

Aussie Survivors

This activity is about plant adaptation.

The teacher notes include answers and explanations. They also have some ideas for extension work when you are back at school.

Suggested level: Years 5-9

Further resources are available to you through the Gardens' web site, www.anbg.gov.au/education/ and through the Environment Australia web site, www.environment.gov.au

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Australian Government
Australian National Botanic Gardens

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EDITION NO. 1

➡ HEAD ED (that's you!)

Aussie survivors



CANBERRA Today —
See survivors from prehistoric times in your walk along the Gardens Main Path. Some of them remain much the same as they were in the time of the dinosaurs, while others have had to adapt to survive the changes in Australia's climate. Since the break-up of Gondwana, Australia has become drier and more prone to fire. So you'll see plants that are almost fire proof, and actually benefit from being burnt! You'll see plants that rely on birds in order to survive. You'll see plants that climb over others, plants that are shape-shifters... and many more!

Welcome to the Australian National Botanic Gardens in the national capital.

1. DON'T PICK
FLOWERS, LEAVES, SEEDS OR FRUIT



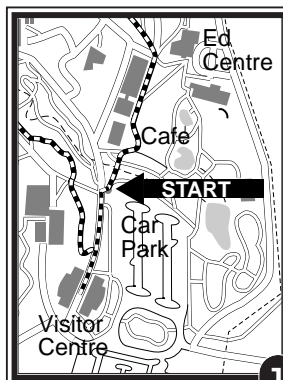
2. STAY ON THE PATH



3. DON'T LITTER OR BIRDS WILL THROW UP



4. LOOK FOR PATH MARKERS



Getting started

This activity follows the Gardens Main Path. It has markers every 10 metres that are black numbers on a grey background. You start today at [1].

Suggested approach

PRE-VISIT

- Familiarise yourself with the booklet.
- Cover any preliminary student learning required.
- Visit our web site.

WHILE AT THE GARDENS

- It is more beneficial for your students to observe, discover and develop attitudes and values, rather than reading and writing comprehensive answers to questions.
- Many of these activities are designed to heighten their observation skills and encourage thinking about what they are seeing.

POST-VISIT

- Follow up the extension ideas offered in the booklet. Some of them can be used on the bus.

Curriculum links

To help you evaluate your tour of the Gardens, some of the objectives and skills that are practised by your students when doing the exercises in this booklet are:

- observation
- description
- making comparisons
- recording
- critical analysis
- cooperative group activities
- word play.

They link across all the Key Learning Areas.



Dear Con,
Some issues are:

- *Small seeds imply:*
 - small food reserves
 - easy dispersal by wind.
- *Many seeds imply an increased chance of some reaching suitable places to germinate.*
- *Woody capsules imply protection from:*
 - heat
 - dehydration.

Signed,
Head Ed

1

- Coiling provides physical protection of the young fronds
 - reduces the exposed surface area
 - reduces the rate of water loss.

1

From the bridge over the Rainforest Gully, look down on the beautiful fronds of the Tree Fern (*Dicksonia antarctica*).



Fern fronds begin life as a coiled mass (called 'croziers') that unfurl as they grow. **This is an important adaptation.**

Can you think why?

18.5

- Paperbark:
 - provides good insulation against fire
 - maintains a more constant temperature for the bulk of the tree trunk.
- Paperbark smoulders rather than burns:
 - Indigenous Australians sometimes used it for cooking – like using a steamer today.

18.5

(Now I'm Con Fused!
What does .5 mean?)

Bark is another feature of many Myrtaceae plants. Stop and observe the soft papery bark on the *Melaleuca* species. This gives them their common name, paperbark.

What would be a reason for these *Melaleuca* trees having layers of papery bark?



13



21

The path now enters an area displaying a group of plants of the family Myrtaceae. This family includes gum trees (*Eucalyptus* species), bottlebrushes (*Callistemon* species), tea trees (*Leptospermum* species) and paperbarks (*Melaleuca* species). Myrtaceae dominate Australian vegetation with around 1700 species.

LETTERS TO THE EDITOR

Dear Head Ed,

I noticed that most of the Myrtaceae family produce lots of little seeds in woody capsules.

Why do they do this and why so many?

Signed,

Con Fused

ON THE BUS...



Write your reply to Con.


Dear Con,

Signed,
Head Ed

- The myrtaceous oils are usually quite unpalatable, protecting the plants from
 - browsing mammals like kangaroos and sheep
 - insect attack.
- The oils are also flammable and are found among the fire promoting plants, which benefit from fire to sustain themselves against competition from invading plants.

20

At the Crimson Bottlebrush (*Callistemon citrinus*), look through a leaf toward the light to see lots of tiny oil glands. These leaves smell slightly of lemon.

