



Secret World:

Carnivorous plants of the Howard Sand Sheets

Education Kit



AUTHORISATIONS & ACKNOWLEDGEMENTS

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Drosera petiolaris, courtesy Emma Lupin

Cover– *Drosera*, *Utricularia dunstaniae* and
Utricularia chrysantha, , courtesy Emma Lupin

Header throughout the materials– *Drosera* by
Jasmine Jan





Greening Australia together with Nomad Art Productions, present

Secret World: Carnivorous plants of the Howard Sand Sheets
Education Kit

Produced with the assistance of City of Darwin, Climate Change and Environment Grants Program.

This education kit examines the environment, issues and science surrounding Howard Sand Sheets near Darwin. However, student activities can also be applied to other environmental locations.

The kit focuses on three strands of the National Curriculum F-10 through :

- **Science**
 - **Humanities and Social Sciences**
 - **The Arts**
- and the cross-curriculum priority of **Sustainability**



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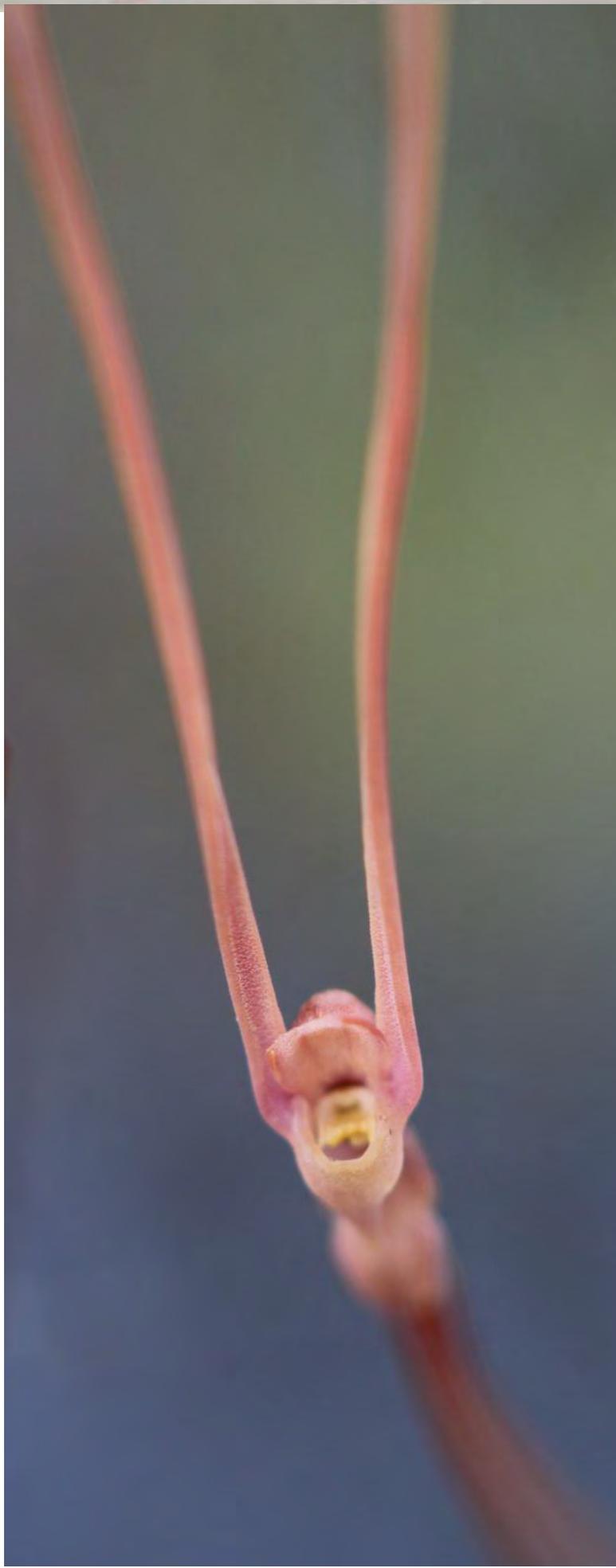
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INTRODUCTION

THE PLACE

The Howard Sand Sheet is a unique landscape type on the outskirts of Darwin. Relatively few people know about this special place and the amazing plants that grow there.

In 2015 the Howard Sand Sheets became the focus of an art project by a group of Darwin and rural artists. The group studied the plants and environment producing a beautiful art exhibition.

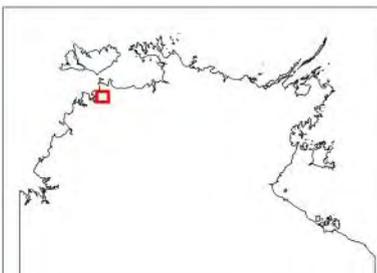
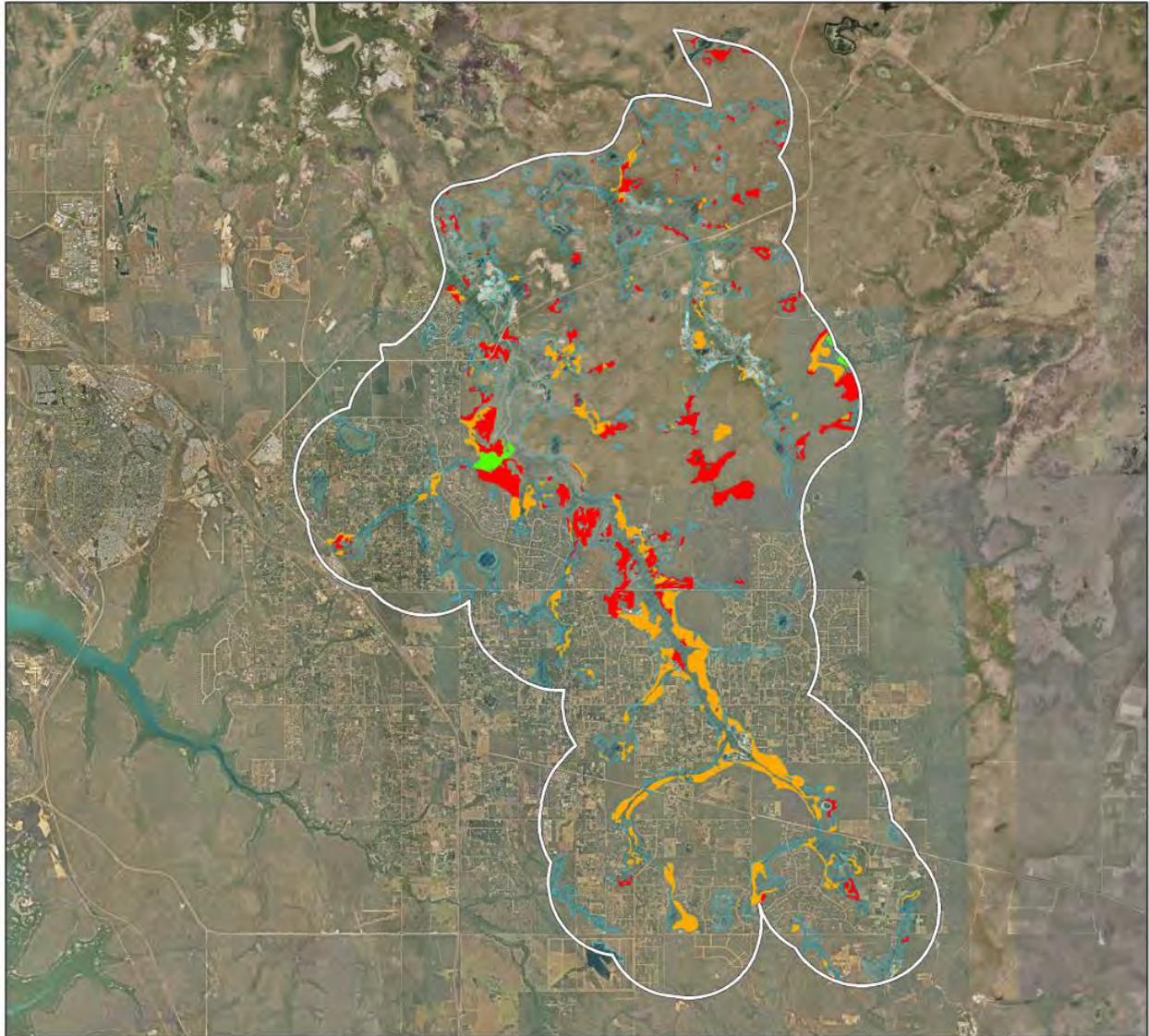


Where is it?

Within this area is the landscape type **Sand Sheet Heath**. It is found within the Howard River region approximately 30 km east of Darwin in the Northern Territory.

A landscape type is an area of natural bush which is defined by the plants that grow there because of different conditions.

An art exhibition is where artists display art together in one location, usually with a theme that ties it together. In this case the theme is the Sandsheet landscape and its flowers and the purpose is to tell the story of that landscape through art. Each artist will tell the story of this landscape in a slightly different way.



Legend

- Sandsheet Heath - Vegetation Community 3 (Liddle et al. 2013)
- Sandsheet Heath - Vegetation Community 4 (Liddle et al. 2013)
- Spring-fed Rainforest - Vegetation Community 16 (Liddle et al. 2013)
- Other floodplain and wetland (Liddle et al. 2013)
- Howard Sand Plains Site Of Conservation Significance (Harrison et al. 2009)

The landscape type is really quite small in size compared to other landscape types and is found in small patches on the Howard River flood plain. Howard Sand Sheet patches cover a total of 2258 hectares within the area.

There are slightly different types of Sandsheet Heath that have a slightly different range of plant types occurring on them. These can be seen on the map, as patches of red or orange.

Why is it special?

The landscape type is special and in the wet season it fills up with a shallow layer of water which sits through and over the sand. There is very little organic matter in the landscape, only a deep layer of sand, which means there are very few nutrients. Like animals and humans, plants need nutrients to grow. Nutrients are the plants' food. Most plants absorb nutrients which are dissolved in the soil through their roots. In these conditions there are very few nutrients to absorb, so the plants have adapted over a long time to find nutrients elsewhere. Many of these plants supplement the lack of nutrients in the soil with insects or microscopic organisms and are "carnivorous".



The small flowering plants start to grow and flower as the rains set in. The greatest abundance of flowers is at the end of the wet season in April, when the area looks like a sea of flowers.

Many of these flowering plants which are "carnivorous" are a group of plants called Bladderworts or called by their scientific name *Utricularia*.

