BIODIVERSITY'S BASE

INCREDIBLE INVERTEBRATES

TEACHERS' NOTES FOR MIDDLE CHILDHOOD CURRICULUM REQUIREMENTS

Pre and post-visit activities to support an excursion to the jarrah forest for Years 4 and 5 students

Department of Conservation and Land Management
EcoEducation Programs

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CONTENTS

OVERVIEW OF TEACHERS' NOTES

These notes should help to prepare students for and to follow up after an excursion to the jarrah forest, ***Biodiversity's Base - Incredible Invertebrates.***

On completion of the six pre-visit activities students will:

- have an increased understanding of the ecological systems at work in the forest and of the various habits and attributes of forest invertebrates,
- be able to define 'biodiversity',
- be able to give reasons why invertebrates are important to the good health of the forest,
- have designed, made and appraised an instrument for capturing invertebrates.

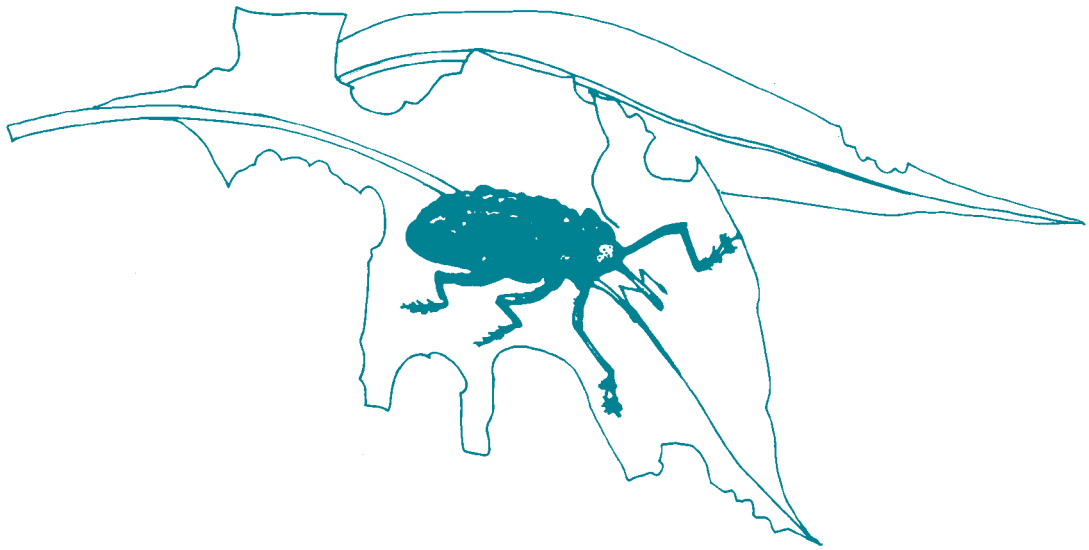
On completion of the two post-visit activities students will:

- have demonstrated their understanding of the concept of biodiversity as it applies to invertebrates in the forest,
- have constructed a visual record of their forest visit.

Phase of development: Middle Childhood

These notes have been written to support teachers who plan to bring their Year 4 or Year 5 students on an excursion to the jarrah forest.

The following matrix describes the key curriculum learning area outcomes derived through using these notes. Many other outcomes from these and other Learning Areas may be achieved whilst using these notes.



These teachers' notes are available in the 'For Schools' section of the Department of Conservation and Land Management's NatureBase Internet site at:
http://www.naturebase.net/schools/index.html

CURRICULUM FRAMEWORK LEARNING OUTCOMES

Using these notes will contribute to the attainment of the following Curriculum Framework Learning Outcomes.

Values

ENVIRONMENTAL RESPONSIBILITY

CONSERVATION OF THE ENVIRONMENT: The management of the environment should take into account the need to preserve its diversity and balance for the future.

DIVERSITY OF SPECIES: Each person should recognise a need to preserve native habitats and arrest the extinction of presently surviving native species.

SOCIAL AND CIVIC RESPONSIBILITY

RESPONSIBILITY AND FREEDOM: People have the right to choose their way of life, and are responsible for the impact of their choices on nature and other community members.

These values are developed through a focus on the outcomes in the learning areas below.

Art

ARTS SKILLS AND PROCESSES: Students use the skills, techniques, processes and technologies of the arts.

