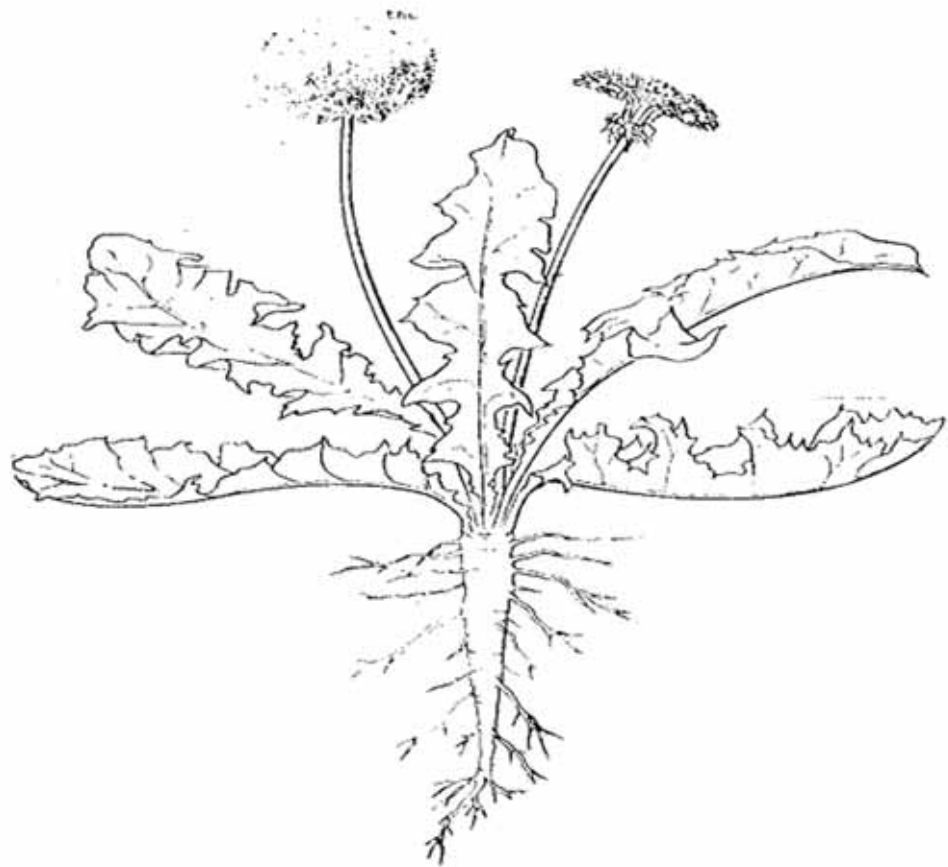
Leaves

- A plum flower produces only one seed. Why does this yellow flower produce so many?
- How does the leaf shape and leaf pattern assist this plant to survive in lawn areas?
- This dandelion has five leaves. Is this the usual number?
- In how many different habitats will this plant grow?

Roots

- In what kind of soil do you find the longest dandelion root?
- Is the latex (milk) that appears when you break open a root useful as a glue?
- What is the use of this latex to the plant?
- If the root is removed will the remainder of the plant produce another root?
- How much of the root is required to produce a new plant?
- What are the functions of the root?

FIGURE:
DANDELION



(J D Leach 1963, *Australian nature studies*, 3rd edn, Macmillan, Melbourne, pp. 165-7)