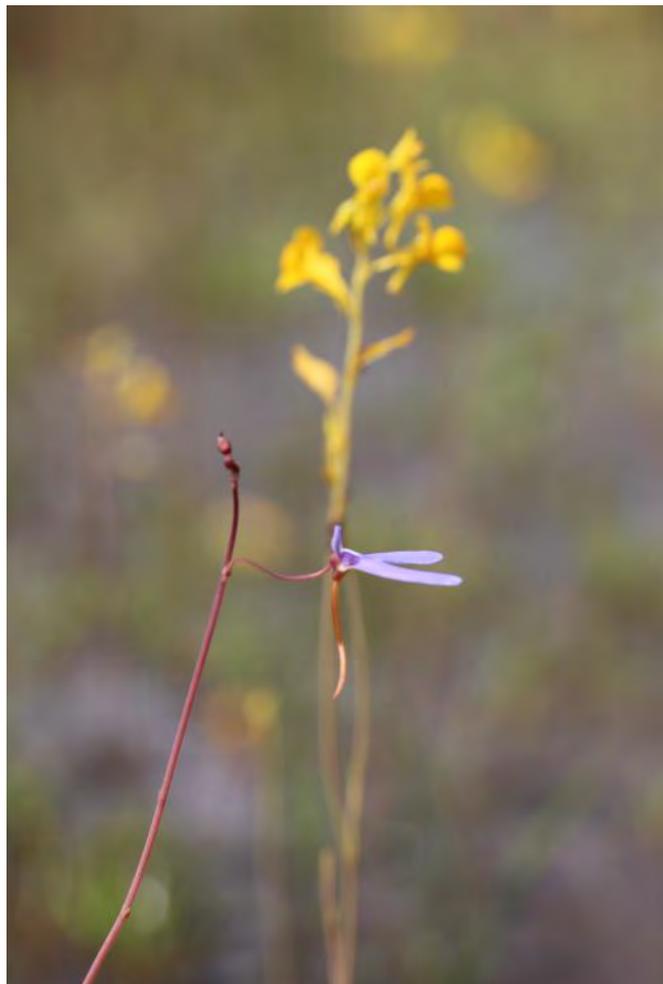
All of the flowers seem to attract insects, so they can be pollinated. Bladderworts intake extra nutrients by sucking in animals through special traps in their roots.



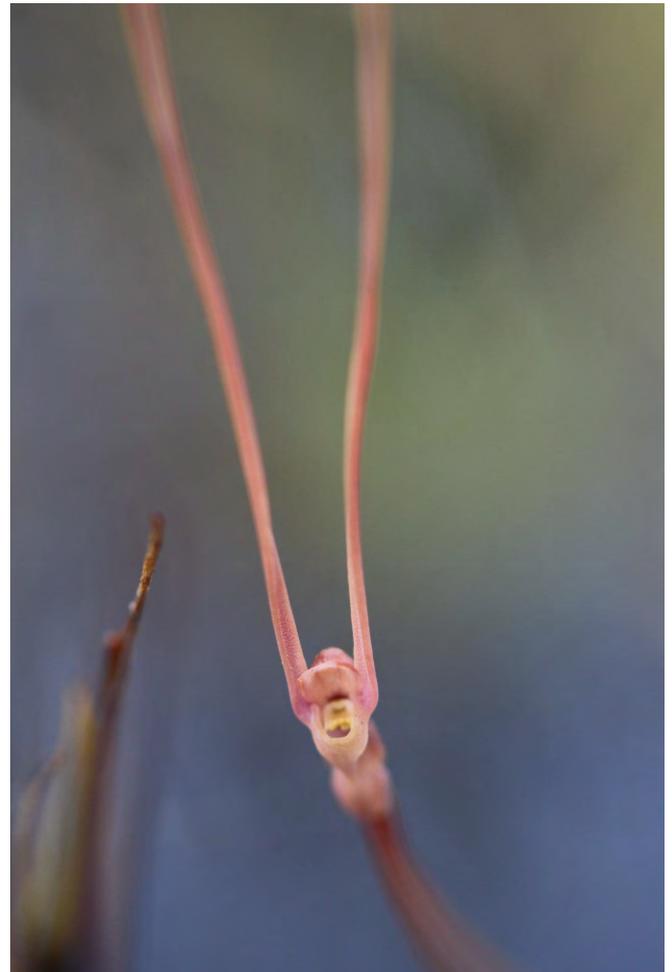
These animals are microscopic and they are moving through the water in and above the sand (they are aquatic). The plants have small sacs attached to their roots that have a door like mechanism which suck in these tiny creatures into the sac by creating a vacuum.

There are 36 known bladderwort species across northern Australia.

Microscopic– Something so small you need a microscope to see it



Utricularia odorata (yellow) and *Utricularia leptoplectra* (purple)



Utricularia dunstaniae

Bladderwort diversity

The Howard Sand Sheets is home to the greatest range or diversity of bladderworts in Australia and was even highlighted by Peter Taylor, an expert and author on Bladderworts. At the end of the wet season up to 10 species of bladderworts (*Utricularia*) can be found occurring within a small area of the sand sheets.

One of these species, *Utricularia dunstaniae* has been listed as a vulnerable species at a Northern Territory level. This means it is rare and only found in some places and the places where it is found are at risk of being changed or cleared.



The Sandsheet landscape makes up an important part of The Howard River flood plain, which supports a rich diversity of plants and animals and has also been an important food source for humans for a long time.

Other important species

In some areas of Howard Sand Sheet other rare species also are found.

A plant with the name *Typhonium taylorii* is found only in the Howard River flood plain so is endemic to the area. This is a small herb which appears after the first rains of the wet season.

An amphibian is also endemic– this is a small toadlet, which is a type of frog with the name *Uperoleia daviesae*, also called the Howard River Toadlet. The tiny frog is only two cm long, a brown colour and very difficult to see. It can be recognised by its call and usually is active at night.



Utricularias low in the landscape

The most intriguing part about the sand sheets' smaller plants are that they seem to be part of a hidden miniature world and actually form their own tiny landscape with small pools, delicate flowers and plants, insects and little frogs. It is not until you look closely from above that you can see so many aspects of the miniature landscape functioning. Humans often overlook aspects of the natural world as they only glance at it and take notice of things more similar to their body size.

Endemic– A plant or animal restricted to a certain place

Amphibian– An animal with a skeleton that includes frogs, toads, newts, salamanders and caecilians.



The Howard River Toadlet

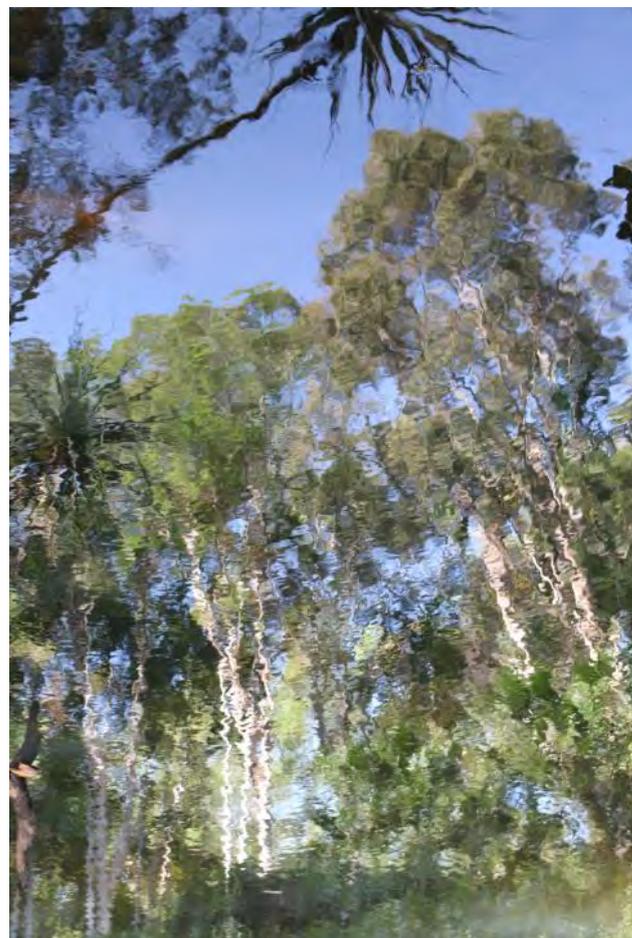


Water in the area

The Howard River floodplain and its sand sheets are also very important as they are a source of water. There are underground systems that are all connected in the area. Some of this water is in aquifers, which are like underground chambers that carry the flowing water.

Water is extracted from this area to supply water to people in Darwin for use in their households. It is mixed with water from Darwin River Dam and makes up about 20% of the water mix.

It is important to know how the water flows and how it supports the landscape, so that the underground water supplies can “recharge”, or fill up again.



Reflection of the Howard River

Why is it under threat?

The Howard Sand Sheet landscape is very close to Darwin, some of it is only 30 kilometres from the centre of the city. Darwin and the rural area continues to grow as there are more people and pressure is put on the land.

The area surrounding the Howard flood plain is becoming increasingly populated and divided up into rural blocks where people live and use the land.

Because these areas are a very specialised water system it is unlikely they will be built on, but there are no rules that say they cannot be filled in or tracks can't be made through them once it is subdivided. Also they will have cleared firebreaks, which change the water flow.

Why is it under threat? Continued

Because of how the sand sheet functions, it is very sensitive and any changes in drainage will affect which annual flowering plants can grow in it, particularly the *Utricularia* (Bladderworts).

As Darwin grows the demand for building materials also grows. One of these building materials is high grade concrete for houses, high rises and industrial buildings. The main ingredient of concrete is fine sand.

The nearest source of high grade sand to Darwin is the Howard Sand Sheet landscapes, it is easily accessible from its shallow deposits and the sparse vegetation is easy to clear. Small sand mines have been operating in the area for many years and the operations have increased as

construction increases. 22% of the landscape within the area of significance has been cleared for sand mining to date.

Due to the complex water flows of the landscape, when the sand is taken away the mined area fills with water. Where the sand once was is instead deeper water, where quite different plants start to grow. This starts to become another landscape type which is more like a melaleuca swamp.

Because some of the original plants are dependent on water depth and flow, it can be difficult to get the landscape back to the same as before. Some of the smaller bladderworts are quite sensitive and may not be recovered. Studies are being carried out with the mining industry to see what can be possible.



Clearing for sand mining in The Howard Sand Sheets

When people value a landscape for different reasons it can be hard to come up with a solution so that the landscape is managed well. To balance the different views about how a landscape is used a compromise may sometimes be made so that some of it can be conserved for its natural assets or features and some of it can be used by people for recreation or as a resource.

Finding a balance can often be complicated and a landscape is not valued if it is not seen to provide something that can be measured in money.