English

PROCESSES AND STRATEGIES: Students use language as a way of coming to grips with new ideas, resolving difficulties or solving problems.

SPEAKING: Students speak with purpose and effect in a wide range of contexts.

READING: Students read a wide range of texts with purpose, understanding and critical awareness.

WRITING: Students write for a range of purposes and in a range of forms using conventions appropriate to audience, purpose and content.

Science

Working scientifically

INVESTIGATING: Students investigate to answer questions about the natural and technological world.

COMMUNICATING SCIENTIFICALLY: Students communicate scientific understanding to different audiences for a range of purposes.

ACTING RESPONSIBLY: Students critically analyse the impact on their local environment of human activities.

ACTING RESPONSIBLY: Students acknowledge human responsibility for the effects of science and make responsible decisions about their own use of science and its products.

Understanding concepts

LIFE AND LIVING: Students understand their own biology and that of other living things, and recognise the interdependence of life.

Society and Environment

INVESTIGATION, COMMUNICATION AND PARTICIPATION: Students investigate ways in which people interact with each other and their environment in order to make informed decisions and implement relevant social action.

NATURAL AND SOCIAL SYSTEMS: Students identify and describe the elements of natural systems such as soil, vegetation, landforms, water and fauna. They recognise how these elements can be combined to produce distinctive systems.

PLACE AND SPACE: Students understand that the interaction people have with places in which they live is shaped by the location. Patterns and processes associated with natural and built features.

Technology and Enterprise

TECHNOLOGY PROCESS: Students apply a technology process to create or modify products, processes, systems, services or environments to meet human needs and realise opportunities.

MATERIALS: Students select and use materials that are appropriate to achieving solutions to technology challenges.

Honeybees air-condition their hive when it gets hot. Some of the workers position themselves at the entrance to the hive and fan their wings. When it gets really hot they bring droplets of watered-down honey with them, which cools the air even more.

BACKGROUND INFORMATION

The concept of biodiversity covers the entire spectrum of life on our planet and the way organisms are interconnected. Biodiversity includes all living organisms, their genetic make-up and their complex connections with the planet's ecosystems. Biodiversity helps to keep our water, air and seas clean and our soils fertile. The south-west of Western Australia is a mega-diverse hot spot of biodiversity.
When we talk about the biodiversity of forests we mean everything living there: the microscopic organisms, the invertebrates, the vegetation, the animals, even the humans.

Invertebrates are the foundation of healthy biodiversity in the forest. They make up around 85 per cent of the animal species. As well as providing food for a large number of reptiles, amphibians, birds and mammals they recycle animal and vegetable matter, pollinate flowering plants, disperse seeds and provide a natural check on plant growth. In particular, burrowing invertebrates like ants aerate soils, 'plant' seeds and redistribute nutrients.

Researchers from Curtin University summarise their findings with the following words:

> *"We conclude that a typical southwestern eucalypt supports a wide diversity of organisms . . . The number of species of macroscopic invertebrates to be found on and around a typical eucalypt species is certainly several thousand, possibly many more. A fragile web of interactions and interrelationships intimately connects all of these creatures . . . These invertebrates in turn, provide food for vertebrates or interact with them in other direct or indirect ways." (B.E. Heterick, J.D. Majer. H.F. Recher and A.C. Postle, 2001).*

Concepts

- Without invertebrates the forest would die.
- Biodiversity is the key to the health of natural environments.

USEFUL REFERENCES

- Teachers guide to animals of the soil and leaf litter. Adrianne Kinnear, Edith Cowan University, Perth. 1994.
- Soil Magic - Landcare Activities for Middle Primary, a publication from the series Landcare For Kids produced by the Department of Conservation, Forests and Lands, Victoria.
- CSIRO Biological Control of bridal creeper website: http://www.ento.csiro.au/bridalcreeper
- Heterick B.E., Majer J.D., Recher H.F. and Postle A.C. (2001). A checklist of canopy, bark and litter fauna of the Darling plateau and adjacent woodland near Perth, Western Australia, with reference to the conservation of forest and woodland fauna. Curtin University of Technology, School of Environmental Biology, Bulletin No. 21.
- Young Entomologist Home Page. Y.E.S. Minibeast world: http://members.aol.com/YESedu/mainmenu.html
- Moths and butterflies website: http://www-staff.mcs.uts.edu.au/~don/larvae/larvae/html
- Website image of a unique Western Australian species: http://www-staff.mcs.uts.edu.au/~don/larvae/cart/saturn.html

Researchers have discovered 1,600 invertebrate species live on only four kinds of eucalypt tree, two of these were jarrah and marri trees. This is amazing when you consider there are only 1,700 or so species of birds, mammals, snakes lizards and frogs on the Australian continent.

