EARTH ALIVE

FIELDOFMARS
ENVIRONMENTAL EDUCATION CENTRE
EXPERIENCE ENGAGE ENABLE

Earth Alive Resource Book
Stage 3

NEW SOUTH WALES
DEPARTMENT
OF EDUCATION
AND TRAINING

EARTH ALIVE

This *Earth Alive Resource Book* supports the teaching of the *Earth Alive* program. *Earth Alive* is a Stage 3 Science and Technology sequence of learning experiences that fits within the DET's Stage 3 COG Unit *Interconnecting Growth and Change (C).* The *Earth Alive* program can also be taught as an independent science unit.

The *Earth Alive* program grid can be downloaded from the Field of Mars Environmental Education Centre website. All internet resources listed in this book are in the Links section of the Field of Mars EEC website.

Acknowledgements

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The Field of Mars Environmental Education Centre (EEC) is one of twenty-three environmental education centres across NSW operated by the NSW Department of Education and Training.

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INTRODUCTION

What is Earth Alive?

Earth Alive is a 9 - 11 week Science and Technology program that aims to develop knowledge, understanding and care for ecosystems and biodiversity.

The purpose of the program is for students to:

- increase their knowledge and understanding of ecosystems and biodiversity
- conduct a scientific investigation into the biodiversity within the school grounds, and
- plan and undertake an action project to improve or construct a local ecosystem.

Who is Earth Alive for?

The program has been developed for Stage 3 students in NSW Department of Education and Training schools.

Where does Earth Alive fit into my program?

The program provides an alternative series of SciTech learning experiences for the Stage 3 **Interconnecting Growth and Change** COG (C) unit of work. It replaces the water quality component of this COG with a local biodiversity investigation whilst still covering all the same outcomes.

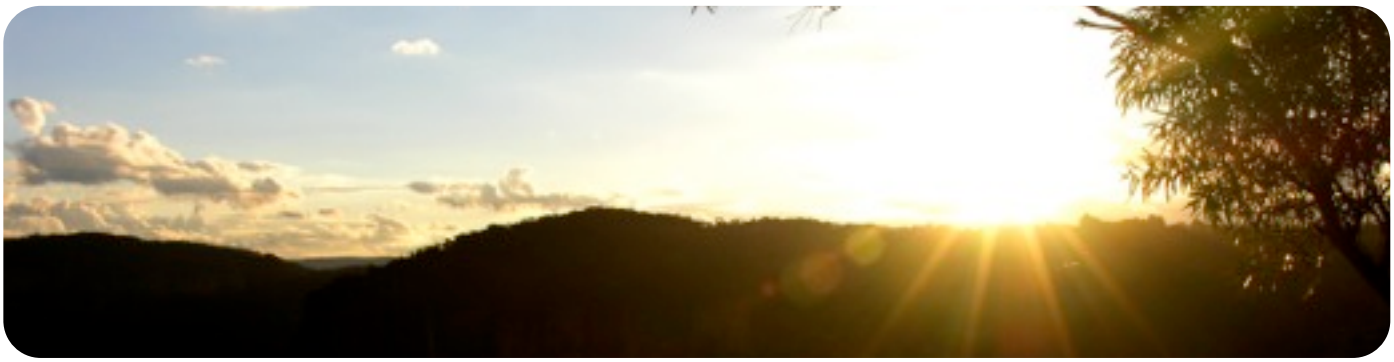
For teachers not working with COG units, the *Earth Alive* program can be taught as an independent unit or in conjunction with the Stage 3 Science and Technology unit *Environment Matters*.

The program contains nine core sequential learning experiences. Optional additional or alternative activities, background information and resources are also included in this resource book.

The Field of Mars Environmental Education Centre supports the implementation by:

- providing teaching/learning resources for the duration of the unit
- providing a program grid (which *c*an also be downloaded from the Field of Mars EEC website)
- bringing specialised equipment for the scientific investigation
- visiting the school and working with the students to introduce the key concepts, guide them through their scientific investigation, and assist in the implementation of their action project.

The biodiversity investigation and action project can be an integral part of the school's School Environmental Management Plan (SEMP).



What does Earth Alive cover?

Bio What? - What is biodiversity? What is an ecosystem? How is biodiversity measured?

Bio Design - Design a scientific investigation to investigate the biodiversity in and around your school.

Bio Investigator - Conduct a scientific investigation to investigate the biodiversity in and around your school.

Bio Conclusions - Present the investigation findings and conclusions.

Bio Links - What are the connections between plants and animals and people?

Bio Threats - Threats to biodiversity and local biodiversity threats.

Bio Action - Devise and carry out action plans to improve or construct a local ecosystem in your school.

Each week the program **builds upon prior learning** from the *Earth Alive* program, and across the COG unit, with the aim of developing in students and teachers an ability to make informed decisions about the management and improvement of an ecosystem within their school.

Why is the Earth Alive program important?

Ecosystems which contain the greatest variety of plants and animals are often the most robust, stable and resilient due to the complex interrelationships that occur between living things. However, with 100 to 1000 species becoming extinct every day (Klomp, 2006), even the most robust of ecosystems are in danger.

What can be done? This program provides students and teachers with opportunities to get out of the classroom, to explore their local environment, to discover what biodiversity is about, and then to do something positive for it.

This requires first investigating what's out there and then determining what actions we can take to help those organisms survive. Regardless of being cute or ugly, pleasant or scary, big or small, all elements of an ecosystem are essential to the maintenance of life.

The *Earth Alive* program stresses the connectedness of all living things and the importance of saving whole ecosystems and all the species they contain. The *Earth Alive* program provides a context in which students and teachers can play an active role in helping to restore the biodiversity in and around their school and local area.

Think globally
Act locally

Australia is one of the most biologically diverse countries on the planet. It is home to more than one million species of plants and animals, many of which are found nowhere else in the world. About 85 percent of flowering plants, 84 percent of mammals, more than 45 percent of birds, and 89 percent of inshore, freshwater fish are unique to Australia.

Yet our vibrant island continent, with its striking natural contrasts, is surprisingly fragile and needs our help to ensure its diversity is protected for generations to come.
(Department of Environment and Heritage, 2005)

SYLLABUS AND POLICY LINKS

Earth Alive contributes to Science and Technology syllabus outcomes in the Living Things content and Investigating process strands. It also contributes to Human Society and Its Environment outcomes in the Environment strand and implements the objectives in the Environmental Education for Schools Policy. Outcomes and SciTech Big Ideas are listed for each learning experience in the program grid (separate document - available on the Field of Mars EEC website).

Science and Technology

Living Things

LT S3.3 Identifies, describes and evaluates the interactions between living things and their effects on the environment.

- All living things interact with other living things and their environments.
- The growth of plants depends on a number of factors, including the availability of light and nutrients.
- Populations of animals (e.g., a colony of insects) display a range of dynamic relationships with each other, with other animals and with their environment.
- The physical characteristics of animals are, in part, determined by the characteristics of their parents (genetic inheritance).
- An understanding of the interactions between living things and between living things and their environment assists in taking actions to conserve both those living things and their environment.
- Technological advances have costs and benefits for living things and the environment.

Investigating

INV S3.7 Conducts their own investigations and makes judgements based on the results of observing, questioning, planning, predicting, testing, collecting, recording and analysing data, and drawing conclusions.

- Constructs appropriate self-questions to guide investigations.
- Decides the type of data needed and works cooperatively to collect such data.
- Plans repeat trials of tests or experimental procedures.
- Identifies factors that are to be kept the same when carrying out tests or conducting investigations, and recognises the term controlled experiment.
- Ensures that equipment is working and can be used effectively and safely.
- Records data in an appropriate form and evaluates collected data to ensure that it satisfies the purpose of an investigation.
- Transforms data to show important relationships, trends, patterns or associations. Uses the ideas of fair testing to evaluate whether predictions or explanations are reliable and valid.
- Communicates what has been learned by choosing from a variety of media, tools and forms, taking into account audience and purpose.

SciTech Values and Attitudes

- Demonstrates confidence in their own ability and a willingness to make and implement decisions when investigating, designing, making and using technology.
- Exhibits curiosity and responsiveness to scientific and technological ideas and evidence.
- Initiates scientific and technological tasks and challenges and perseveres with them to their completion.
- Gains satisfaction from their efforts to investigate, to design, to make, and to use technology.
- Works cooperatively with others in groups on scientific and technological tasks and challenges.
- Shows informed commitment to improving the quality of society and the environment through science and technology activities.
- Appreciates contributions made by individuals, groups, cultures and communities to scientific and technological understanding.
- Appreciates the significance of Australian scientific and technological expertise across gender and cultural groups.

Human Society and Its Environment

Environments

EN S3.5 Demonstrates an understanding of the interconnectedness between Australia and global environments and how individuals and groups can act in an ecologically responsible manner.

- Patterns of human involvement and use of environments.
- Effects of human and natural changes on environments.
- Ecologically sustainable development of environments.
- Different perspectives about maintenance and improvement of environments.

SCI TECH

Investigate

Observe and explore

Hypothesise and predict

Devise and test

Collect and record

Analyse and conclude

Publish and present

Environmental Education Policy for Schools

Environmental Education

Students will develop:

Knowledge and understandings about...