Artists in the Sand Sheet landscape

Value–

- 1) The material or monetary value of something*
- 2) Principle or standards of behaviour, judgement of what is important in life*

Compromise– An agreement or settlement of a dispute that is reached by each side agreeing to less than originally wanted.

Howard Sand Sheets: A unique environment on Darwin's doorstep

Student activities – **SENIOR**

Civics and citizenship, sustainability

1) Web search

Read the Education Notes and Exhibition Catalogue and discuss as a class.

As a follow up - divide into small groups and explore the following subjects in a computer lab. Use the websites to research various aspects of the Howard sand sheets. Make notes and report back to the class with your findings.

Group 1 The Place

Use a map to locate the Howard Sand Sheets.

Find out about the environment. What does the country look like?

What kind of plants and animals live there.

Describe the climate.

Group 3 What is a bladderwort?

How does it live? What makes it a unique plant?

Why do bladderworts live on the Howard Sand Sheets?

Group 2 Plants and animals

What are the rare and endangered plants and animals that live on the Howard Sand Sheets? Describe each species. Why are they important?

Describe the climate.

Group 4 Darwin Water

The Howard Sand Sheets are an important source of Darwin water. Describe how the water is taken from the area. Why is it important to keep Darwin water supply clean and plentiful? What can people do to make sure the water source is maintained?

Group 5 Conservation and development

Find out about the Howard River extractive industries. What kind of mining activities take place on the Howard sand plains. Why are they important? How are they managed? How can mining activities coexist with other important properties of the Howard Sand Sheets?

Group 6 Environmental Protection Authority

Look at the Northern Territory Environment Protection Authority – Environmental Quality Report. Summarise the findings to the class. Discuss.

2 Environmental Report

Imagine you are an environmental consultant. You have been asked to write a balanced single page report on the Howard Sand Sheets. Discuss the competing interests. Come up with a solution that may protect some of the sensitive species, but also address the need for concrete in the building industry.

3 Glossary of terms

Discuss the meaning of the following terms. Write your own description of each word in the context of the Howard Sand Sheets

Biodiversity

Extinction

Rehabilitate

Bladderworts of the genus *Utricularia*

Howard Sand Sheets: A unique environment on Darwin's doorstep

Student activities – **JUNIOR**

Civics and citizenship, sustainability

1 Research the environment around you- Make a study your school grounds.

Introduction

As a class discuss the following:

Natural environment

Urban environment

Biodiversity

Extinction

Conservation

Rehabilitation

Investigation

Divide in pairs. Go out into your school grounds.

With your partner identify all the different plants, animals you see, write them down in a note book. Or photograph them with a phone, ipad or camera

Back in the classroom

Share your findings with the class.

As a class write a list of all the plants and animals you found. Use a field guide or ask an expert to come in and help you do this. Discuss how the plants create habitats for the various animals that live there.

Discuss how you can attract more birds and animals into you school environment.

Application

Write a report to the grounds committee with the following headings:

1) *Location- Describe where your school is located?
What is special or unique about the environment?*

2) *Describe the different plants and animals that live there.*

3) *List the important activities that take place within the school grounds for both plants and animals and students?*

4) *How can you assist the plants and animals that live in your school environment?*

5) *Come up with classroom guidelines for the development and management of your school grounds and environment.*

THE PLANTS

There are many different plants in the world, which vary widely in size, shape and features. There are estimated to be 350, 000 species of vascular plants in the whole world.

Different plants adapt and grow in different climates and regions. The greatest diversity of plants is in the Tropics. In the “Top End”, which includes the Darwin region and Kakadu, there are 3,500 species.

Identifying plants

Plants are given names. Many plants have common names, but this can be confusing as the same plant may be given different names in different places that may have different languages.

Classifying plants

To make sure the correct plant is identified a worldwide classification system has been developed by the Scientific world.

Vascular plant– A green plant with a vascular system (transportation system) . These include seeding plants and ferns and are the majority of plants in the world.

There are seven levels to this system -

Kingdom- Plants
Division
Class
Order
Family
Genus
Species

Examples of plant families are

MYRTACEAE

CYCADACEAE

POACEAE

FABACEAE

Plant Divisions

In the Plant kingdom there are four major divisions-

Bryophyta-

Pteridophyta

Pinophyta

Magnoliophyta

Bryophyta: Bryophytes are small, herbaceous plants that grow closely packed together in mats or cushions on rocks, soil, or as epiphytes on the trunks and leaves of forest trees (for example mosses).



Pteridophyta: Pteridophytes are the non-seed or spore-producing plants such as ferns. They normally reproduce by spores which are often seen as brown spots on the underside of leaves.



Pinophyta: Also known as Gymnosperms, these are plants that bear seeds in cones such as conifers and pine trees.



Magnoliophyta: Also known as Angiosperms, these are flowering plants found all around the world. They produce seed enclosed in a fruit to reproduce.



Fern Leaved Grevillea.

Scientific name- *Grevillea pteridifolia*



How are plants named?

As you can see from above, the scientific name a plant is given is from the genus and species, the genus is the first part of the name.

Many other plants are also Grevilleas, meaning they have similarities and are grouped together (in the same genus) but only one type of plant is *Grevillea pteridifolia*. That makes it its own species and like no other plant and because of this it has its own name.

Scientific names seem complicated, but once you break them down they usually have a story and are easier to understand.

The names often come from Latin or Greek and can be named after the plants features. Names can also be given in honour of a famous or rich person of the time when they were “discovered” by the scientific world.

Do remember that plants often had names and were known before the scientific world, often through European explorers naming them. In Australia these were often language names (see later section).

This scientific naming system is worldwide, so allows plants with similarities or differences to be compared across the world and many different countries.

Grevillea is named after Charles Francis Greville, who was a member of English aristocracy at the time explorers described the type of plants.

Pteridifolia is from Greek- “Pteris” meaning fern and “folia”, meaning leaf- so altogether meaning fern like leaf.

Other names for plants

Common names are easier to remember, but many plants may have the same common name. Eg “Wait-a-while” is a name often given to a plant that has thorns and sticks on clothes or skin as you walk by it.

As you can see below this common name refers to very different plants, with different forms, that are in different plant families and occur in many locations.



Left– *Calamus species* (readtiger.org)



Right– *Smilax australis* (floragreatlakes.info)

Common Name	Locality	Botanical name	Botanical family	Habit
Wait-a-while	East Coast Australia	<i>Calamus muelleri</i> .	ARACEAE	Climbing Palm
Wait-a-while	Northern East Coast Australia	<i>Calamus aurensis</i>	ARACEAE	Climbing Palm
Wait-a-while	NT, Queensland and NSW	<i>Smilax australis</i>	SMILACEAE	Shrub
Wait-a-while	Northern Australia, SE Asia and Pacific Islands	<i>Caesalpinia bonduc</i>	CAESALPINIACEAE	Climbing shrub
Wait-a-while	SE Asia, introduced elsewhere	<i>Caesalpinia decapetala</i>	CAESALPINIACEAE	Climbing shrub
Wait-a-while	Western Australia	<i>Acacia cuspidifolia</i>	FABACEAE	Tree
Wait-a-while	Southern US, Mexico	<i>Senegalia greggii</i>	FABACEAE	Tree
Wait-a-while	Southern US, Mexico	<i>Mimosa aculeaticarpa</i>	FABACEAE	Shrub

Other names for plants

Language names can also be different for plants. This is particularly true in Australia where some species of plants are found across a large region, but Aboriginal people were or are living in many of the different regions and have different names for the same species of plant.

Example- Green Plum, *Buchanania obovata* (family ANACARDEACEAE), a common woodland tree found across Northern Australia which fruits in December and is good bush tucker.



Botanical name	Language name	Language group	Region
<i>Buchanania obovata</i>	Yankumwani	Tiwi	Tiwi islands, NT
<i>Buchanania obovata</i>	Mi-wurrngin	Marri Ngarr	Moyle River, Port Keats, NT
<i>Buchanania obovata</i>	Elu	Malak Malak	Daly River, NT
<i>Buchanania obovata</i>	Munydjutj	Yolngu	Arnhem Land, NT
<i>Buchanania obovata</i>	Yurrulk	Iwaidja	Coburg Penninsula, NT
<i>Buchanania obovata</i>	Kurumal	Jawoyn	Katherine region, NT
<i>Buchanania obovata</i>	Birnak	Warray	Upper Adelaide River, NT

Using features to identify the plant

Certain features of a plant can be used to identify them. The more features that you can gather the easier it is to identify the specific type of plant (its species). The habit is the form the plant takes and helps identify the plant. The flower is often the most useful feature as it is unique for each species, but flowers may only be on the plant at a particular time of year.

Habit

How does it grow?

E.g. Is it a large tree, a vine, a small herb, a shrub or a grass.

Bark

What type of bark does it have?

Only larger shrubs or trees will have bark.

See the diagram over leaf.

Flowers

What is the flower like?

There are many flower shapes and types .

Look at the colour and features. Some plants will not always have flowers on.

Look at the flower diagram over leaf.

Leaves

What shape and arrangement are the leaves?

There are many shapes, textures and arrangement of leaves on a plant.

Habitat

Knowing where the plant comes from may also help you identify it. In the natural environment there are different habitat or landscape types where you find different types of plants.

If a plant is a garden or an area that has been planted by humans identifying the plant may be harder as plants from all over the world may be planted. The plants would have to be from the same climate zone and often would be a popular garden plant.

What can help you identify NT plants?

You can use different resources to help you;

There are guides to different plants and keys.

Keys are like a code that let you find out what species of plant you have.

You can also contact an expert or person with local knowledge.

Some recommended reading for NT plants:

“Native Plants of Northern Australia” by John Brock, published by New Holland Press

“Jawoyn Plants and Animals” various contributors, published by NT Government, NRETAS.

“Native Plants for Top End Gardens” by Nicholas Smith, published by Greening Australia

www.topendnativeplants.org.au has a good key to native flowers, by colour.

Bark

BARK



BARK

Barks of trees vary enormously. Some of the more common types are:

Corky bark — the trunk has deeply furrowed bark with thick corky cells, these cork cells tend to have thin-walls and are filled with air.



Cracked bark — as a trunk increases in size, great tension on the bark can cause vertical and/or horizontal cracking.



Fibrous bark — stringy types of bark made from closely held fibres.



Fissured bark — the trunk has a net-like pattern from splitting of the outer and inner bark.



Flaky bark — pieces of bark crack and come away from the surface.



Peeling bark — the bark on the trunk separates like thin wrappers, peeling from where a layer breaks.



Scaly bark — the trunk has small patches of bark that shed giving a scaly appearance.



Smooth bark — the trunk can be smooth and very glossy to dull, generally it has a very thin outer bark.