PRE-VISIT ACTIVITIES

1. THE IMPORTANCE OF BIODIVERSITY

Purpose
To introduce the concept of biodiversity and its importance to the health of the forest.

Equipment and resources
Large sheet of butcher's paper, blue tack, wool, photocopied card for each student and Resource Sheet 1, Watching Invertebrates.

Activities
In small groups students research an invertebrate they are likely to see in the forest. Refer to Watching Invertebrates for ideas.

Each group completes a card similar to that below:

What I look like:

Where I live: _____

What I eat: _____

What eats me: _____

My competitors: _____

Students draw or create a collage of a forest scene on a large piece of butcher's paper, (trees, shrubs, leaf litter, sand, water, etc.) with the motto 'Without invertebrates the forest would die' prominently displayed.

Students place their information cards close to their invertebrate's preferred habitat. Using pieces of coloured wool, students link their invertebrate to anything else in the ecosystem that it affects. This may be food, competitors, shelter, etc.

Class discussion: All elements of the forest are interconnected.
Focus question: *What would happen to this ecosystem if 'your' invertebrate became extinct?*

Students write a story or play that shows the importance of protecting the biodiversity of the forest. They share this play with other classes in the school.

Curriculum Framework Links

Society and Environment

NATURAL AND SOCIAL SYSTEMS: Students identify and describe the elements of the jarrah forest natural systems such as soil, vegetation, landforms, water and fauna. They recognise how these elements can be combined to produce the jarrah forest ecosystem.

Science

LIFE AND LIVING: Students recognise the interdependence of life in the forest.

COMMUNICATING SCIENTIFICALLY: Students communicate scientific understanding of the forest to their school community.

English

PROCESSES AND STRATEGIES: Students use language as a way of coming to grips with the concept of biodiversity.

A bat colony containing five million bats is capable of eating 30 tonnes (60,000 pounds) of moths each night (and moths have not gone extinct).

WATCHING INVERTEBRATES

Lifeform, lifestyle and lifecycle

There are over 200,000 species of invertebrates in the Australian bush of which only about 10,000 have been described. They display an incredible diversity of lifeforms and functions. The major groups of invertebrates are the beetles and weevils, moths and butterflies, dragonflies and damselflies, flies and mosquitoes, ants and termites, spiders, grasshoppers and crickets, bees and wasps, cicadas and leafhoppers. Here in Wellington Discovery Forest you can find representatives of these major groups and many others.

The "Jarrah Trail" is a good place to take a stroll watching for evidence of the invertebrates found within this jarrah forest community. Provided here is a key to identifying the creatures that make the holes, scribbles,scratches, blotches and brownings on leaves and the burrowings into wood and soil. If you are observant and fortunate you may see the creatures responsible.

Invertebrate shapes reflect functions such as locomotion (flying, crawling or hopping) and feeding (biting, sucking, chewing and boring) on plants and animals (including other invertebrates).

Some have intriguing lifecycles with many metamorphosing (changing shape) from a larval stage as a grub or caterpillar to a winged creature; others shed their exoskeleton (inflexible skin) as they grow bigger.

Dragonflies & damselflies

Cockroaches

Mosquitoes

Scorpionflies

Termites

Bugs, cicadas, leafhoppers, lerps & aphids

Spiders

Lacewings (antlions)

Grasshoppers & crickets

Butterflies

Bees, wasps, ants & sawflies

Stick & leaf insects

Beetles, weevils & leaf eating buts

Mantis

Flies

Looking for Clues

You can look for invertebrates and identify them by shape or you can look for evidence of them.

Longicorn beetle

Helena Gum Moth

Evidence on the trunks and branches

Long horned or longicorn beetles are 'borers' in their larval stage and are known as bardi grubs.

Daddy-long-leges fly

Orb weaver

Daddy-long-leg flies rest on the trunks and branches but can also be seen flying around.

Moths are camouflaged to blend into their surroundings when resting to avoid predators.

Bardi gub

Borer damage

Spiders build webs between trunks and branches to ensnare flying creatures and are often found beneath the bark.