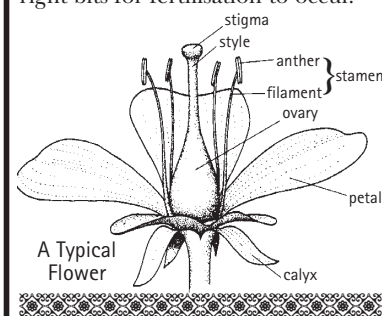
LOOK CLOSE 

Suggest how oil glands assist in the survival of *Callistemon* and other Myrtaceae plants.

 **RUDE bits!**




Flowers display their rude bits to passing birds and insects who, while drinking the plant's nectar, pick up a bit of pollen and then pass it on to the next flower that attracts them. Those birds and insects like a bit to drink and don't really mind where it comes from, so they are attracted by all sorts of rude bits — and after so much drinking and carousing, they sometimes drop the pollen on the right bits for fertilisation to occur.



24


Here you can see the grass tree (*Xanthorrhoea*).



If you were a kangaroo, would you eat leaves from a grass tree?

Yes or No?

Why?

LOOK CLOSE  **Suggest how grass trees survive bush fires.**

3

- The sharp leaves are avoided by herbivores like kangaroos.
- Grass trees as seedlings have large contractile roots, which pull the body of the plant well down into the soil to protect the apical bud (growing tip) from excessive water loss or damage from fire.
- The apical bud is also sunken into the crown of the hard, woody trunk in older plants, giving it some physical protection.
- The new leaves are arranged close to the apical bud and contain significant quantities of water which assist against scorching.

EXTENSION PROJECTS

- Investigate the nature of Australia's climatic change since the break-up of Gondwana.
- Research fire management practices in Australia:
 - by forestry staff
 - by Indigenous Australians.

[RUDE BITS]

EXTENSION PROJECT

- Find out the truth about pollination and fertilisation.

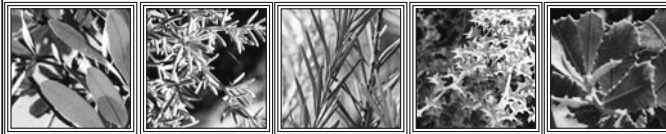


- Although individual flowers are similar, when the flowers are grouped as in banksias or the Tooth Brush Grevilleas, the whole flower head may confuse.



In this area, the plants displayed mostly belong to the Proteaceae family — also strongly represented in the Australian bush. It includes such well-known genera (groups) as *Grevillea*, *Banksia*, *Hakea* and *Telopea*. You may have some in your garden at home or back at school.

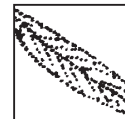
There are many different leaf shapes, sizes and textures, but despite their differences in size and shape, notice the similarity of their flowers.
(Head Ed comment: Con probably won't notice it, though!)



See how many different leaf shapes you can draw before you reach marker [48]. To draw them you might use some of these techniques: dots, lines, hatching, solids.



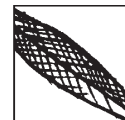
dots



lines



hatching



solids



ON THE BUS...

Like Myrtaceae, many of the Proteaceae have extremely tough, leathery leaves.

Suggest how this feature could assist plants to survive in harsh environments.



ON THE BUS

- Plants transpire, losing water through their leaves.
- A shiny, waxy coating that reflects heat frequently occurs over the epidermis (the outer layer).
- Many of these leaves have their pores ('stomates') sunken into the waxy coating and/or on the underside of the leaf. This:
 - reduces air movement
 - reduces the rate of transpiration.

39.3

- Lignotubers house a massive collection of dormant bud tissue.
- This enables the plant to regenerate after damage to the above ground parts by such things as:
 - fire
 - grazing by larger herbivores
 - drought
 - insect attack
 - wind damage.

EXTENSION PROJECT

- You might like to find out about lignotubers on mallee eucalypts.

39.3

(How is your approximation of 0.3 going?)



Hakea cycloptera shows a fine example of a developing **lignotuber**: a swollen stem base containing many dormant buds.

What could be the reason for a plant having a lignotuber?

44.5



Pause at the seat. Here you can add more leaf shapes to your set and observe the variety of plant forms amongst the grevilleas.



When in flower, these plants produce large quantities of nectar. What's the evidence?

49

Like grevilleas and bottlebrushes, the Saw Banksia (*Banksia serrata*) has grey-green flower spikes that are also nectar-laden.

The large seed follicles on the banksia fruit have not opened yet.

Why?

When would they open?