Eucalypts are often grouped by their bark type.

1. Rough barks e.g. stringybarks, bloodwoods, boxes, peppermints and ironbarks. e.g. *Eucalyptus phoenicea* Scarlet Gum.



2. Smooth barks e.g. scribbly gums and white gums. e.g. *Eucalyptus alba* White Gum.

Leaves

When identifying a plant by its leaves look at its
leaf type

leaf shape

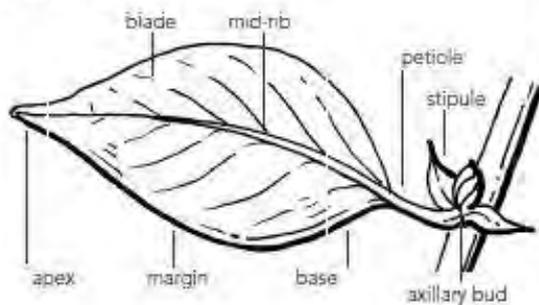
Leaf arrangement

Veins in the leaf and also the leaves texture and colour.

LEAF TYPE

There are two major leaf types Simple and Compound.

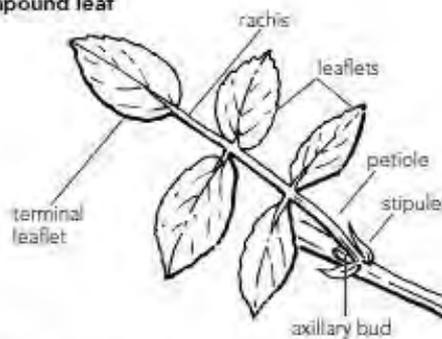
Simple leaf



SIMPLE – A simple leaf has three main parts:

- The **blade** which is the broad part of the leaf where food is made.
- The **petiole** which is the stem-like part that holds the blade.
- The **stipules** which are mostly small, leaf like structures found in pairs at the base of the petiole where it joins the stem, these protect the axillary bud.

Compound leaf



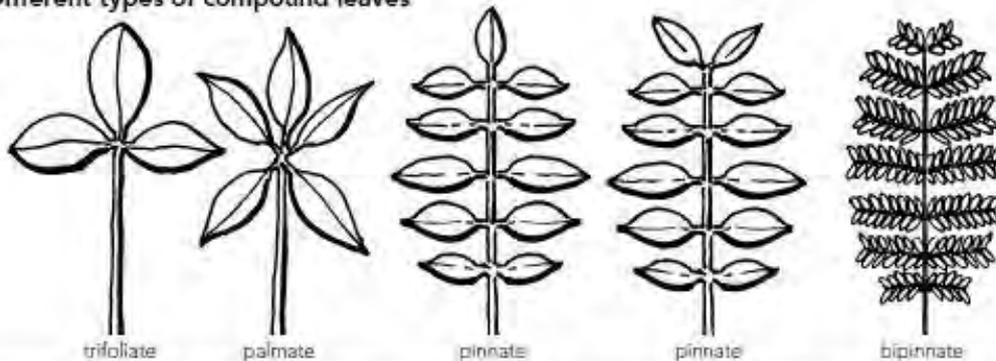
COMPOUND – A leaf that consists of a number of distinct leaflets.

It is important to be able to tell the difference between a simple and a compound leaf.

An **axillary bud** will be present at the junction of the leaf and the stem.

Leaflets will never have axillary buds (leaflets don't have stipules either, sometimes the stipules fall off and leave a scar which is another hint that it is not a leaflet).

Different types of compound leaves





Leaves (continued)

LEAF ARRANGEMENT

Leaves of all types can be arranged in various ways.



alternate



opposite



whorled



radical

LEAF SHAPE



acicular



linear



lanceolate



oblanceolate



falcate



spatulate



oblong



rhomboid



cordate



obcordate



oval



elliptic



ovate



obovate



lyrate



deltoid



reniform



orbicular

LEAF VEINS

Leaf venation refers to the types of veins in the leaf.



pinnate



parallel



reticulate



palmate

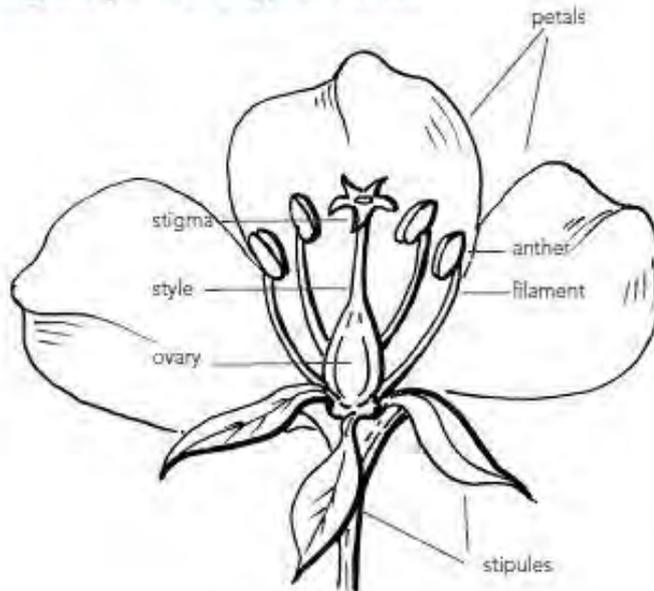


dichotomous

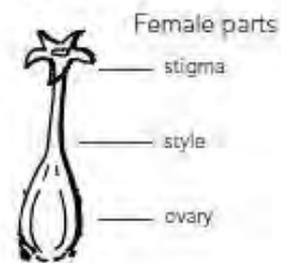
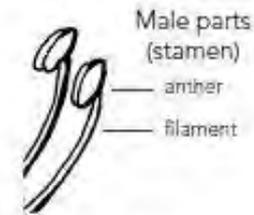
Flowers

FLOWERS

Describing the parts of a typical flower



FLOWERS



Describing how flowers are arranged on the plant

Flowers are normally arranged in an inflorescence which is really a term for a group of flowers. They come in many different types. The most common types are given below.

Solitary — borne singly (a single flower).

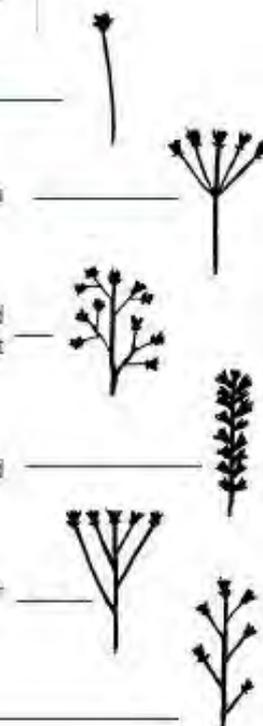
Umbel — a flower cluster with stalks of equal length arising from a common centre to form a flat or curved surface.

Raceme — a flower head where stalked flowers are on an unbranched axis, the oldest flowers are at the base and the youngest at the top.

Spike — a long unbranched cluster of stalkless flowers produced along a central axis.

Corymb — a cluster of flowers with lower stalks proportionally longer so that the flowers form a flat topped head.

Panicle — a loose branching cluster of flowers.



Habitat



Woodland: The most widespread habitat in the Top End, woodland has an overstorey dominated by eucalypts and an understorey mostly of tall grasses. It also contains many other trees, shrubs, cycads, grasses and herbs.



Sandstone escarpment: An escarpment occurs at the edge of a sandstone plateau. It is a rocky cliff-face that supports hardy woodland in the better-soiled areas, and spinifex in the drier, rockier parts. The plateau behind is covered by woodland vegetation, while waterfalls and gorges at the escarpment base support monsoon forests.



Coastal: Beaches and sand dunes line parts of the coast not fringed by mangroves and mudflats, and support a distinct coastal group of plants.



Mangroves: These plant communities form belts along the coast including tidal creeks and rivers. They are subjected to periodic inundation by seawater. Typically the mangroves grow in zones or belts of the same species, often parallel to the coast depending on the amounts of tidal inundation they receive. There are over 30 different species recorded from the Northern Territory.



Monsoon forest: These forests are dark green in appearance. Located in fire-protected areas around springs, water bodies, waterways, escarpment valleys, coastal areas and rocky outcrops, they typically cover small areas. They generally have a closed canopy with a sparse understorey including ground ferns, palms and saplings. Sometimes they are referred to as vine-forests and when found in gorges at the edge of escarpments are called gallery forests. Their structure varies considerably depending on water availability and soil type, those around permanent water on the deep-soiled lowlands (wet monsoon forest) being taller and more diverse than those found in coastal areas and on rocky outcrops (dry monsoon forest) where they may be thicket like in appearance.



Riverine: The Top End's rivers support corridors lined with a narrow belt of plants referred to as riparian vegetation. While some species are specific to this riparian habitat, many also occur in monsoon forests.



Wetland: The Top End's high rainfall produces large wetlands including floodplains and billabongs. The floodplains are extensive, flat and usually treeless. As the dry season sets in, water gradually recedes to the permanent billabongs. The edges of these permanent wetlands are fringed with trees.

PLANTS OF THE SANDSHEET

There are particular plants that grow in the Howard Sand Sheet landscape that have adapted to the nutrient poor conditions. There is a deep layer of sand and very little topsoil. During the wet season the landscape fills with fresh water that sits 2- 10 cm above the surface of the sand at its peak, and forms subtle pools in amongst the small ridges of the under layer.

The surface is shaped by tiny mounds formed by a sedge like plant (*Dapsilanthus spatheceus*) and worm activity, leading to the name “Devil-devil country” which is sometimes used to describe it.

Below the surface the water moves slowly through the sand and across the surface during the wet season, with peak flow being between January and April.

Water continues to filter through the landscape from adjoining higher woodland country until the beginning of the dry season.

These special conditions of low nutrients and shallow water flow have led to some incredibly specialised and unique species inhabiting the landscape type and filling a niche where many others cannot survive.