- the nature and function of ecosystems and how they are interrelated (K1)
- the impact of people on environments (K2)
- the principles of ecologically sustainable development (K4).

Skills in…

- applying technical skills within an environmental context (S1)
- identifying and assessing environmental problems (S2)
- communicating environmental problems to others (S3)
- adopting behaviours and practices that protect the environment (S5)
- evaluating the success of their actions (S6).

Values and attitudes relating to...

- a respect for life on Earth (V1)
- a commitment to act for the environment (V3).

School grounds management

Schools will:

- manage school grounds in accordance with the principles of ecologically sustainable development
- develop school grounds as part of the overall school plan
- identify learning opportunities for students resulting from the management of school grounds.

ACTION	SCHOOL ENVIRONMENTAL MANAGEMENT PLAN (SEMP)
	The Environmental Education for Schools Policy requires all schools to develop a School Environmental Management Plan (SEMP) covering the areas of curriculum, resources and grounds management. The Earth Alive biodiversity investigation and action project can be an integral part of the school's SEMP.

BEFORE YOU START

What the class teacher needs to do

- Become familiar with the contents of the *Earth Alive* resource kit.
- Read through this *Earth Alive* support book.
- Familiarise yourself with the contents of the *Earth Alive* sequence of learning experiences and the associated Big Ideas (on the separate program grid). The program can be taught as it is, or can be modified to suit the needs of your students and school.
- Review the *Earth Alive* program grid to include in your teaching program (available as a Word document on the Field of Mars EEC website).
- The program consists of activities to be taught by the class teacher and by Field of Mars EEC staff at your school. These are identified on the timetable and program grid as ***Field of Mars at Your School***.
- Duplicate student worksheets. These work well stapled into a booklet for use during the program.
- Assess students' prior knowledge using the *Biodiversity Mindmap* (WS 1) before Learning Experience 1. This will provide the students' entry level knowledge. At the end of the program, the sheet can be returned to the students so they can add further information to show their growth in knowledge and understanding.
- If appropriate, invite parent and community involvement.

What Field of Mars EEC staff will do

- Lend the *Earth Alive* kit of resource materials to your school. This includes posters, books, picture kits, DVD/video, and specimen boxes for your class to use during the program.
- Introduce the concepts of biodiversity and ecosystems to your students and demonstrate ways in which biodiversity can be measured.
- Help students conduct biodiversity investigations outside the classroom using a variety of collecting and magnifying equipment.
- Advise and assist your students finalise an action plan to construct or improve an ecosystem within the school.
- Assist your students in the implementation of their action plan.
- Provide support and assistance throughout the program and following the program as needed.

Activities run by the Field of Mars EEC will require between one and one and a half hours per class depending on the lesson content.

SUGGESTED TERM TIMETABLE

Week	Learning Experiences
1	Set up resources General introduction to program What do we know?
2	***Field of Mars at Your School*** **Learning Experience 1 - Bio What?** Observing and exploring What is biodiversity? What is an ecosystem? How is biodiversity measured?
3	**Learning Experience 2 - Bio Design** Hypothesising and predicting Procedure design
4	***Field of Mars at Your School*** **Learning Experience 3 - Bio Investigator** Collecting and recording data in the school grounds
5	**Learning Experience 4 - Bio Conclusions** Analysing and drawing conclusions Publish and present
6	**Learning Experience 5 - Bio Action - Planning** Applying understandings Devise an action plan to improve or construct a local ecosystem ***Optional Field of Mars Video Conference***
7	**Learning Experience 6 - Bio Links** Food chains and webs Food chain pizza
8	**Learning Experience 7 - Bio Threats** Threats to biodiversity Local biodiversity threats Action plan review
9	***Field of Mars at Your School **** **Learning Experience 8 - Bio Action – Doing** Construct or improve a local ecosystem
10	**Learning Experience 9 - Evaluation** Evaluate the investigation and the action project

** Learning Experience 8, Bio Action - Doing, could be undertaken in Week 7, 8 or 9*

Learning experiences

On the following pages the learning experiences included in the *Earth Alive* program grid are repeated. Background information has also been included together with additional optional activities. These can be used as extra or alternative learning experiences. Worksheets are included in the back of the book.

Overview

This session will help develop in students an understanding of biodiversity and ecosystems. Methods of measuring biodiversity will be demonstrated and the scientific investigation will be introduced.

LEARNING EXPERIENCE 1 - BIO WHAT?

Field of Mars at Your School – *Field of Mars EEC staff will conduct this session*

Background

What is biodiversity?

What do ponds full of micro-organisms, a forest containing powerful owls, a mangrove area teeming with crabs, the local neighbourhood creek and a flock of galahs screeching overhead have in common? The answer is that they are all facets of Australia's rich biodiversity.

The term **biodiversity** describes the immense **variety of all living things** - the different plants, animals and micro-organisms, the genetic information they contain and the ecosystems they form. It is usually considered at three interconnected levels: genetic diversity, species diversity and ecosystem diversity. Biodiversity stresses the **connectedness** of the living world.

What is an ecosystem?

The term **ecosystem** describes a **community of living things** in a particular area and their **interaction** with the non-living things in that area, for instance, soil, rocks, weather and water. Matter constantly cycles and recycles in an ecosystem and energy moves through the cycle.

PROTECT

Life supporting life

It is our responsibility to take care of the diversity of life.

By taking steps now to conserve biodiversity, we can reduce future damage and costs resulting from inaction. Conservation begins with our actions at home, at school and in the local area.

There is an enormous variety of ecosystems in the world providing many different habitats. An ecosystem can be very small or very large. For instance, an entire ecosystem can be underneath a fallen log but that fallen log may belong to a larger dry forest ecosystem.

Why is Australia's biodiversity special?

Millions of years of isolation from other continents have resulted in the evolution of unique Australian plants and animals. It is estimated that Australia has well over one million different species and because of our isolation a high percentage of these species occur nowhere else.

With habitats ranging from the arid inland to the Great Barrier Reef, from the wet tropical rainforests of the north to the temperate grasslands and tall eucalypt forests of the south, Australia is graced with a rich diversity of ecosystems.

Why is biodiversity important?

Biodiversity is nature's insurance policy. It is about life supporting life. Biodiversity helps to maintain important ecological processes such as oxygen production, pollination, and flood control that, in turn, help support all life on earth.

Biodiversity provides us with clean air and water, soil for crops and forests and to sustain the productivity of terrestrial and aquatic ecosystems. We rely on a vast range of plants and animals, and an equally vast array of micro-organisms, as sources of food, fibre and medicines. For instance:

• Australia has many native fish and crustacean species that are harvested for food.

• A vine from Queensland's rainforests has proved effective in treating leukaemia.

• Bark from a tree in the Kimberleys is a pain killer, more powerful than morphine.

Potential products of the future include sunscreens from corals, light and high tensile fibres from spider silk (eg, bullet proof vests) and instant adhesives from velvet worms or barnacles.

Biodiversity allows for important recreation activities such as bushwalking, fishing, and camping. It also generates significant income for Australia in terms of tourism. The growing ecotourism industry is dependent upon maintaining the natural environment. Biodiversity also provides inspiration and provokes curiosity and imagination, often expressed through art, music and poetry.

All species have the right to exist and no generation has the right to destroy the environment and resources on which future generations depend.

(Source: Recher, 1997, World Wildlife Fund, 1999; Environment Australia, 1998)

How is biodiversity measured?

Biodiversity is usually measured by assessing the variety of species in a particular area. This can be done by counting the variety of plant species, checking for the presence of and combination of plants belonging to different layers, or counting the abundance and variety of animal species. The types of animals present will be influenced by vegetation in the area.

Invertebrate organisms, such as ants, termites and beetles, play a key role in ecosystem health because of their dominant contribution to biodiversity, and their influence on important ecological processes. If an ecosystem's invertebrate populations are in good shape, then this indicates that the ecosystem in general is also in good shape. (CSIRO, 2005)

As invertebrates are a good indicator of the health of an ecosystem, collection and recording of invertebrates in an area provide a good measure of the biodiversity of the area.

Further information on biodiversity is available from the Australian Museum at www.amonline.net.au/biodiversity/index.htm. This site includes a video showing scientists collecting invertebrates in the field.

Lessons

Observing and exploring

What is biodiversity? What is an ecosystem?

Using a digital slide show, Field of Mars EEC staff will introduce the concepts of 'biodiversity' and 'ecosystem'. A joint definition will be developed and a variety of ecosystems identified.

The *Bare to Biodiverse* interactive display will be used to demonstrate the interconnectedness within a local ecosystem. Using the display the students will be introduced to the variety of habitat components. These include trees, shrubs, groundcover plants, flowering plants, leaf litter, rocks, logs, tree hollows and water. The display starts as a bare school playground. Once the habitat components have been identified, selected students place the habitat component onto the display. As the lesson progresses the students will see a bare playground become far more biodiverse and therefore better for native animals. In essence the display will provide the students with an idea of how all the elements found in a school or natural environment work together to support life - biodiversity.

How is biodiversity measured?