Seen on the flowers and in the air

Day flying moths suck nectar from flowers.

Hover flies are also known as bee or drone flies because they are stoutly built like bees. They are swift fliers, hovering, apparently motionless, in the air. They are important plant pollinators. The larvae (maggots) of some species are predators of other insects such as aphids and lerps.

Orange and blue-black beetles feed on nectar and are distasteful to birds that might prey on them. Like the jewel beetle (and some moths) they mimic the look of toxic creatures to discourage predators.

March flies or horseflies such the blood of humans, kangaroos and other mammals. They are prolific in early spring and less abundant during autumn.

Butterflies vary in shape, size and colour and feed on flower nectar. The colours may be used for concealment and for warning that they are poisonous to predators.

Scorpion flies can sometimes be seen hanging by their forelegs from the long flowering spikes of the balga (the grass tree). The male curls his tail over his back like a scorpion's sting.

Day flying moth

March flies

Jewel beetle

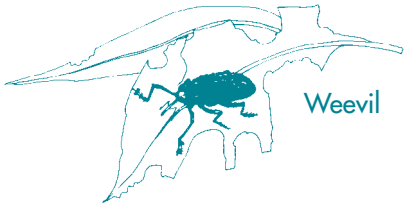
Hover fly

Butterfly and chrysalis

Scorpion fly

Evidence on the leaves

The 'scribble trails' on marri leaves are made by **leaf mining caterpillars** feeding on the leaves. The 'shark fin' serrations on other leaves are made by **leaf eating beetles and weevils**. Weevils also make holes in the leaves. Browning on some of the leaves is caused by the weevil larvae that are black, slug-like caterpillars. If you look at the leaves of the young jarrah trees you can see holes surrounded by brown blotches indicative of the **jarrah leaf miner**.



Weevil

Leafminer damage

Leaf skeletoniser caterpillar

Evidence on the ground

Termites build sandy surfaced tunnels in which they travel to avoid sunlight. You can see these on the stumps and trunks of trees. They link these fibre-food sources to the nest of the termite colony. Termite nests are constructed from wood fibre, saliva and termite dung.

Termite nest

Most **ants** construct underground nests in which they live.

Twig mound ants construct a conical nest of sand and sticks for the drier months. During winter they live underground. In spring they reconstruct another conical nest in a different spot from the previous nest site.

Worker ant

Twig mound ant nest

Trapdoor spiders live in web-lined tunnels in the ground and prey on passing creatures.

Trapdoor spider

Wolf spiders are dramatically coloured with contrasting shades of yellow, brown, and grey or black.

The **antlion**, the larval stage of the lacewing, constructs a conical pit in the ground and lies buried at the bottom with just its open jaws protruding. Any insect that tumbles into the pit is immediately seized and eaten. If the prey tries to escape, the antlion flicks sand at it, causing a miniature landslide which makes the prey fall to the bottom of the pit.

Antlion

Native cockroaches, unlike their domestic cousins, live in and on rotting wood and debris on the forest floor.

Native cockroach

Grasshoppers are mostly foliage feeders. Many camouflage themselves with elaborate cryptic resemblances to leaves, twigs, bark and stones.

Grasshopper

2. DESIGNING A BIODIVERSITY BADGE

Purpose

To develop an understanding about the physical structure of a range of invertebrates in the jarrah forest.

Equipment and resources

Card, colouring materials

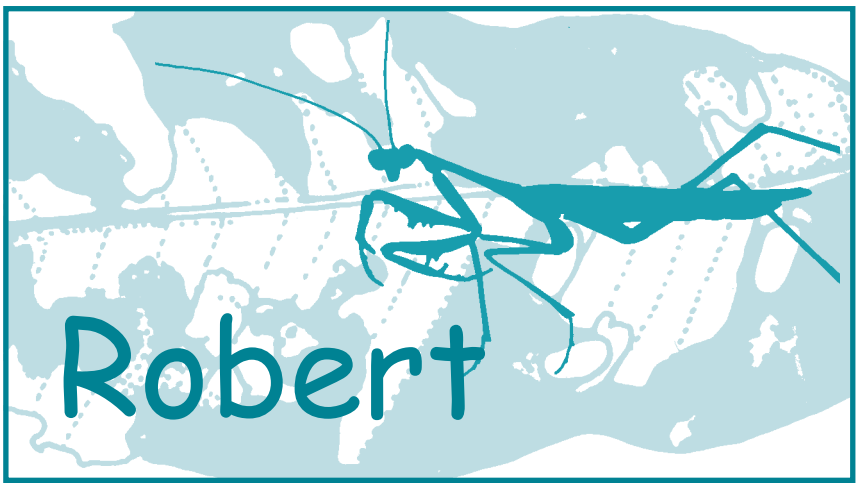
Activity

Students divide into the six groups that will be used for the excursion. Each group chooses an invertebrate and designs a name badge to wear during the excursion. The badge should prominently display their group's invertebrate and the student's first name.