There is a sparse layer of trees in the mid-upper layer, which are adapted to sitting in water during the wet season. These also can occur on the margins of rivers and floodplains

The tree layer includes:

Verticordia cunninghamii

Melaleuca nervosa

Melaleuca dealbata

Banksia dentata

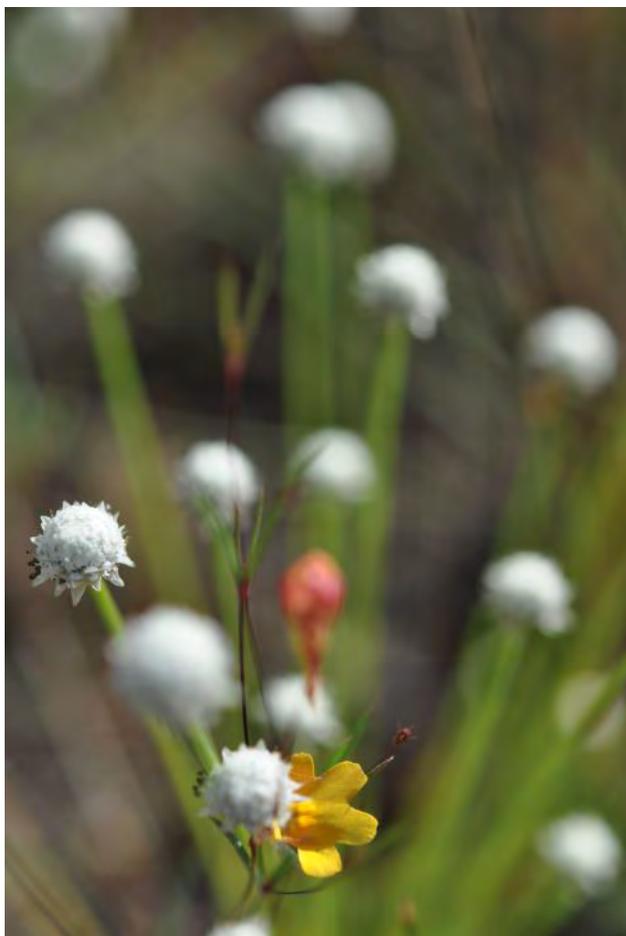
Grevillea pteridifolia



Verticordia cunninghamii and a Golden Tree Snake.



The understory of Sand Sheet Heath has a much higher diversity of plants and many of these are flowering and only present in the wet season and early dry season. Some of the flowering plants are found in a variety of wet landscapes but some are only found in Sand Sheet Heath, so are very unique.



Eriocaulon and Utricularia flowers

It is the diversity of bladderworts which is particularly unique to the Sand Sheet Heath. Some of these species are rare and only found in this habitat. One of these species is only found in this region and nowhere else. This makes it endemic. This species is *Utricularia dunstaniae*.

What is a carnivorous plant?

A carnivorous plant is a plant that intakes some of its nutrients by trapping and consuming animals. The animals can be small insects or tiny micro-organism and even protozoa (single celled organisms). Carnivorous plants mostly live in nutrient poor landscapes, where they have adapted to substitute a good nutrient uptake in the soil with other organisms. Landscapes where carnivorous plants have adapted include rocky outcrops, bogs and of course sandy landscapes such as Howard Sand Sheet.

There are different types of Carnivorous plants; those with-

- 1) Pitfall trap*
- 2) Adhesive or fly paper traps*
- 3) Snap trap*
- 4) Lobster traps*
- 5) Bladder traps*

How do carnivorous plants work?

There are several different types of carnivorous plants which catch their prey in different ways.

Pitfall traps: One of the most famous kind of carnivorous plants are Pitcher plants. These plants are in the families Nepenthaceae and Sarraceniaceae and have a pitfall traps to which insects are attracted and then fall into. The insect is then digested through the walls of the trap.



Nepenthes vetchii from Curtis's journal
1859



Dionaea sp. botanical drawing

Snap traps: Some plants use snap traps like the genera *Dionaea* and *Aldrovanda*. The most famous is the Venus Fly Trap (*Dionaea muscipula*) which have traps triggered by movement. They are found in the Americas.

Adhesive traps: Another mechanism plants can use is an adhesive trap mechanism. Examples of these plants are *Drosera*, which are a genus of plant that also occur on the Sand Sheet Heath and have mobile sticky tentacles that trap tiny insects.



Darlingtonia californica by Serre Froide.
An example of a lobster trap carnivorous plant.

Lobster traps: There are plants that have lobster traps.

Examples of these are the genus *Darlingtonia*, and the genus *Ginlisea*. These plants have modified leaves which are traps that attract insects or tiny organisms into, these have a mechanism of inward facing bristles that mean their prey cannot escape, much like a lobster trap. *Ginlisea* have these mechanisms

Bladder traps: Finally we come to the group of plants found on the Sand sheets in their greatest diversity: plants that use bladder traps. These use suction to catch their prey and more is written about them below. *Utricularia* are plants with bladder traps



Utricularia sp. by Vincent Brooke Day

What is a Bladderwort?

The collective common name for the plant genus *Utricularia*. There are 36 species of Bladderwort within Australia and over half of these are found in the Darwin region. These plants are carnivorous.

These plants are small herbs in the Lentibulariaceae family. They can be small and cryptic, like *Utricularia simsii*, which is smaller than a tiny pin, or larger and obvious with a long stem like the showy *Utricularia odorata*.

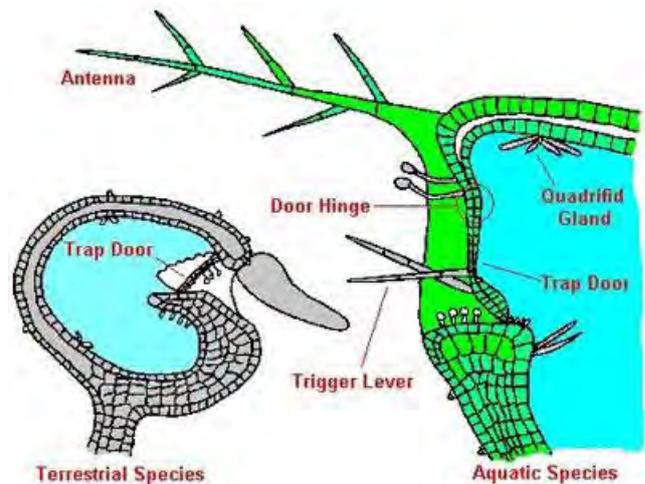
(bladderwort photos can be seen on page 35 and 36)

Some of the *Utricularia* are fully aquatic, and others, like those most common in the sand sheet sit in slowly moving water and catch their prey.



Bladderwort traps

What *Utricularia* (or bladderworts) have in common is the specialised and rather secret mechanism they have to trap tiny organisms. These special suction bladders are in their roots, so unlike the other carnivorous plant species that we covered above, it is not obvious on first glance that the plants are trapping tiny animals.



A bladder mechanism of the Bladderworts

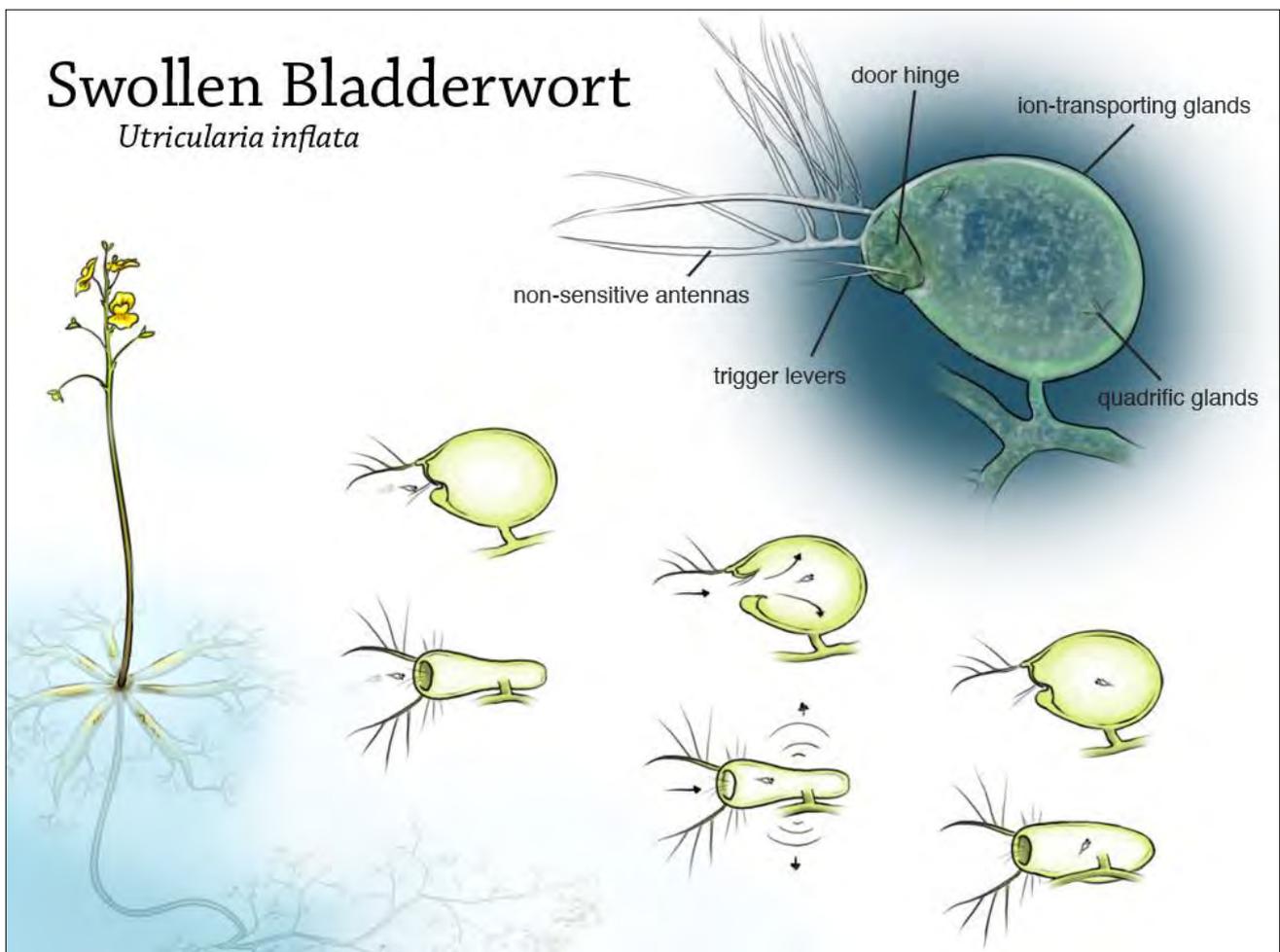
www.carnivorousplants.com



How does a Bladderwort work?

The plant traps these tiny animal into bladders or sacs, which are attached to the roots. These little sacs have a mechanism that uses suction, by causing a vacuum within the sac.

The sac has a door and hinge seal and small trigger hairs on the outside. When touched by the micro-organism the vacuum is broken and surrounding water and the prey is sucked into the bladder.



When can you find bladderworts?

In the Darwin region bladderworts are annuals. This term means they appear once a year with the seasons. They reproduce by seed. They flower, are pollinated and then seed falls into the ground for the next season.

The bladderworts are annuals because of the seasons and the rain. In Darwin the rain comes for about five months and then stops for about five months, with a couple of patchy months in between.