The question will be posed: *If you were a scientist how would you find out about the biodiversity in your school?* Methods used by scientists for determining the biodiversity of an area will be discussed and demonstrated.

In the school grounds, the students will be shown how to use a range of invertebrate collecting equipment. They will be shown how to collect invertebrates in the leaf litter using trowels, sifters, trays and specimen containers. They will also be shown how to collect invertebrates from the branches of trees and shrubs using tree shakes onto sheets and sweep nets.

What is the biodiversity of the school grounds?

To conclude the session the scientific investigation of biodiversity within the school grounds will be introduced.

FoM Brings: *Bare to Biodiverse* display, data projector, laptop, invertebrate collecting equipment

School Provides: Projector screen, access to power

Optional Extras

Biodiversity video

Watch the *Totally Wild* biodiversity DVD/video. This provides a great overview of biodiversity. Students list or discuss the key points.

FoM Lends: *Totally Wild* biodiversity DVD/video (in *Earth Alive* resource kit)

School Provides: TV and video player

Hidden biodiversity

Biodiversity is all around us but we are often unaware of its existence. Read the book *The Hunt* by Narelle Oliver to illustrate that biodiversity is not always obvious. Look for the variety of different animals hidden in the pictures as well as other examples of biodiversity. How many animal species are on each page? What other animals do you know of that are camouflaged?

Students could create an artwork to show (hide) a camouflaged animal, eg, colours, camouflage patterns, etc. A print-making technique similar to *The Hunt* illustrations produces effective results.

FoM Lends: *The Hunt* by Narelle Oliver (in *Earth Alive* resource kit)

School Provides: Art materials

Australian habitats

What are the main types of habitat in Australia and the characteristics of each? For example, dry, wet, cold, sandy, hilly, tall trees, scattered trees. From the *Habitat Pictures Kit* pick the most relevant habitats to your area, or any you think the students would find interesting. These habitats are all examples of ecosystem diversity. The habitats shown in the kit are:

Wetlands, rivers and waterways, rainforests, woodland, bushland, alpine, grasslands, heath, mallee, marine, urban and agricultural.

What habitat types are represented in the school grounds? Within the Sydney area the most common remnant natural habitats are eucalypt bushland or woodland.

FoM Lends: Habitat Pictures Kit (in *Earth Alive* resource kit)

School Provides: Nil

Resource: *Hands on for Habitat* – teacher resource kit - www.deh.gov.au/biodiversity/threatened/publications/habitat-teachers-guide/index.html

Reading about biodiversity

Use the class set of the booklets *Biodiversity: Nature's variety, Our heritage, Our future* for class reading activities.

FoM Lends: *Biodiversity: Nature's variety, Our heritage, Our future* (class set in *Earth Alive* resource kit) or at www.deh.gov.au/biodiversity/publications/natures-variety/index.html

School Provides: Activities based on booklet

Overview

Students undertake a preliminary biodiversity investigation of their school grounds by measuring plant diversity. The students will then formulate a hypothesis for the scientific investigation, predict results, and design the procedure for their investigation.

LEARNING EXPERIENCE 2 - BIO DESIGN

Background

Plant layers

Plants are the foundation of most ecosystems. In most ecosystems plants can be found in a number of layers. Layers describe groups of plants that usually share similar characteristics. The three most common terms for plant layers are trees, shrubs and ground covers. In areas where certain layers have been removed it is likely the animals that depend on those layers will also be absent. (NSW National Parks and Wildlife Service, 2003)

Trees: Usually tall with a single trunk at the base and with the canopy at the top. Native examples include gums, wattles, she oaks and paper barks. Non-native examples include camphor laurels and pine trees.

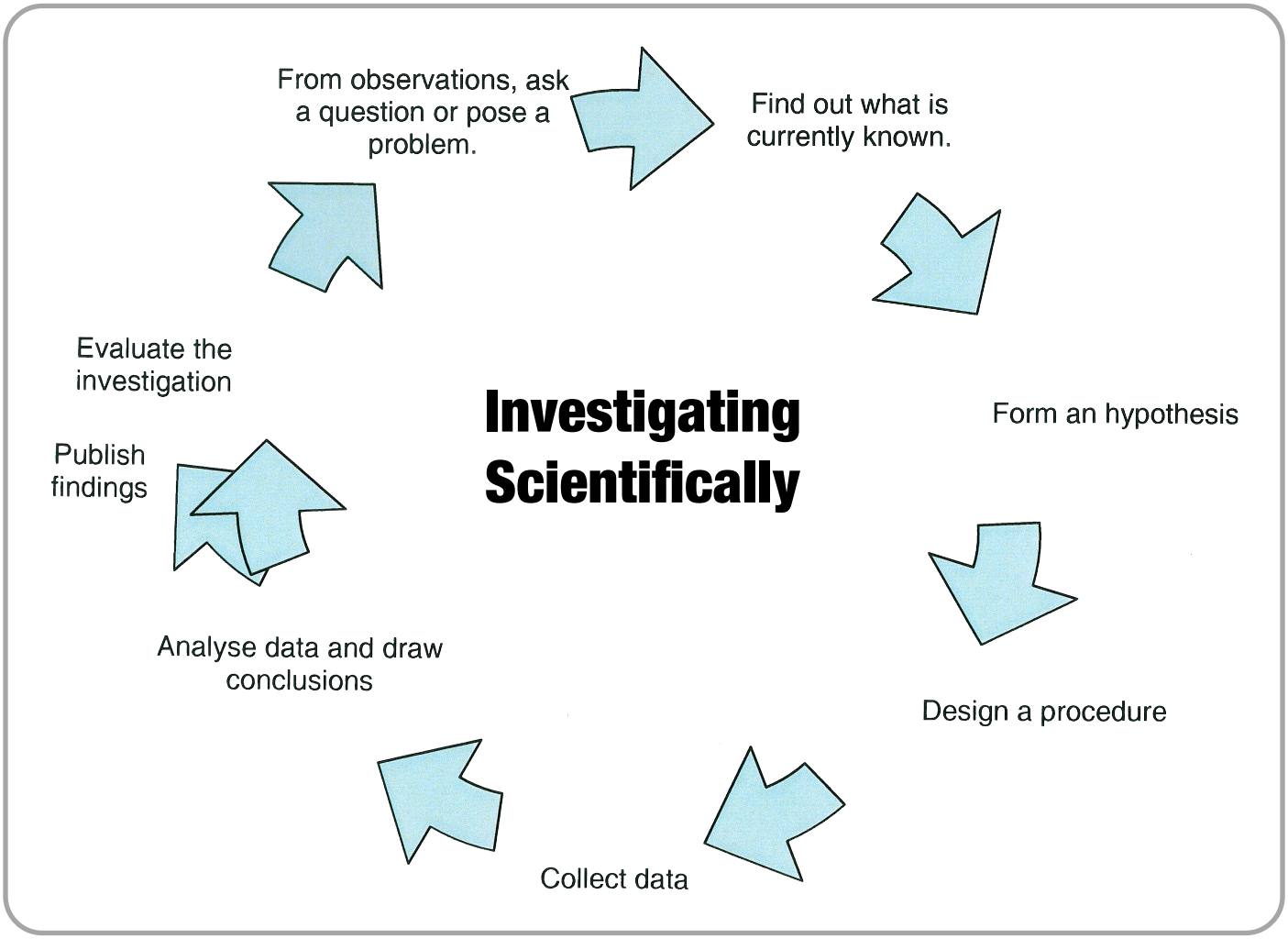
Shrubs: Usually mid-height with several woody stems growing out of the base with foliage growing from the stems. Native examples include bush peas, wattles, grevilleas and banksias.

Ground covers including herbs: Usually low height with flexible green stems growing from the base. Examples include native grasses, lilies, mat rush, vines and orchids.

Conducting scientific investigations

The investigating scientifically process involves students using the processes of observing, questioning, planning, predicting, testing, collecting, recording and analysing data to draw conclusions in order to develop a better understanding of the world around them, relying heavily on first hand information.

The process is illustrated here (DET, 2005) and is further explained in Appendix A. It is quoted directly from NSW Department of Education and Training, Curriculum K-12 Directorate (Dec 2005) *Investigating Scientifically: Support for Stage 3 Teachers*.



Source: DET, 2005

Lessons

Observing and exploring

What is the biodiversity of the school grounds?

This initial biodiversity survey will focus on plant variety and vegetative layers. Plants are the foundation upon which most ecosystems are based.

Walk around the school grounds with the students. Using the *Biodiverse Playground Data Sheet* (WS 2) give the groups a time limit to count as many species as possible belonging to one of the vegetative layers in particular areas. The students justify the number counted by describing or sketching leaf shape, flowers and bark on the data sheet. Students should also take digital photos of each area.

The variety of plant species counted will help the students make inferences about the possible number of animal species at a later date. Also look for evidence of animals in each area, eg, droppings, chewed leaves, scratch marks, webs, etc. Note these on the recording sheet.

Ask the students to compare the areas as you walk around asking questions such as: Do you think this garden area would have greater biodiversity than the bush corner? What invertebrates would you expect to find in this area? (Explain to the students that invertebrates are a good indicator of biodiversity.)