44.5

- Nectar attracts birds, insects and other animals (like possums) to the flower.
- These animals transfer pollen to other flowers they visit.
- This increases the chances of fertilisation and therefore seed production.

49

- In some banksias, the large seed follicles remain closed until the heat from a fire causes them to open, allowing the winged seed to disperse.
- Conditions on the ground after a fire are initially more favourable to seedling growth due to:
 - increased nutrients within the ash
 - less competition for water and light from other plants.



A range of environmental factors in the Sydney Region determine its plant associations:

- climatic factors:
 - temperature
 - rain
 - wind.
- edaphic factors:
 - geology
 - soils.

- topographic factors:
 - exposure
 - drainage
 - aspect.
- biotic factors:
 - birds
 - insects
 - animals
 - fire.

Find out more from:
Sydney's Bushland — More than Meets the Eye. Published by Royal Botanic Gardens Sydney.

Because of the variety of all of the above, a very diverse plant population exists.



The correct matches and where they're found:

- 1B [74.5]
- 2C [70]
- 3A [73]

67.2

- The Scribbly Gum Moth larva eats its way through the bark.
- It reaches a point where it appears to be too big, so it turns around and enlarges its tunnel on the way back.
- No one has ever observed this.
- Look out for roundabouts!

EXTENSION ON THE BUS

- Leaves hanging vertically ensure that the entire leaf surface is not subject to the direct sun throughout a whole day. Leaves are at an angle to the sun and reflect heat, reducing water loss.

52
67

PUBLIC ANNOUNCEMENTS

Sydney Region- Divisional Winner of Rich & Diverse Flora Category!

This is what it looked like in 1788.

NATIVE VEGETATION 1788 Sydney Region

69
79

Not chewing 'gum', *Eucalyptus* is a better name! See some of Australia's most widely distributed, large tree genus (group).

Match these three barks to their Latin name and common name.

A

B

C

1. *Eucalyptus eximia*
Yellow Bloodwood
2. *Eucalyptus multicaulis*
Whipstick Mallee Ash
3. *Eucalyptus patens*
Western Australian Blackbutt

LOOK CLOSE ON THE BUS...

Suggest how it might be an advantage if some leaves hang downwards — especially in inland Australia.

67.2 Graffiti in the Gardens!

This is what the culprit turns into.



- The hard seed coat ('testa') protects the seed from:
 - desiccation (drying out)
 - decomposition
 - some insect attack.
- This enables the seed to remain viable until favourable environmental conditions for germination to occur.
- The heat from fire causes the seed coat to crack, allowing water penetration. Germination can then occur.

- Phyllodes have significantly fewer stomates (pores), lessening the rate of water loss from the plant.

EXTENSION PROJECTS

- Investigate the differences between leaves and phyllodes.
- Suggest why a dry climate wattle might have phyllodes.

- Canberra is subject to quite cold winter conditions:
 - often experiencing three or four successive frosts
 - actual temperatures fluctuate daily from -8°C to $+15^{\circ}\text{C}$.
- The rocks act as a thermal mass:
 - absorbing heat throughout the day
 - radiating warmth to the soils at night
 - maintaining somewhat warmer temperatures
 - reducing the temperature fluctuation.
- This allows the Gardens to grow more frost-sensitive plants in the Rock Garden.
- The decomposed granite soil allows the Gardens to grow plants that can't tolerate waterlogged conditions.



They're everywhere — from ocean to desert, lowlands to the high country — as trees, bushes and ground-covers! Wattles, with their distinctive fluffy yellow flowers and pea-like seed pods, belong to the largest and most widely distributed Australian genus *Acacia*.

Can you find any Acacia seed pods containing the hard, shiny black seeds?



SUGGEST WHY THE SEEDS ARE SO HARD.

THE LEAF YOU HAVE WHEN YOU'RE NOT HAVING A LEAF!

Acacia parvipinnula on one side has retained its true leaves in contrast to *Acacia caroleae* on the other, which has modified leaf stems called 'phyllodes'.

How can you tell which is which?

Winter in Canberra is not always cold. The Rock Garden exhibits plants that might not otherwise grow in Canberra because

- it's too cold in winter.
- the clay soils provide poor drainage.

The large rocks absorb heat and maintain a higher soil temperature throughout the year. The imported soil is highly porous and has been used for increased drainage.

Suggest some characteristics of plants that would grow well here, but not in the nearby clay soils.

How could this be advantageous to the plants?

WHERE'S 'WOLLI'?

WHY IS 'WOLLI' IN A CAGE?



102.4

IT'S SO EASY BEING GREEN!

FEELING TIRED? HUNGRY?