Bladderworts start to grow and flower when the rains start and are found in the Darwin region between December and June.

Species of bladderworts

The plants need water for them to catch the tiny animals in their specialised suction sacs and so are only found when there is water in the sand sheet, or in other habitats where they grow.

Different species flower at different times, depending on the depth of water. Some species are quite versatile, whereas others, like the smallest species need shallow water.

There is still a lot more to find out about bladderworts. Some are so tiny and hard to find their presence is often not known.



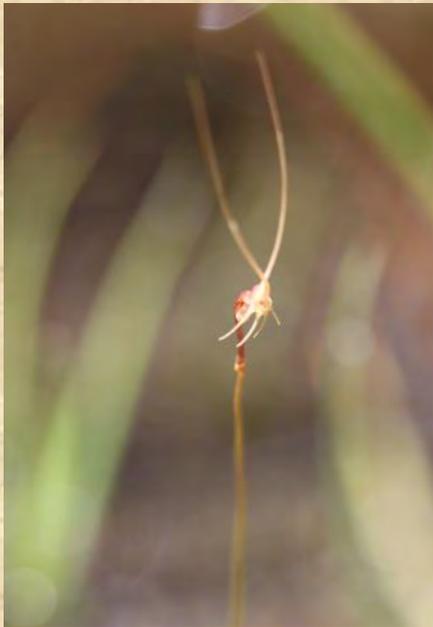
Utricularia odorata



Utricularia chrysantha



Utricularia leptoplectra



Utricularia capilliflora



Utricularia dunstaniae



Utricularia holtzei



Utricularia lasiocaulis



Utricularia hamiltonii



Utricularia kamienskii

Botanical Illustration

Student activities – SENIOR

Natural Science

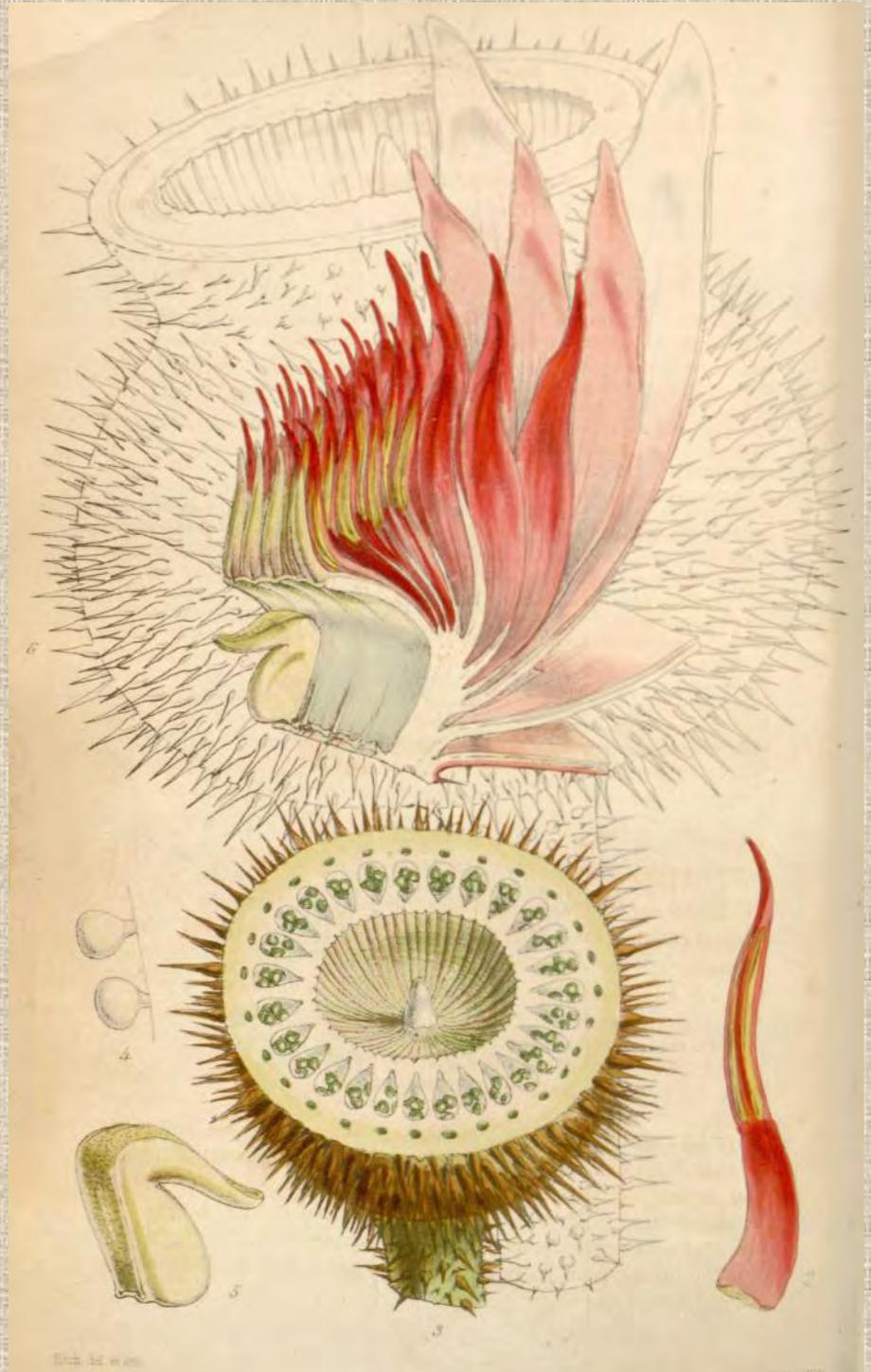
1) Introduction

As a class discuss the idea of botanical illustration. Why do scientists use botanical illustrations when describing or studying plants?

Botanical illustration is an exact art form that carefully shows the makeup of plants. It is used to make scientific descriptions and is an artistic composition as well.



Example- Victoria Regina
Botanical Illustration by
Walter Hood Fitch circa
1847 (right)



2) Investigation

Look at some botanical drawings. Discuss how accurate scientific drawings need to be. How can an artist achieve accuracy when drawing from live plant materials?

Discuss how tools, such as rulers, compass, grids, photocopier and scanner can be used to help make an accurate drawing. Discuss the idea of composition and balance.

Choose a plant to illustrate. Decide how you are going to show the different elements such as seedpods, flowers, roots and leaves.

3) Application

Collect a plant for the illustration. Lay the plant or parts of the plant to form a composition. Measure and plan an arrangement of the plant material so all the parts fit on the paper while maintaining a pleasing arrangement. Pay attention to the number and type of leaves, petals, length and girth of stems (internodes) and colours. Consult leaf type diagrams and anatomy graphics. It will not be possible to show all phases of the plant simultaneously (bud, bloom, fruit). It may not be possible to show roots if plant has been cut or is in the ground.

Begin the drawing process with a hard-lead pencil onto paper. Try different drawing methods to refine the drawing i.e. use a ruler, tracing paper or a photocopier. Make all the necessary changes on this sheet until the drawing is satisfactory in scale, proportion, shape, and accuracy.

When complete, compare the drawing of the plant to a written description or illustration, found either online or in a field guide. Check for accuracy, scale, and proportion.

Use tracing paper to lightly transfer the drawing onto watercolour paper, or if you are confident redraw the plant lightly with a hard pencil. Begin painting with light washes of watercolour with small brushes. Experiment with techniques for creating washes, shading, and textures. Consult botanical references for examples.



Finally write your own description of the plant. This description can be used as label for display. Display the drawings with labels telling the name of the artist, name of plant (common and Latin names), medium, date and text description.

Try a second version of the drawing using pen and black ink. Use lines, dots to create textures and tones. Try “blowing up” a section of the illustration as a separate drawing. Use a grid to enlarge the drawing to scale.



Example- Victoria Regina Botanical Illustration by Walter Hood Fitch circa 1847
Drawing 2 (above)

Plant function, design and illustration

Student activities – JUNIOR

Natural Science/ Art– Creative Arts

1) Introduction

Look back at the notes and the different types of carnivorous plants that are found in the world.



2) Investigation.

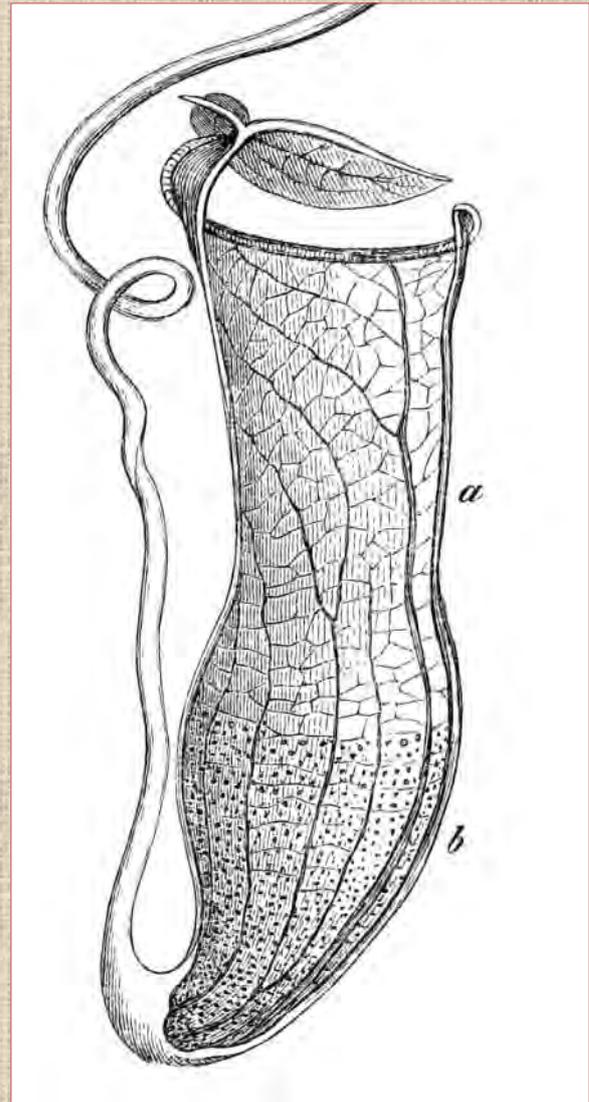
In groups find more information about these plants, how they work and where in the world they are found, using books and the internet. Find as many pictures, photos and diagrams as possible.

Make notes and present this to the class., if possible with chosen printed or projected images.



3) Discussion.

As a class discuss the different images found and find any that are botanical illustration. Why do scientists use botanical illustrations when describing or studying plants?



Carnivorous plant diagram in a scientific style.