Display a large map of the school grounds. Include information from the *Biodiverse Playground Data Sheet* (WS 2) and digital photos.

Hypothesising and predicting

Assist the students to formulate a hypothesis for investigation. For example:

There is a greater diversity of animals in the native garden than the non-native garden. OR

There is a greater diversity of animals in the area with shrubs and trees than the area with just trees.

The students should record the hypothesis on the *Conducting an Investigation* worksheet (WS 3).

Ask the students to predict what they think they will find and why.

LAYERS

Plant layers

Layers describe groups of plants that usually share similar characteristics. The three most common terms for plant layers are trees, shrubs and ground covers.

The greater variety of layers = the greater diversity of animals.

Procedure design

Remind students of the methods and equipment used for collecting invertebrates demonstrated by Field of Mars staff. Also show the students examples of invertebrate traps on the *Trapping Invertebrates* worksheet (WS 4).

As a class with teacher guidance, or in pairs or small groups, students describe a procedure for their investigation and the equipment they will need to use. Discuss with the students how they should make their investigation fair and reliable. For instance, two or more pairs of students collect data from the same area, on the same day, at a similar time of day from areas of similar sizes. The procedure should be written on the *Conducting an Investigation* worksheet (WS 3). Students should identify the specific areas of the school they are going to study.

In the investigation, the students will measure the number and variety of invertebrates at each study site. The invertebrates are the **dependent variable**. The independent variable is what the investigator changes or controls. Selecting two or more areas with differing characteristics provides the **independent variable** and therefore comparisons can be made.

Trapping biodiversity

Some simple invertebrate traps are provided on the *Trapping Invertebrates* worksheet (WS 4). Students could make one of the traps on the *Trapping* sheet or students can try to design their own. This is a good homework task.

These traps can be used in conjunction with the other collecting equipment Field of Mars EEC staff will bring and should be put into the study area the night before the invertebrate collecting session (next session with Field of Mars EEC staff). Students should consider what they are trying to trap and issues related to trap safety for the animals and themselves.

FoM Lends: Nil

School Provides: *Biodiverse Playground Data Sheet* (WS 2), *Conducting an Investigation* worksheet (WS 3), *Trapping Invertebrates* worksheet (WS 4) for trap-making task, large map of school, photos of study areas

Overview

This session will be the data collection stage of the scientific investigation. The students will use the traps they have constructed and equipment brought by Field of Mars staff to trap and collect invertebrates. Data will be recorded for future analysis.

LEARNING EXPERIENCE 3 - BIO INVESTIGATOR

Field of Mars at Your School - *Field of Mars EEC staff will conduct this session*

Background

Invertebrates are animals without a backbone and include animals such as insects, spiders, ticks, slaters, snails, slugs and worms. 99% of all animal species are invertebrates.

In natural systems invertebrates are very important animals. For instance, invertebrates help to recycle dead plant and animal matter, help to pollinate flowers and distribute seeds, and help aerate and turn the soil. Some eat other invertebrates which balances population numbers. Invertebrates are also an important food source for vertebrates higher in the food chain. Loss of habitat and inappropriate use of pesticides have an impact on invertebrate populations.

Scientists use invertebrates as a bio-indicator, that is, an indicator of the biodiversity of an area. This is because invertebrates are easy to sample, have great variety and abundance, play an important role in ecosystems and are sensitive to environmental changes. When assessing the biodiversity of an area, scientists make comparisons in invertebrate samples collected from various sites at the same time and also within the same area taken at different times.

Lessons

Collecting and recording data

If required, student-made traps should have been put into the study areas the night before. In the introduction Field of Mars EEC staff will ask students about their planned investigations, their hypotheses, predictions and procedures. Students will be reminded how to use the equipment and safety factors.

The students, working in pairs or small groups, will then select the equipment they need to conduct their investigation. Staff will guide students in the use of the equipment.

Ground dwelling invertebrate collection

Leaf litter invertebrates can be collected by scraping leaf litter into a colander and shaking the colander over a tote tray. Tiny invertebrates will fall into the tray while larger animals will be trapped in the colander. Once the tiny invertebrates have been collected, the rest of the leaf litter in the colander can be tipped into the tray. Animals will be transferred into collection jars and examined using the magnifying equipment provided by the Field of Mars EEC.

Arboreal invertebrate collection

To dislodge invertebrates from a branch a tree shake is used. This involves students holding a sheet under a branch while another person vigorously shakes the branch. Any invertebrates on the branch should be dislodged and fall onto the sheet for collection.

Depending on the school grounds, sweep nets can be used to capture invertebrates that live in or near the ground layer of plants. Nets are swept side to side through low soft foliage plants and grass. Captured animals are transferred from the net into a collection jar.

Data recording

Students record the invertebrates found on the *Bio Survey Data Sheets* (WS 5). Digital photos of the animals could also be taken. Students will also have an opportunity to use magnifying devices to examine their animals.

On completion of the *Bio Survey Data Sheet* (WS 5) the animals are returned to their habitat.

To conclude the session students will have a closer look at some of the invertebrates collected using electronic magnifying equipment (macro scope). Adaptations will be pointed out and interactions with other living things discussed.

FoM Brings: Invertebrate collection devices, magnifying equipment, macro scope, data projector, digital cameras

School Provides: Projector screen, *Bio Survey Data Sheet* (WS 5) (will need two per student), pencils, clipboards, access to power, student-made traps set the day before.

Overview

The students collate their data collected during the bio investigation, analyse it and draw conclusions. The investigation is then published.

LEARNING EXPERIENCE 4 - BIO CONCLUSIONS

Background

Refer to Appendix A for information on the process of conducting scientific investigations quoted from NSW Department of Education and Training, Curriculum K-12 Directorate, Dec 2005, *Investigating Scientifically: Support for Stage 3 Teachers.*

Lessons

Analysing and drawing conclusions

As a class, or in groups, collate the data for each study area.

Students construct graphs to show the diversity and number of invertebrates found in each area. This could be done using the chart function in a spreadsheet application such as *Microsoft Excel*.

Display the graphs with the large map of the school grounds that also includes photographs of the study areas and plant count record sheets.

Discuss the results with the students asking questions such as: What is the total number of animals found in each area? Which species were the most common? Which areas had the greatest number of invertebrates?

Discuss whether or not the data collected supports the hypothesis. Assist the students to write a conclusion to their scientific investigation. Students complete the *Conducting an Investigation* worksheet (WS 3).

Publish and present

Students publish their investigation as a scientific report, a scientific poster, or as an electronic presentation. Analysis of student reports, posters or presentations can be used as an **assessment strategy**.

FoM Lends: Nil

School Provides: Completed *Bio Survey Data Sheets* (WS 5), *Conducting an Investigation* worksheet (WS 3), large display map of school

West Ryde PS, 2007

Optional Extras

Information report

This activity could be conducted as a research task in the library or for homework. Students create an information report about one of the animals that was collected. Include details such as:

- What does it eat? (Food)
- Where does it live? (Habitat)
- What does it look like? (Appearance)
- What are its predators?
- What characteristics does it have which may help it's survival? (Adaptations, e.g., flat body, hard shell)

FoM Lends: Information texts on invertebrates (in *Earth Alive* resource kit)

School Provides: Information texts on invertebrates, web sites – in *Links* on Field of Mars EEC website www.fieldofmar-e.schools.nsw.edu.au

Bug box

Design and create a habitat for an invertebrate found in the school grounds. Completed habitats can be used to house invertebrates in the classroom. Students need to consider elements like size, access, food, water, temperature and cleaning for their chosen invertebrate.

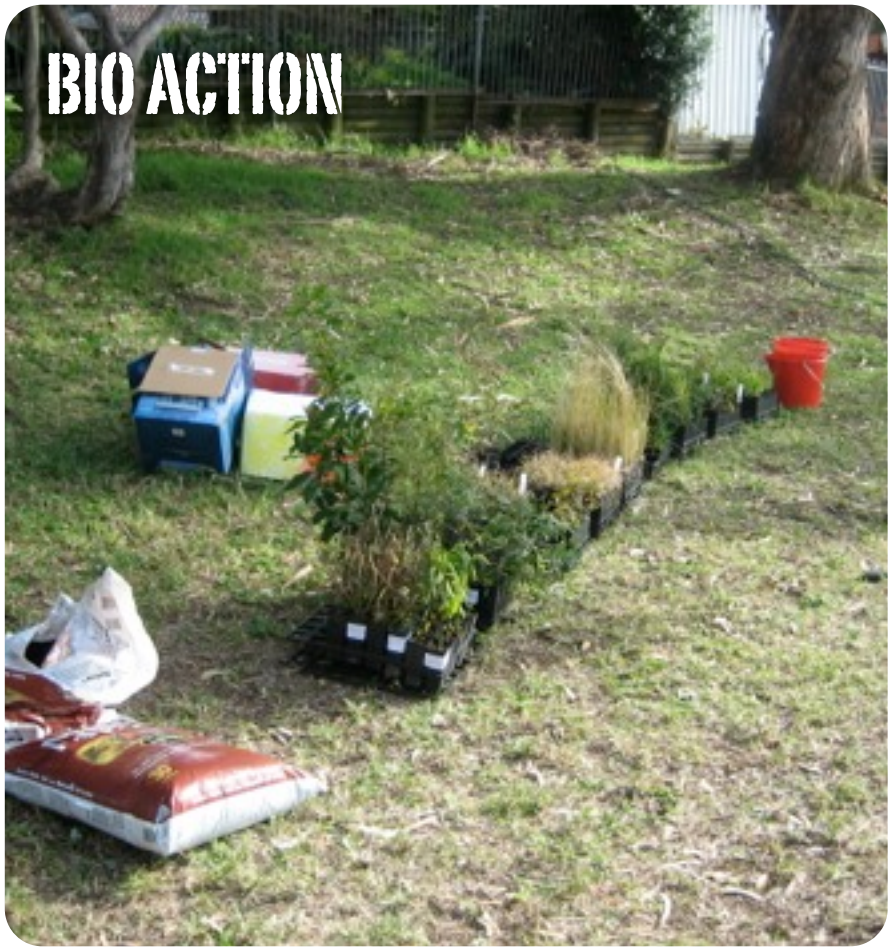
Alternatively, create a diorama that shows an invertebrate in its habitat.