Curriculum Framework Links

Art

ARTS SKILLS AND PROCESSES: Students use the skills, techniques, processes and technologies of the arts to create an imaginative name badge.



3. LEAFHOPPERS

Purpose

To help students to value the need for making responsible decisions about biological control.

Background information

One of the major weeds of the south-west is the bridal creeper. It climbs over other vegetation and its underground tubers form 'mats' that prevent native plants from growing. Leafhoppers have been imported from South Africa to help control this harmful weed. The leafhoppers suck on the leaves, bleaching them white. Damaged plants lose their leaves and their ability to set seeds.

Equipment and resources

Small aquarium, supply of fresh bridal creeper, leafhoppers provided by CSIRO.
Refer to the biological control of bridal creeper website at:
http://www.ento.csiro.au/bridalcreeper.

Contact your local Department of Conservation and Land Management office or Landcare Officer for advice on problem areas of bridal creeper and when and where to release leafhoppers.

Activities

Students breed and study leafhoppers in the classroom.

Class discussion: The use and misuse of biological control.
Discuss biological control failures, for example, the cane toad; and successes, for example, leafhoppers.

Curriculum Framework Links

Science

ACTING RESPONSIBLY: Students acknowledge human responsibility for the effects of biological control based on science and make responsible decisions about their own use of biological control of bridal creeper.

Society and Environment

PLACE AND SPACE: As part of understanding and valuing the relationship between people and places, students have to take responsibility for the impact of their choice of biological control when taking care of a place.

4. MYSTERY BEAST

Purpose

To create a sense of anticipation and excitement prior to the excursion. "What is this mystery beast students will meet on the excursion?" Do not reveal its identity prior to the excursion.

Equipment and resources

Clues to Mystery Beast (Resource Sheet 2)

Activity

Present the clues a few at a time over a period of days leading up to the excursion so that students can build up a picture of the mystery beast. Students can attempt to draw the invertebrate based on the given clues. Encourage students to take their drawing on the excursion to compare with the invertebrate in real life.

Curriculum Framework Links

Science

INVESTIGATING: Students investigate to answer questions about a mystery beast of the natural world of the forest.

Honeybees may travel a distance equal to twice around the world in order to gather enough nectar to make half a kilogram of honey.

CLUES TO MYSTERY BEAST ?

MYSTERY BEAST
FIND ME IN THE FOREST

WHO AM I?

I have two large eyes.
I usually live on nectar.
My old home becomes a home for others.
I am mostly brown in colour.
I make tunnels in the soil which helps to bring fresh air into the earth.
My jaws open and shut sideways.
My young help to recycle dead insects into soil.
My head is triangular in shape.
In winter I live underground.
My body often looks shiny.
I have two spiky mouth parts.
I 'polish' and waterproof my home.
In summer I live in a house with a thatched roof.
Sometimes I take my whole family and move to a new home.
If I were as big as a man I could run as fast as a racehorse.
I stroke bugs which then give me tasty honeydew to eat.
I have small erect hairs on my head and body.

CAN YOU DRAW ME?

5. BE CAREFUL . . . YOU'RE TREADING ON ME

Purpose

To develop an understanding of the impact human visitors can have on the jarrah forest's ground dwelling species.

Equipment and resources

Large sheet of butcher's paper or newspaper, intact eggshells or eggshell halves, leaf litter and bark.

Activities

Outside the classroom (if possible in natural bushland) supervise students to place intact eggshell halves between sheets of newspaper. Students collect and cover the newspaper with leaves and bark and walk over them as if they were going for a walk through the bush. Students then examine the impact they have had on the eggshells.

CLASS DISCUSSION: How and where should people walk in the forest?
FOCUS QUESTION: Why do we need to take care when walking through the forest?