Botanical illustration is an exact art form that carefully shows the makeup of plants. It is used to make scientific descriptions and is an artistic composition as well.

4) Design

Taking ideas from your investigations into carnivorous plant designs, design your own carnivorous plant.



Using a pencil, draw your plant in a scientific way, as if just discovered by science. Add labels showing all of its parts and how it works.

When designing your plant think about what it will eat and where it lives– what is its climate and habitat? . Write this at the side of the drawing.



5) Freestyle Drawing

Now using different materials such as paints or coloured pencils or pastels make another more artistic and less scientific drawing of your plant. This can be more expressive and abstract.



Finally give your plant a name.



Carnivorous plant drawing by Deadia 1989

The world around me

Student activity – **JUNIOR**

Science – Biological sciences, Science as a Human Endeavour

Introduction

This activity involves investigating plants in your school environment.

As a class discuss your school grounds. What is your favourite place to play or to sit? What makes it a good place. How do trees and plants help make places better? Do you have a favourite tree or a place you like to explore and play, to daydream and imagine?



Investigate

Together with your class, go outside into your schoolyard with a notebook, mobile phones or a camera. Divide into groups.

IN your group chose a plant– a tree, shrub or garden flower in your school grounds or in a near by location. Make observations and notes about it. Describe the location it is in. In your group you may choose more than one plant.



Back in the classroom

Try to identify your tree or plant.

Use different keys, guides to plants and the internet.

Use the table provided to fill in the details about the plant





Fill in the details of you plant or plants below.

Use a guide, key and the internet as well as knowledge from experts (if possible) to identify your plant or plants.

Plant Feature	Plant 1	Plant 2	Plant 3
Common name			
Language name			
Botanical name			
Habit			
Bark type			
Flower colour			
Flower arrangement			
Leaf type			
Leaf arrangement			
Leaf shape			
Leaf veins			
Habitat			
Draw or note any other features of importance			



Use the photographs to draw, label and describe four parts of the plant.



Make a list of all the things you know about the plant, i.e. it has leaves and roots, it is big or small. Share the list with the class. Write up all these things you know about trees and plants on a large sheet of paper or on the white board.



Next write down a list of questions about things you do not know about the plant or plants in general, i.e. How do plants grow? How do plants breathe? What do roots do?

Discuss the list of questions you have written down.

Select one question from your list to investigate.

Investigate your question through libraries and the internet, or by interviewing experts in the field. You may be able to arrange a visit from a botanist, or visit a herbarium to find out more information.

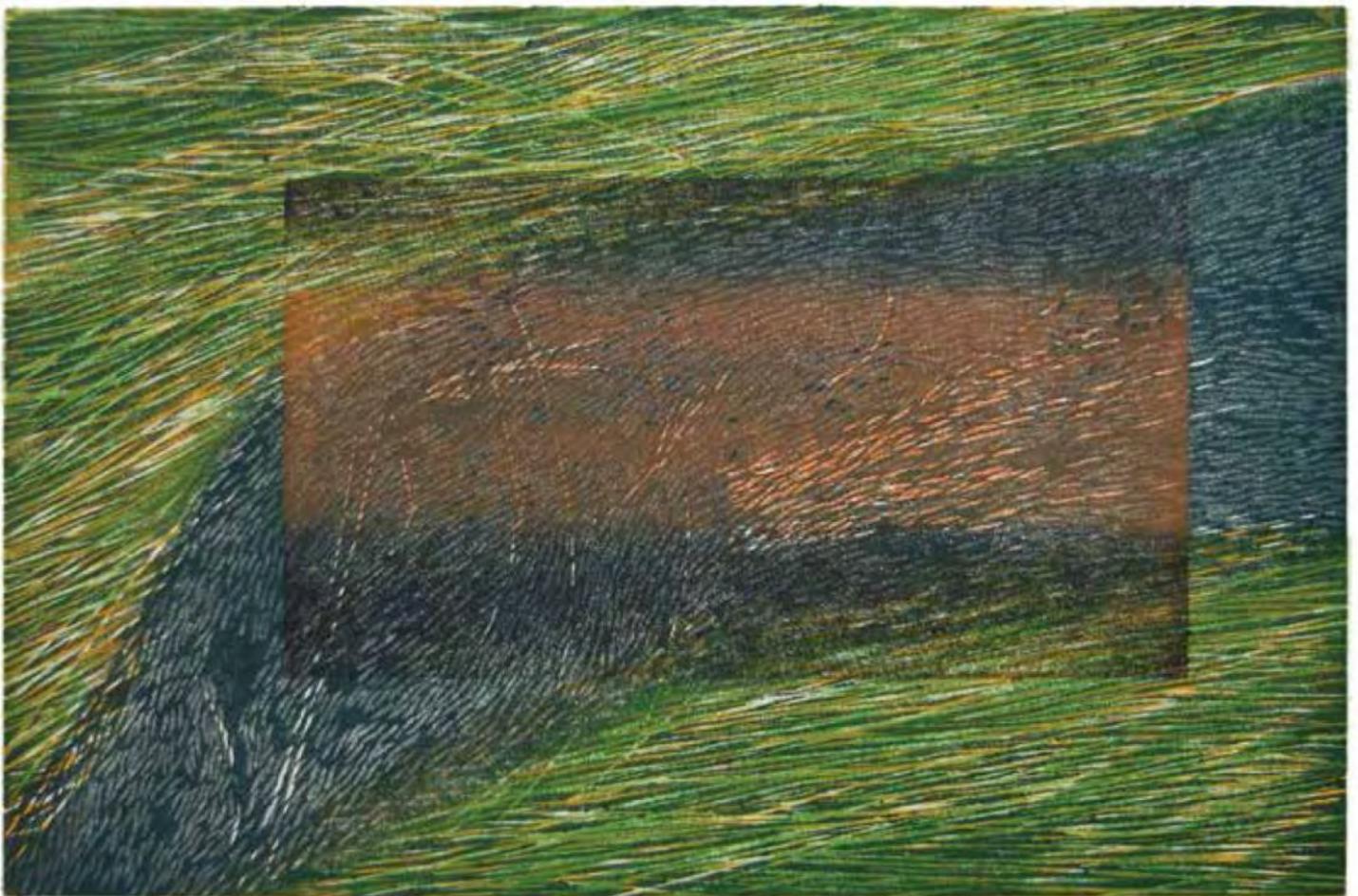


Write a one-page illustrated report on your question.

Report back to the class to share and discuss the information you have found.

THE ART

A group of artists were brought together to create works based on the plants of the Howard Sand Sheets. The artists were Jacqueline Gribbin, Jasmine Jan, Karen Mills, Sarah Pirrie and Winsome Jobling. These are all local artists from Darwin and the rural area. The artist have different styles, but were all taken to the experience the Sand Sheets landscape at the same time. And worked on a collaborative project together as well as their own works. An exhibition was put together in partnership with Nomad Art Gallery and with Botanical Assistance from Greening Australia.



Please refer to the exhibition Catalogue: “Secret World: Carnivorous plants of the Howard Sand Sheets” for background information about the artists and the exhibition.

Collaborative—involving two or more people or organisation together.

Image– Standing in Water (*Utricularia dunstaniae*) by Jacqueline Gribbin

You can visit the art exhibition in Parap between the 5th and 28th November 2015 at Nomad art Gallery Parap.



Utricularia capilliflora environs, mixed media on paper by Sarah Pirrie

Below is a segment from the Media release about the exhibition-

Secret World: carnivorous plants of the Howard sand sheets is an art exhibition focusing on the unique bladderworts that thrive in the Darwin hinterland. The sand sheets host rare and threatened species including these carnivorous plants, which have adapted to the area. A group of artists and scientists gathered on the sand sheets in April 2015 during peak flowering to investigate complex species that flourish through their own ingenuity, yet vulnerable to outside forces.

During the workshop botanical and environmental scientists explained the unique nature of the site, identified plants and lead field trips to key environmental hot spots. The artists responded to the experience by taking photographs, making drawings and developing art works. An exhibition of the works will take place at Nomad Art Gallery in November 2015. A catalogue will record the exhibition, document the process and highlight the critical importance of the Howard sand sheets.

Winsome Jobling, Sarah Pirrie, Jasmine Jan, Karen Mills, and Jacqueline Gribbin are Darwin based artists with a particular interest in the natural and cultural environment of the Top End. They worked together with botanical specialists Emma Lupin from Greening Australia NT and Dr Greg Leach who accompanied the artists during site visits and provided scientific background and plant identification. Angus Cameron from Nomad Art Productions curated the project.

The natural world

Student activities – **SENIOR**

The Arts – visual arts

Secret World: Exhibition Review

Look at the Secret World exhibition catalogue.

Look carefully at the artwork and read the information.

Now answer the following questions:

1) What is the exhibition about?

2) Where did the workshops take place? Find out about the Howard sand sheets. Why are they considered unique and important?

3) Who are the artists and where do they come from?

4) Select one of the artists. Look carefully at their work.

5) Choose one of their artworks. Describe it in detail. Describe the colours, texture, shape medium, size. How was the work made? What special skills, knowledge and abilities does the artist have? Make a drawing of the artwork to illustrate your report.

Botanical Art

Student activities – **SENIOR**

The Arts – visual arts

Botanical art can vary according to the intention of the artist. They can be purely scientific depictions of plants with little consideration of aesthetics. Or the emphasis can be on the artistic or cultural merit of the work. Artists can also combine these elements by balancing attention to detail with beauty of form and composition.

Introduction

Discuss the difference between an artistic work and a botanical illustration. What makes a botanical illustration? What is the difference between a scientific drawing and a work of art?

Investigation

Using a plant specimen paint or draw two different representations of the same plant. Draw a botanical illustration, focusing on the flowering and sexual parts of the plant (you may even want to dissect the plant to record it in greater detail).



1) What is the exhibition about?

Using the same specimen, complete a more creative interpretation thinking about the following:

Beauty and mystery

Geographic location

Natural elements of movement, colour, texture, pattern, shape

Historical or cultural associations of the plant

View point of birds or insects

Microscopic view

Experiment with watercolour and natural materials to reflect water, movement, focus and pattern.



Write a poem to accompany your art work.

Print making from plants

Student activity – JUNIOR

The Arts – visual arts

Introduction

Discuss the idea of print making with the class. Look at different kinds of prints and talk about how they have been made.

This activity involves making a collograph from natural plant materials. A collograph is a print made from a collage of items glued to a sheet of cardboard, metal or similar flat material. Pablo Picasso, Juan Gris and Georges Braque were famous for the collagraphs they made.