FoM Lends: Information texts on invertebrates (in *Earth Alive* resource kit)

School Provides: Information texts on invertebrates, materials for habitat development

Resource: *Keeping Live Invertebrates Fact Sheet* -

www.pma.edmonton.ab.ca./natural/insects/projects/insects.htm



Overview

From the scientific investigation, the students will identify the areas in the school with low biodiversity then assess these areas to determine what is missing and what may be changed to increase biodiversity. The students suggest ways to improve or construct an ecosystem within the school and prepare an action plan.

LEARNING EXPERIENCE 5 - BIO ACTION - PLANNING

Optional Field of Mars Video Conference - *Field of Mars EEC staff can assist in this session*

Background

By creating the right conditions for one group of animals, you also make a home for other wildlife. For example, a ground cover of native grasses and herbs planted as a seed supply for finches, is also home to lizards, small mammals and butterfly larvae. Trees and shrubs are often planted to attract birds seeking nectar or pollen, but they are equally attractive to leaf eaters like possums, and a host of wonderful insects. Try to recreate natural conditions by including all plant layers and habitat components in your action project.

Habitat components

Layers of trees, shrubs and groundcovers - allow animals to move from one plant layer to another layer safely and provide different kinds of food all year round such as flowers, seeds, fruit and leaves. Some animals only like to live in one plant layer whilst other animals might live in one plant layer but feed in another. Each plant layer helps to keep the other plant layers healthy.

Trees - provide nest sites for mammals, birds, reptiles and frogs and homes for invertebrates. Trees grow flowers containing nectar and produce seeds and fruit which is used as food for birds, invertebrates and mammals. Trees also provide safe places to hide from predators and provide birds with a perch to check the ground for food. Trees provide hollows, which are used by many animals for homes.

Shrubs - grow flowers containing nectar used by nectar feeders. They also produce seeds and fruit which are food for many animals. Shrubs provide nest sites for small mammals, birds, reptiles, frogs and

HABITATS

Habitat components

Try to recreate natural conditions by including all plant layers and habitat components in your action project. By creating the right conditions for one group of animals, you also make a home for other wildlife.

invertebrates and safe places to hide from predators. They protect the roots of trees.

Ground covers - provide homes and nest sites for invertebrates, small mammals, ground feeding birds, reptiles and frogs. They also produce seeds that provide food for many small birds and safe places for them to hide from predators. Ground covers help keep the ground moist.

Flowering plants - provide nectar and pollen for invertebrates, small mammals and birds. Flowers develop into seeds and fruit that are food for many invertebrates, mammals and birds.

Leaf litter or mulch - stops soil from drying out. It prevents soil from washing away or being blown away in storms. It provides homes for invertebrates, reptiles and frogs and food for decomposers such as slaters and springtails. As leaf litter rots, it forms soil and creates nutrients for plants.

Rocks - are used by small mammals, reptiles and frogs for homes, nest sites and for protection from predators and the weather. Reptiles also use the surface of rocks to warm their bodies. Rocks help to hold the soil together and reduce moisture loss. They also create moist places for young plants to grow.

Fallen logs - provide small mammals, ground feeding birds, reptiles frogs and invertebrates with homes, nest sites and protection. They provide a perch from which birds and reptiles can hunt and food for decomposers such as millipedes and bush cockroaches.

Tree hollows or nest boxes - provide nest sites for different animals at different times of the year and provide homes for invertebrates. About 17% of birds, 28% of reptiles and 42% of our native mammals need tree hollows to nest in. Hollows also provide safe places to hide from predators and protect animals from bad weather.

Ponds, creeks and water - provide water for animals to drink, moisture to keep plants alive, and provide moist places for young plants to grow. Ponds also provide habitats for invertebrates, frogs and fish.

Lessons

Applying understandings

As a class, review the graphs and large map of the school grounds constructed from the scientific investigation. This map provides a 'biodiversity snapshot' of the school and can be part of the school's SEMP. Identify areas of low or lower biodiversity.

Use the *Habitat Features Card Set* to provide information on the importance of each habitat component of an ecosystem.

As a class, revisit the areas of low biodiversity. Students use the *Habitat Scorecard* (WS 6) to rate the habitat value and determine what is missing from the areas. The scorecard helps students make informed decisions about what is needed in the school to support

biodiversity and can be used as the basis of their action plan.

Ask questions such as:

- What are the features of the site that are good for biodiversity?
- In what ways could habitat and biodiversity values be improved, e.g., adding some nest boxes for different species, removing weeds?

(Adapted from *Victoria's Biodiversity: Education Resource Book 1*, 1999, p56-57)

Devise an action plan to improve a local ecosystem

Action is one of the most important components of this program.

Recall the *Bare to Biodiverse* display shown to the students at the start of the program and the way biodiversity was increased.

As a class, or in groups, students use their knowledge and understandings to suggest ways in which an ecosystem within the school or local area could be improved or created. (Analysis of student suggestions can be used as an **assessment strategy**.)

With teacher guidance, the students devise an action plan that will improve or create an ecosystem within the school. The *Action Plan* (WS 7) sheet can be used as a planning guide.

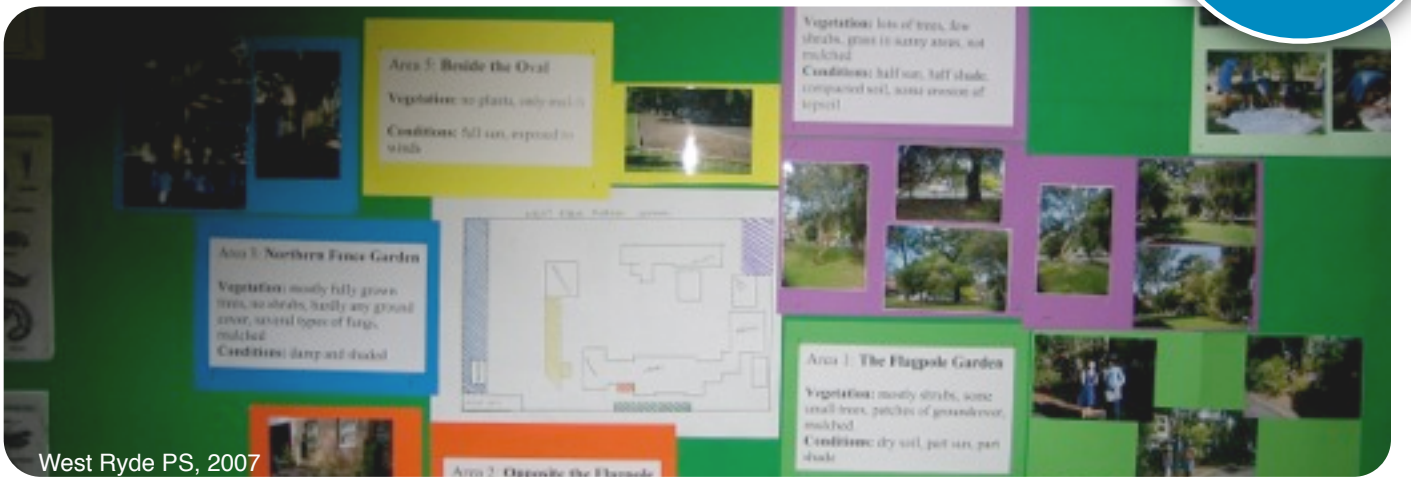
Actions might include:

- Create an area rich in biodiversity
- Make a frog pond
- Regenerate an area of bushland
- Propagate local native plants, trees, shrubs and grasses
- Grow a bush food garden
- Establish a permaculture garden
- Remove weeds
- Install nest boxes for birds, possums, native bees
- Ensure pet owners do the right thing with their pets
- Keep worm farms.

FoM Lends: *Habitat Features Card Set* (in *Earth Alive* kit)

School Provides: *Habitat Scorecard* (WS 6), *Action Plan* worksheet (WS 7)

What areas are low in biodiversity?