Curriculum Framework Links

Science

ACTING RESPONSIBLY: Students critically analyse the impact of walking in their local bush environment.

Society and Environment

INVESTIGATION, COMMUNICATION AND PARTICIPATION: Students investigate ways in which people interact with their forest environment in order to make informed decisions and implement careful walking habits.

PLACE AND SPACE: Students understand their impact on the natural landscape of the forest which helps build values of caring for the natural environment.

Researchers have found 422 invertebrate species living in the canopy and 313 on the bark of the jarrah tree.

6. POOTERS

Purpose

To challenge students to design an instrument for the study of forest invertebrates.

Equipment and resources

600ml clear plastic bottle, two 10 to 12 centimetre lengths of six millimetre clear plastic tube, a piece of stocking doubled over, a rubber band and glue for each student. Hand drill.

Activities

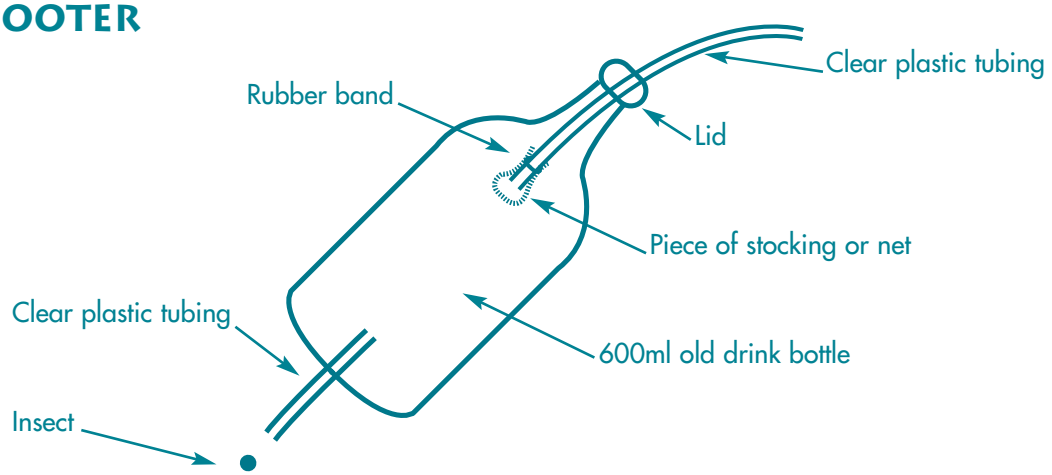
Brainstorm with students their ideas on different designs of instruments for capturing and studying live invertebrates. Then challenge students by presenting them with the pooter materials. In groups they discuss and write down their ideas on the steps to be followed to assemble the pooters.

CLASS DISCUSSION: Discuss each group's proposals and suggested method of building a pooter.

Instructions for building the pooter

1. Drill one hole in the base of the bottle and another hole in the lid to fit the tubing.
2. Push one piece of tube through the hole in the lid. Allow for two to three centimetres of tube on the inside of the bottle.
3. Place the stocking on the inside, and secure firmly on the tube with the rubber band. This will prevent students from swallowing invertebrates while collecting.
4. Place the other piece of tube in the base of the bottle with two to three centimetres inside.
5. To ensure a tight fit and seal, glue around the edge of the tube and the bottle; a hot glue gun is ideal.

POOTER



Using the pooter

Outside the classroom students explore leaf litter invertebrates and suck them into the bottle. They can be examined in-situ through the sides of the bottle or decanted into a petri dish for analysis and observation using a magnifying glass.

Curriculum Framework Links

Technology and Enterprise

TECHNOLOGY PROCESS: Students apply a technology process to create an instrument to study forest invertebrates.

Alternatively students can experiment with different sized containers, length of tubing, etc. Students discuss as a whole class or small group which pooters worked best and why. Students take their pooters to the excursion and use them to collect and study invertebrates.

NB. Some pooters will be provided on the excursion should the students' pooters not be a success.

Curriculum Framework Links

Technology and Enterprise

MATERIALS: Students are challenged to select and use materials to make an instrument for collecting live invertebrates.

EXCURSION TO THE JARRAH FOREST

This excursion is currently offered at Wellington Discovery Forest near Bunbury. For inquiries and bookings, phone 9734 1988 or fax 9734 4539. For inquiries concerning other venues, phone 9295 6149 or 9334 0387.

Equipment and resources

Biodiverse badge, pooter
Other equipment will be provided.