MATERIALS NEEDED

Masonite, plywood, mat board or any thin and durable material that can have items glued to its surface

Acrylic wood glue or craft glue

Water based varnish

Printers ink

Cloth

Print press alternatively use a spoon or rolling pin

Paper suitable for etching

Each student will need a piece of pre-cut masonite, ply wood or stiff cardboard that will be used for the plate. Make the plates around 30 cm x 25 cm or smaller to facilitate ease of printing and to be in proportion to the plant material.

The collograph plates can be printed in relief (the ink is placed on the highest parts), or intaglio (the ink is placed in the lowest parts) or both. The collagraphs will work best if the materials used are an even thickness.

Discuss the kind of natural materials that can be used. Bring a selection of materials from home or from a garden. These can include leaves, bark, seeds, twigs, grass, sand etc.

Investigation - making the collograph

Arrange the leaf and plant material on a sheet of paper the same size as the plate. Paint or pour a film of PVA glue onto the printing plate. Transfer the objects onto the glued surface. Sand or other textured material can also be adhered to the surface of the collograph plate. Press down firmly to make sure the materials are permanently and firmly pressed onto the glued surface and wait for it to dry. Once the plate is dry, brush or roll a coat of shellac or PVA glue over the material you pasted on the plate to make a waterproof surface.



To print the image apply ink to the top surface with a roller or wipe on with a soft cloth or stiff brush. Wipe the edges and remove any excess ink. Take the inked and wiped plate and place your printing paper on top of your printing plate. Or if using a press place it on the bed of the etching press face up. A sheet of clean newsprint under the plate will keep the bed of the printing press clean and help deter the spread of unwanted ink onto the print.

Apply pressure with a roller or spoon or run through the printing press. Remove the paper, by slowly peeling it from one side. You may need to adjust the printing pressure to achieve the desired result.

If you like your design, you can re-ink the collograph plate and make another print. You can add further detail to your print by hand painting or drawing designs. Number and sign each print as they are made.



CURRICULUM LINKS

This education Kit promotes student engagement through interacting with the environment around them. Activities are designed to enhance self-expression, self-directed learning, co-operation, social understanding and cultural awareness with a focus on the botanical science, art and the environment.

This education Kit links with the Australian National Curriculum from Foundation to Year 10 through:

Science

Science Understanding

Science as a Human Endeavour

Science Inquiry Skills

Humanities and Social Sciences

Geography

Civics and Citizenship

The Arts

Visual Arts

Cross-curriculum priorities

This Education Kit is aligned with cross-curriculum priorities: Civics and Citizenship through a focus on

Systems

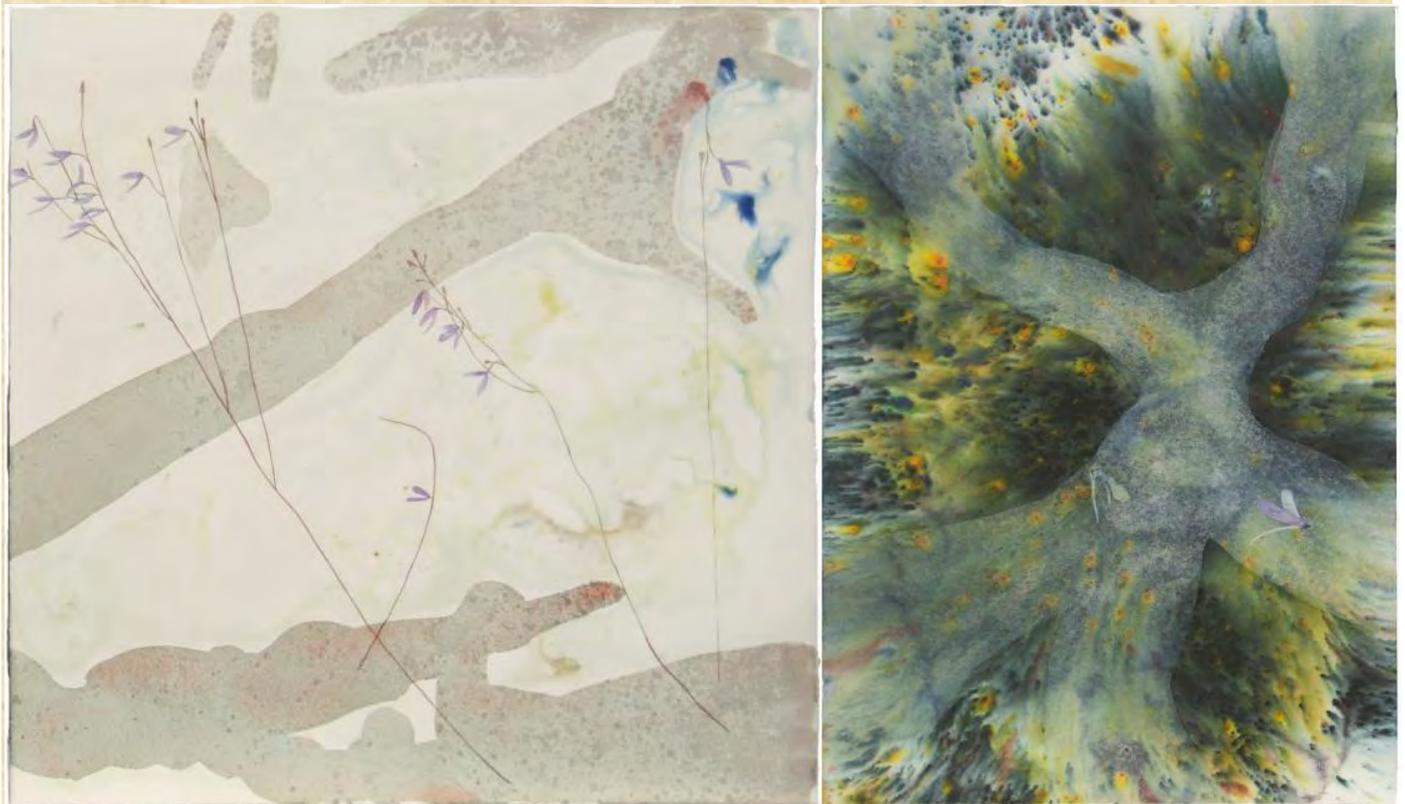
World Views

Futures



Sustainable patterns of living meet the needs of the present without compromising the ability of future generations to meet your needs. Actions to improve sustainability are both individual and collective endeavours shared across local and global communities. You necessitate a renewed and balanced approach to the way humans interact with each other and the environment.

Education for sustainability develops the knowledge, skills, values and world views necessary for people to act in ways that contribute to more sustainable patterns of living. It enables individuals and communities to reflect on ways of interpreting and engaging with the world. Sustainability education is futures-oriented, focusing on protecting environments and creating a more ecologically and socially just world through informed action. Actions that support more sustainable patterns of living require consideration of environmental, social, cultural and economic systems and your interdependence.



Utricularia capilliflora environs, mixed media on paper by Sarah Pirrie

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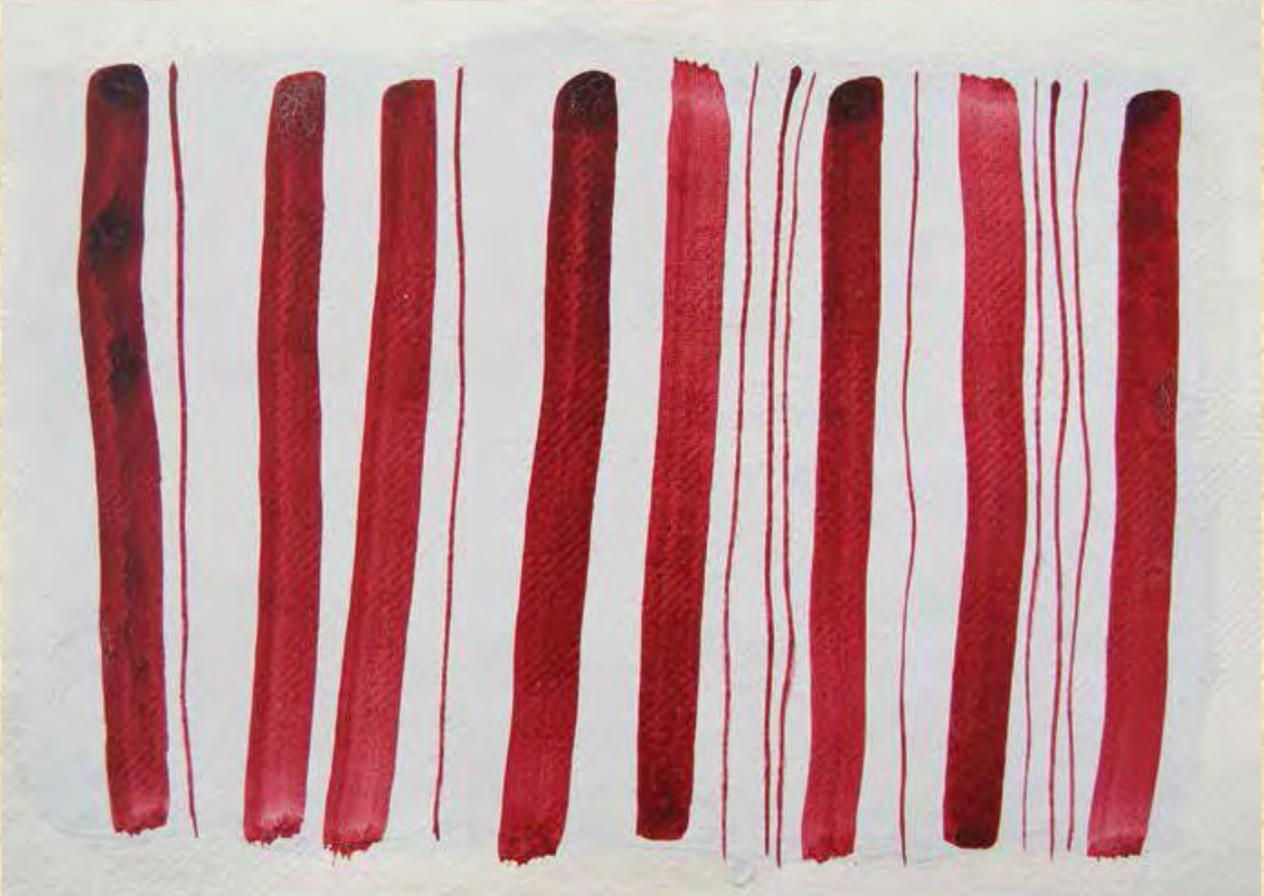


Image by Karen Mills, Drosera, mixed media on paper, 30 x 40 cm, 2015.



Image by Winsome Jobling Lunch, Howard sand sheets mud on rag paper, 42 x 30cm, 2015.