West Ryde PS, 2007

Action Plan Resources

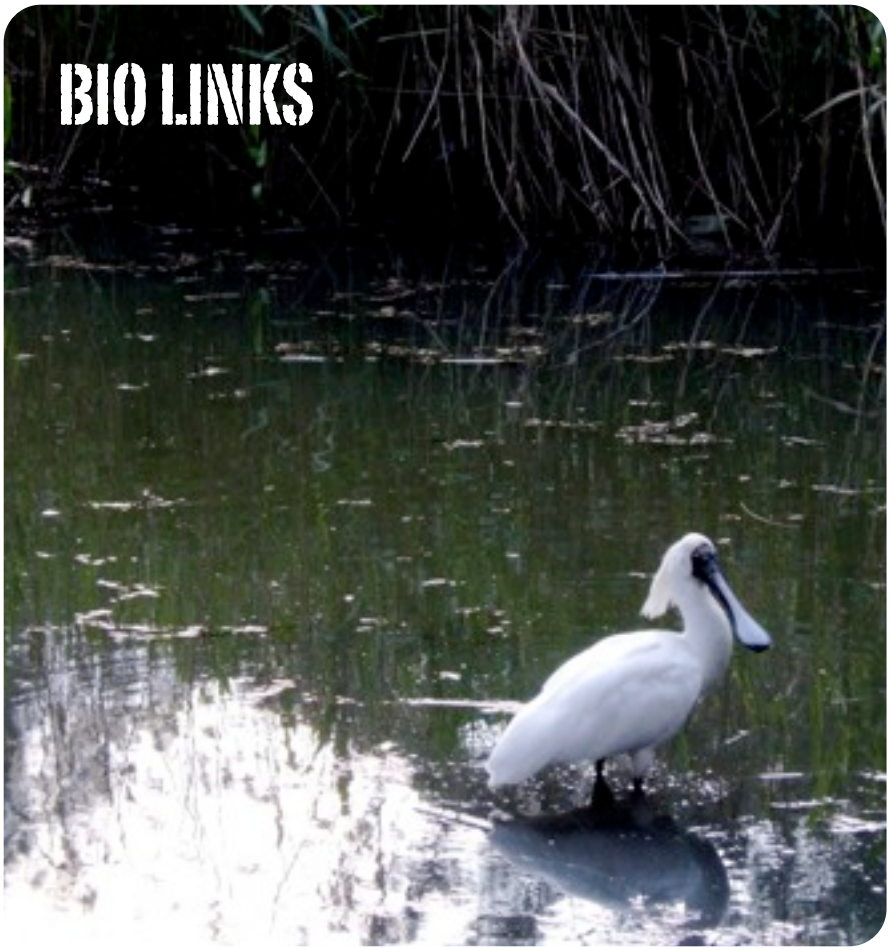
The following Internet sites and organisations can be of assistance with the preparation of an action plan. These sites are listed in the Links section of the Field of Mars EEC website.

- *Flora for Schools* has an online tool for creating Flora for Fauna Garden Plans and a range of other resources – www.floraforfauna.com.au/schools/
- *Landscape Management in NSW Schools* (DET, 2005) - provides practical advice for the planning and design of school landscapes and includes case studies and a resource list. It was sent to all schools in 2005. Also available on the DET Intranet – detwww.det.nsw.edu.au/assetmanagement/safecomp/landscape/
- *Planet Ark National Tree Day* – has tips for planting in drought conditions, lesson plans and case studies - www.planetark.com.au/campaignspage.cfm/newsid/3/story.htm
- *Giving Our Land a Hand* – contains ideas on actions that can be taken - www.nrm.gov.au/publications/land-a-hand/pubs/land-a-hand.pdf
- *Society for Growing Australian Plants* – provides detailed information on growing native plants - farrer.csu.edu.au/ASGAP/sgap1a.html
- Your local council - can usually provide plant lists for the area and possibly some native plants.
- Some grants may be available. See the Field of Mars EEC website, www.fieldofmar-e.schools.nsw.edu.au (in 'Links'), for a list of organisations that provide financial assistance for school environmental projects.

Optional Video Conference with Field of Mars staff

Once the students have prepared an action plan, a video conference can be held with Field of Mars staff to finalise the plan. If you have planned a planting project, email a photograph of the area to be planted to Field of Mars EEC - fieldofmar-e.school@det.nsw.edu.au. This will be used as the background on the interactive whiteboard. Scanned plants and habitat features from the *Bare to Biodiverse* display can be manipulated by the students using Bridgit desktop sharing software to create an impression of what the planted area will look like when it is finished. The session is facilitated by Field of Mars staff and run as a video conference.

NB Some preparation time will probably be needed prior to implementing the action project (*Learning Experience 8 - Action Project - Doing*). *Bio Link*s and *Bio Threats* learning experiences can be undertaken during the weeks leading up to the Action Project.



Overview

Through the use of plant and animal pictures and the preparation of a pizza, students gain an understanding of the links between plants and animals and the environment.

LEARNING EXPERIENCE 6 - BIO LINKS

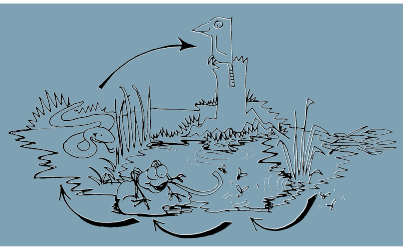
Background

The interrelationships between plants and animals and the non-living elements of an environment form the basis of all ecosystems. Food chains and food webs show the flow of energy through an ecosystem.

A food chain shows feeding relationships at the simplest level. A food chain always begins with a green plant which is a producer. This is eaten by an animal which is a consumer. Consumers that eat plants are herbivores and consumers that eat other consumers are carnivores. Animals that eat some plants and some animals are omnivores. The arrows in a food chain mean ‘eaten by’ and show the flow of energy.

Example: grass → grasshopper → lizard → kookaburra

Energy flows are not this simple as animals eat a variety of species. The more complex flow of energy among many species are shown as food webs.

FOOD CHAINS	LEAF →	SNAIL →	LIZARD →	KOOKABURRA
	**Producer** The majority of foodchains begin with a plant.	**Consumer** The animals that eat plants are called primary consumers.	**Consumer** Consumers that eat other animals are secondary consumers. They are carnivores.	**Consumer** The animal at the top of the food chain is a carnivore. These are tertiary consumers.

Lessons

Food chains and webs

Refer to the *Bare to Biodiverse* interactive display used by Field of Mars staff in the first session. Recall the links between plants and animals in that ecosystem.

Use the magnetised Gould League *Food Webs, Classification and Biodiversity Kit* to demonstrate links between animals and plants. Begin with simple food chains, e.g., grass → wallaby → dingo. Food webs should only be introduced when students have a clear understanding of food chains. Knowledge about what some native species eat is essential for this activity to be effective.

Refer back to the data recording sheets from the invertebrate investigation. The students copy the names of the animals collected onto cards then sort them into herbivores, carnivores and omnivores. They can then make food chains using these animals. Results could also be graphed. Which group is the largest?

Discuss what happens when an animal or plant is removed from the chain. Also discuss the most important elements in the food chain/web. Discuss why it is better for an ecosystem to have lots of different plants and animals.

FoM Lends: Gould League '*Food Webs, Classification and Biodiversity'* Kit (in *Earth Alive* resource kit)

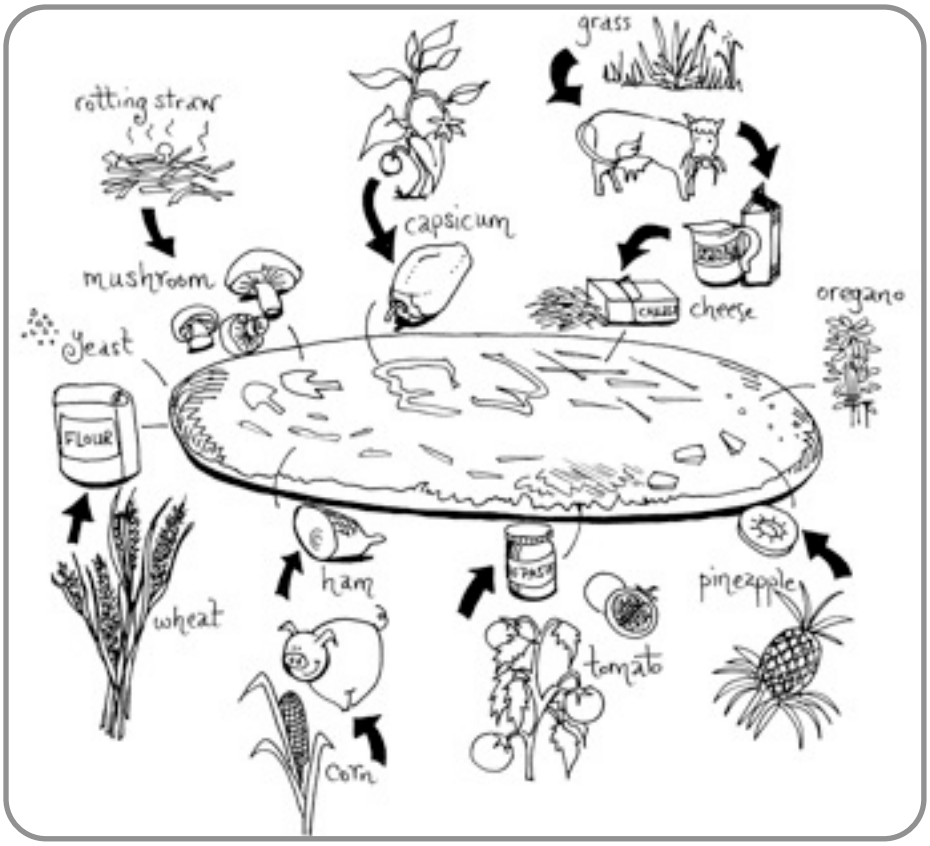
School Provides: Magnetic whiteboard, completed *Bio Survey Data Sheets* (WS 5), palm cards or similar