Activities

This excursion takes a full day (10am to 2pm) and is led by trained Department of Conservation and Land Management Education Officers. Teachers and other adults take an active role in supervising the students and learning about the forest. Activities may include the following:

1. Re-enforcement of the concept, 'without invertebrates the forest would die.'
2. Reminder of students' responsibility to the forest ecosystem and its inhabitants, and introduction to the Forest Code of Conduct.
3. Release of leafhoppers in pre-arranged areas.
4. Exploration of a section of the forest floor and leaf litter with special magnifying glasses.
5. Inspection of invertebrates fallen from the canopy onto shake sheets on the ground. Students use their pooters to scoop up and examine the invertebrates.
6. Examination of large and small pitfall traps and observations and recordings of trapped animals.
7. Investigation of the invertebrates of the soil and leaf litter.
8. Role-playing the movement of an invertebrate students have seen during the excursion.
9. Recording evidence of invertebrates 'at work'.
10. Discovery of the Mystery Beast.

Curriculum Framework Links

This excursion contributes to the attainment of the following Curriculum Framework Outcomes:

Science

INVESTIGATING: Students investigate to answer questions about the natural world of the jarrah forest.

LIFE AND LIVING: Students understand the biology of other living things, and recognise the interdependence of life in the jarrah forest.

English

PROCESSES AND STRATEGIES: Students use language as a way of coming to grips with new ideas, resolving difficulties or solving problems.

Society and Environment

NATURAL AND SOCIAL SYSTEMS: Students identify the elements of the jarrah forest natural system such as soil, vegetation, landforms, water and fauna. They recognise how these elements can be combined to produce the distinctive jarrah forest ecosystem.

INVESTIGATION, COMMUNICATION AND PARTICIPATION: Students investigate ways in which people interact with the jarrah forest environment in order to make informed decisions and implement relevant behaviour.

The following values are developed through a focus on the outcomes of the learning areas listed above:

Values

ENVIRONMENTAL RESPONSIBILITY

CONSERVATION OF THE ENVIRONMENT: The management of the jarrah forest environment should take into account the need to preserve its diversity and balance for the future.

DIVERSITY OF SPECIES: Each person should recognise a need to preserve native habitats and arrest the extinction of presently surviving native species.

SOCIAL AND CIVIC RESPONSIBILITY

RESPONSIBILITY AND FREEDOM: People have the right to choose their way of life, and are responsible for the impact of their choices, for example, use biological control on the natural environment of the jarrah forest.

Researchers believe that the number of species of invertebrates eg. ants, spiders, beetles etc living on and around jarrah trees is several thousand.

POST-VISIT ACTIVITIES

1. INSECT FEATURE STORY!

Purpose
To consolidate students' understandings of invertebrate species they encountered during their excursion and their importance in maintaining biodiversity of the jarrah forest.

Equipment and resources
Textas or paints, lined and plain paper.

Activities
In their groups students examine feature stories in magazines about famous people. Students design a feature story about aninvertebrate that lives and works in the forest. Students should include biographical information (how long it lives, what it looks like, its habitat), the important work the insect does (why it is famous), and what would happen to the forest if it weren't there. Feature stories can be made into a magazine and shared with other classes.

Curriculum Framework Links
Science

COMMUNICATING SCIENTIFICALLY: Students communicate scientific understanding of jarrah forest invertebrates to different audiences within the school for the entertainment of other classes.

English

WRITING: Students write for entertainment of their peers using conventions appropriate for the level of their audience.

2. COLLAGE OF LEAVES

Purpose

To reflect on their excursion experience and reinforce the importance and impact of invertebrates on the biodiversity of the jarrah forest.

Equipment and resources

Leaves and information recorded on them during the excursion.

Activities

Students arrange their leaves on a collage 'tree' to show the evidence of invertebrates at work in the forest and the name of the Mystery Beast.

Students write a letter to a school in another country telling them about the forest and its invertebrates.

Class discussion

To summarise the main concepts of the program.

Curriculum Framework Links

English

WRITING: Students write to spread amongst children of other countries the message of the importance of biodiversity conservation.

Society and Environment

PLACE AND SPACE: Students reflect on their excursion experience and their interaction with the forest which is shaped by the features of the natural jarrah forest landscape.

The loudest insect in the world is the male cicada. He can be heard over 400 metres away, about the distance of four football fields.