If you're a growing plant, it doesn't matter where you are, **YOU'RE GOING TO NEED CHLOROPHYLL.**

Together with air, water and light, chlorophyll concentrate helps make yummy sugar to create healthy growth!

Chlorophyll is the green in your leaves that says,

'Hey, I'm alive and I'm healthy!'

And the miracle process that creates this sugar from light?

It's an age-old process with a funky new name:

photosynthesis (sold separately)

Plant sugar.
A natural part of life.



ON THE BUS...

Australia's MOST WANTED!

**'Here is the wattle,
The symbol of our land.
You can stick it in a bottle,
You can hold it in your hand.'**

Now you have a go at a second verse:

102.4

- Wollemi Pine (*Wollemia nobilis*) is classified as a rare plant, recently discovered in the Wollemi National Park, north west of Sydney.
- This cage keeps potential thieves out. Wolli is currently being propagated in large numbers for commercial release to the public, and the cage is to prevent the theft of propagation material.

[ADVERTISEMENT]

EXTENSION PROJECT

- Find out the truth about photosynthesis.

108.5

- The tall gums provide a canopy that shelters the rainforest from Canberra's:
 - hot summer sun
 - cold, frosty, winter nights
- They provide shelter and protection from wind, keeping the humidity high.

[LOOK CLOSER NOTES]

- Leaves are dark green because the light intensity in a rainforest is low and the plants need a large amount of the green pigment, chlorophyll, to absorb the little sunlight that is available.
- Plants in the understorey can absorb a higher proportion of the limited sunlight available if their leaves have a big surface area.

115

- There was no need to change because its environment didn't change.
- The rainforest environment has provided a stable habitat through the great climatic changes experienced in Australia through the later Tertiary Period, about 25–30 million years ago.

123.5

- Lilly pilly 'fruits' are the berries that contain seed. These berries are attractive to birds and other animals, which assists in the dispersal of the seed via the alimentary canal.

EXAMPLE JINGLES AND SLOGANS

- Don't be a really silly trilly, try lilly pilly!
- Eat your fill of lilly pill!

112.8

- Plants climb using:
 - tendrils
 - spines
 - twining stems
 - aerial roots.
- By climbing up trees the vines are able to reach more light.
- As a consequence, some vines constrict the host tree – and may eventually cut off the food supply to the roots.

EXTENSION PROJECTS

- You explained the 'crime', so try explaining the 'climb'.
- What is an epiphyte? Investigate the sorts of features that enable them to grow in forests.

116

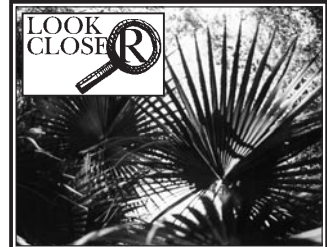
- The actual body of the fungus (*mycelium*) is inside the log or stump, living on the deadwood and producing the fruiting body which you can see emerging from its host.
- Fungi decompose organic materials to obtain their required food.

108.5

TRUE RAINFORESTS DON'T USUALLY HAVE GUM TREES!

The Rainforest Gully is 30 years old and totally fake. Around 2000 misting sprinklers keep the gully damp and humid.

If true rainforests don't have gum trees, why were they planted here in the first place?



Check out the Cabbage Tree Palm (*Livistona australis*). Palms (family *Arecaceae*) are one of the distinctive features of rainforests in warmer areas.

- Suggest why these leaves are:**
- dark green
 - big and flat
 - horizontal.
-
-

112.8 SEE THE STRANGLER IN ACTION!

At the Commemoration Seat, observe the climbing plants.

Find the murderer and explain the crime. Spot the victim. Is it murder? You be the judge.

115 Dinosaur alive!

The tall Antarctic Beech (*Nothofagus moorei*), like 'Wolli', has ancient relatives found as fossils in Antarctica. Many primitive or 'relic' plants live in rainforests and give us clues to the types of plants that lived millions of years ago.

LOOK CLOSER Suggest why this plant hasn't changed significantly from its ancient relatives.

116

The tree trunk on the forest floor is home to a Bracket Fungus (*Trametes versicolor*). Fungi aren't green and don't use light energy.

So how do they get their food?

123.5

FOOD FOR THOUGHT! A POO STORY...

Many birds relish the bright red berries of the Brush Cherry or lilly pilly (*Syzygium australe*). Though we can't eat all fruits, you may have tasted lilly pilly jelly. Lilly pilly belongs to the Myrtaceae family, but doesn't have the hard, woody seed capsules that you saw earlier — so they rely on other ways to scatter their seeds.

LILLY PILLY FRUIT

NEW LILLY PILLY PLANT

On the bus

Write an advertising slogan or jingle that will attract birds and animals to the lilly pilly berries.