Food chain pizza (or fried rice or sandwich)

Students are provided with a range of ingredients to create a pizza. Students prepare then cook the pizza. While cooking, students draw a picture of a pizza and trace each of the food items used back to its origin, eg, cheese to milk, to a cow, to grass. Muffins make ideal mini pizza bases. This activity also works well for fried rice or a sandwich. (Source Gould League, 1999, p. 25)

FoM Lends: Nil

School Provides: Ingredients for pizza making or fried rice or sandwich, cooking equipment



Optional Extras

Animal connections

Students could use the Gould League's online food web creator available at www.gould.edu.au/foodwebs/australia.htm. Students then create a food chain or web for a local Australian animal. This could be done as a mobile or using mind mapping computer software such as *Inspiration*.

FoM Lends: Nil

School Provides: Texts on native animals and invertebrates, mobile materials, computers

Resource: www.gould.edu.au/foodwebs/foodwebs_p.htm

Overview

The students become aware of threats to biodiversity through picture books, mind mapping and calculating their eco-footprint. Local biodiversity threats are identified within the school grounds and local area.

LEARNING EXPERIENCE 7 - BIO THREATS

Background

There are many threats to biodiversity and many of these are a result of activities by humans. Threats include land clearing (habitat destruction), feral animals, weeds, pesticides, pollution, and agricultural and farming techniques.

Feral animals, e.g., foxes, cats, dogs, carp, horses, goats, cane toads, European wasps, honeybees and rabbits. These animals affect our biodiversity because they:

- prey on native animals
- compete for nest sites
- compete for food
- cause soil erosion
- foul waterways.

Weeds, e.g., blackberry, salvinia (water weed), privet, morning glory, balloon vine, wandering jew, pampas grass, and camphor laurel trees. Weeds:

- compete with native plants for light and growing space
- are unpalatable for many native animals
- smother vegetation and prevent and/or inhibit native plant re-growth.

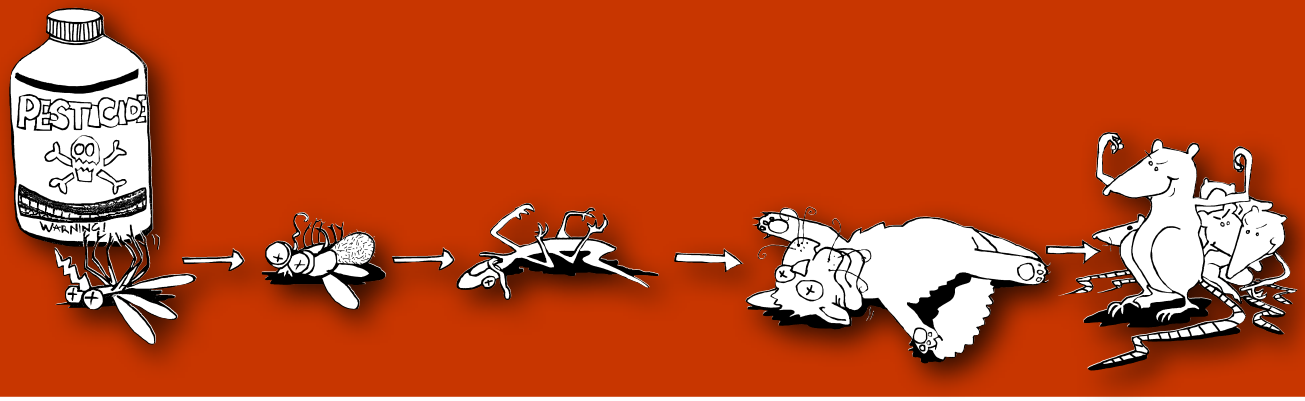
Agriculture and farming techniques, e.g., land clearing, the farming of hoofed animals and the use of pesticides. Problems caused include:

- Native vegetation is cleared, destroying animal habitats and causing erosion. With mass tree removal the water table rises and dryland salinity can result.
- Hoofed animals such as cows and sheep compact the soil, can lead to erosion and increase competition for food.
- Mono crops need chemicals such as pesticides, fungicides, fertilizers. These can wash into waterways causing increased nutrients which cause algal blooms. Pesticides can poison many animals, even those not intended.

Chain reaction

Malaria once infected nine out of ten people on the island of Borneo. In 1955, the World Health Organisation (WHO) began spraying dieldrin (a pesticide similar to DDT) to kill malaria carrying mosquitoes. The program was so successful that the dreaded disease was almost eliminated from the island. But other unexpected things happened. The pesticide killed other insects, including flies and cockroaches inhabiting the houses. The islanders applauded. But then small lizards that also lived in the households died after gorging themselves on dead insects. Then cats began dying after feeding on dead lizards. Without cats, rats flourished and began overrunning the villages. Now people were threatened by sylvatic plague carried by the fleas on the rats. The situation was brought under control when WHO parachuted healthy cats onto parts of the island. On top of everything else, roofs began to fall in. The pesticide had killed wasps that fed on a type of caterpillar that either avoided or was not affected by the insecticide. With most of its predators eliminated, that caterpillar population exploded. The larvae munched their way through one of their favourite foods, the leaves used in thatching roofs. Eventually the situation was brought under control but the story shows the unpredictable results of interfering with an ecosystem.

(WWF, 1999, p. 29)



Climate change can affect global biodiversity as habitats change faster than species can adapt to them. This can lead to the extinction of species. Other impacts of climate change include:

- Breeding and migration can become out of synchronisation with food availability, e.g., caterpillars hatching before their food source is available. The newly hatched caterpillars die. This will impact on birds which feed on these caterpillars.
- Warmer temperatures will favour some species over others and will destroy the balance of nature.

Consumption habits and product choice can affect biodiversity. For instance:

- purchasing rainforest or non-plantation building materials and furniture destroys animal habitats
- buying non-recycled paper destroys habitats

- buying endangered animal products threatens the existence of species
- purchasing from companies that don't have strict environmental guidelines can contribute to environmental destruction and degredation.

Lessons

Threats to biodiversity

Throughout the week read a variety of picture books with an environmental message and display posters showing threats to biodiversity.

The students create mindmaps to show a range of threats to Australian biodiversity, for example, feral animals, weeds, pesticides, agricultural techniques, habitat loss, pesticides, pollution. The students could research the impacts of these on biodiversity. As a class, discuss ways in which these threats could be reduced or eradicated. The students could debate topics relating to biodiversity threats.

Local biodiversity threats

Discuss the threats relating to biodiversity in the school or local area. Walk around the school or local area and identify threats and their impact on biodiversity. Also look for management strategies, for example, pollution traps on drains, fox-baiting programs, “Dumping Prohibited” signs. Students complete the *Biodiversity Threats* worksheet (WS 8).

Local council environment officers or bush care members could be invited to talk to the class about issues affecting local biodiversity and their solutions to these issues.

Students could design and display posters outlining actions people can take to solve or reduce an environmental problem in their school.

Ecological Footprint

Discuss ways in which everyday living impacts on the planet and explain the concept of “ecological footprint”. Students then calculate their ecological footprint using the web-based *Bigfoot* calculator available at www.powerhousemuseum.com/education/ecologic/bigfoot/mid/.

Action plan review

Students review the class’s action plan in the light of their new knowledge and understandings.

FoM Lends: *Out of the Spinifex* feral animal poster (in *Earth Alive* kit)

School Provides: Picture books, *Biodiversity Threats* worksheet (WS 8), guest speakers

What is your ecological footprint?

All of our activities use resources from the planet and create waste. For instance, a day at school requires forests, energy and chemicals to produce the books we use, coal to generate the electricity to light , heat and cool our rooms and large areas of land is needed to grow our food. The waste generated in a day at school and in the production of the resources we use also needs to be dealt with by the planet. The impact an individual has on the planet is called an ecological footprint. Even if we make small changes to the way we live we can reduce our ecological footprint. For example, bringing a rubbish free lunch to school and walking or riding instead of being driven can make a difference.

Optional Extras

Biodiversity debates

This is a good **assessment strategy**.

This activity helps students develop deeper thinking about an issue relating to biodiversity and gets students to analyse some of the associated feelings and values towards the issue. Groups of students select a biodiversity issue (or select from the list below) and then they decide which pair argue for the affirmative or the negative. Debates are presented to the class.

Possible topics:

- Native gardens are better than non-native gardens
- Cats should be kept inside
- All pesticides should be banned
- All non-native animals should be culled
- Aboriginal fire-stick farming was good for the bush
- Bush regeneration is a waste of time and effort.

FoM Lends: Nil

School Provides: Nil

(Source: Pirkko Hamalainen, Old Guildford PS)

Remnants game

This game provides students with an insight into how the fragmentation of bush can affect biodiversity. Students will experience habitat loss, overpopulation and breeding problems.

In an open space spread large sheets of newspaper on the ground to represent trees. Each square can only support four animals if it is intact. When the music plays the students move like animals around the newspaper. Liken this to night-time with nocturnal animals. When the music stops (sunrise) students need to find a newspaper to stand on.

Start to remove newspaper sheets while providing a scenario such as, "We need to put a road through here, a housing development, a new shopping centre, a school, etc." As the newspapers are removed the students who are not standing on a paper are also removed from the game. They represent animals which died because they were not located in a safe place in the bush during the day.

As the game continues the sheets of newspaper become tatty and torn. These represent over populated areas, that is, too many animals in one small part of the bush. Remove some animals from these sheets as they can now only support two animals. How long does it take for the animals to die off without sufficient bush? What happens when the bush is cut up into small bits?

Add another element to the game. As the number of students decreases introduce the problem of breeding. If a paper does not have both male and female animals on them when the music stops then the species won't be able to breed and they will die.

At the end of the game discuss the importance of the size of the areas of bushland, linking remnant bushland together to create bush corridors, and our behaviour in the bush that is left.

FoM Lends: Nil

School Provides: Newspaper, CD player, music (or tapping sticks)

Overview

The students will take positive action for their local environment by undertaking a project that improves biodiversity. This is the culmination of the students' scientific investigation and the knowledge they have gained throughout the program. The action project provides the opportunity to act locally.

LEARNING EXPERIENCE 8 - BIO ACTION - DOING

Field of Mars at Your School - *Field of Mars EEC staff will assist in this session*

Background

Local projects which improve ecosystems and biodiversity make a difference.

Action projects within school grounds fall within the Grounds Management component of the School's Environmental Management Plan (SEMP). The DET's Environmental Education Policy for Schools requires schools to develop a SEMP annually.

Lessons

Construct or improve a local ecosystem

Action is one of the most important components of this program.

Implement the action plan. Field of Mars staff will come and assist. If appropriate, invite the school community and local council to assist or to contribute to the action project.

Field of Mars EEC staff can supply planting equipment, order suitable native plants, and provide advice and useful contacts.

ACTION

Improve biodiversity

Take action and improve an area of your school grounds. In this photo sequence the eroded soil area was a trip hazard and was washing into the stormwater drains. A native grass garden solved the erosion problem, improved amenity and increased biodiversity.

Inform others

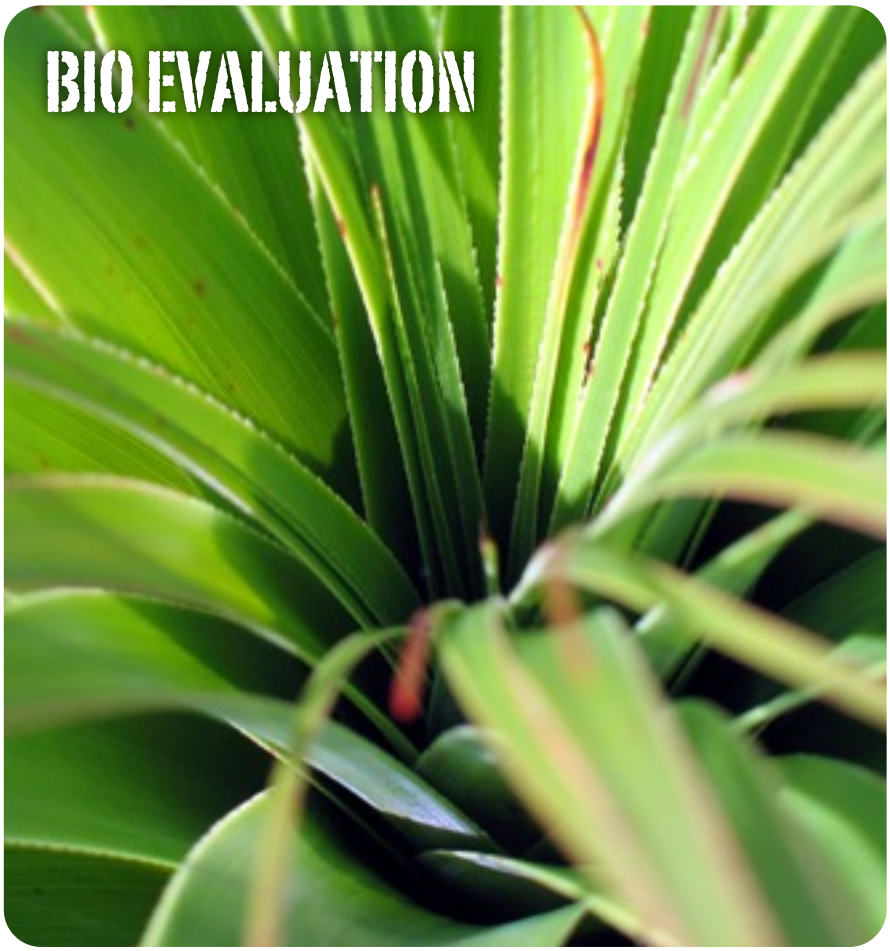
Record the progress of the biodiversity action project with photos or video. Display the progress on a news board, the school's website or in an album in the foyer or library.

Keep the school community informed of your actions through the school newsletter, web pages and school presentations.

Write and let local politicians, newspapers, local environment groups and the local council know what you are doing to conserve biodiversity in your school.

FoM Brings: Equipment as needed

School Provides: TBA – depending on action project



Overview

The students consider ways in which the action project can be maintained and continued into the future. They also reflect on their learning through the Earth Alive program.

LEARNING EXPERIENCE 9 - EVALUATION

Background

Ongoing maintenance is essential once the action project is completed. This will ensure the project has long-term benefits and provides a lasting legacy to the school from the Stage 3 students. Processes will need to be put in place to ensure this happens.

Lessons

Ongoing action

The action has begun. What steps are you and your class going to take to ensure it continues into the future? For instance, consider maintenance, future funding and additional actions. An environment group could be instigated to maintain the area. A committee of teachers, students and community members may need to be formed to formulate and monitor the school's SEMP.

Students could report on their scientific investigation and action project to the whole school with the intent of gaining their support for the action project into the future.

Students could write a pledge about their personal future actions for biodiversity. The pledge should be something achievable which students could also do at home. It may be encouraging their family to keep their cat in at night or to join a bush regeneration group.

Assessment strategy

Return the *Biodiversity Mindmap* (WS 1) the students completed before the start of the program. Ask the students to add further information about what they know now.

Evaluation

Field of Mars EEC staff would appreciate feedback about the *Earth Alive* sequence of learning experiences. Students (and the teacher) could write a reflection on the program. Also, if possible, Field of Mars EEC staff would like to see a range of samples of the *Biodiversity Mindmaps*. Staff are also interested to see samples of student scientific investigation reports and photos of 'before, during and after' the action project. Material can be sent by mail or emailed to fieldofmar-e.school@det.nsw.edu.au. Original student work will be returned to the school.

FoM Lends: Nil

School Provides: *Biodiversity Mindmap* (WS 1)

Overview

A variety of additional or alternative learning experiences is provided.

BIO OPTIONS

Additional activities for teaching about ecosystems and biodiversity

Bio news

Students collect or make notes on a range of articles from newspapers, magazines, Internet, radio and TV which relate to biodiversity or any environmental issue. (The Planet Ark website provides daily Reuters World Environment News. Available at www.planetark.com.au/dailynewshome.cfm.)

Students form ‘news groups’ to share the main points of an article with a group of students. Articles could be sorted into international, national and local issues and displayed.

FoM Lends: Nil

School Provides: Newspapers, magazines, Internet etc

Bio glossary

Students create or look up definitions for the following words and terms. As the students encounter other new 'bio' words they add them to the glossary. Display the glossary.

Word bank

adaptation	fauna	mammals	threatened species
animals	feral	parasite	tree hollows
diversity	flora	recycle	web of life
ecocommunities	habitat	reduce	wetlands
ecology	indigenous	reuse	woodland
endemic	interdependence	sustainable	
extinct	interrelationship	symbiosis	

(Adapted from *Clockwork*, 1997, p. 15, http://home.vicnet.net.au/~clokwork/pdf/BigHand.pdf)

FoM Lends: Nil

School Provides: Dictionaries

Bio collage

This is a suitable **assessment strategy**.

Make a biodiversity collage showing the importance and value of biodiversity. Examples of the value of biodiversity include:

- We eat it and drink it
- All food originates in wild plants and animals
- Native birds, bats and insects pollinate plants, gardens and crops
- Invertebrates fertilise and protect the soil
- Crops are protected from pests by foraging birds and insects
- We rely on biodiversity for the origin of many medicines, eg, aspirin from willows, antibiotics from mould, cancer treatments from plants
- Recreation and tourism depend on healthy ecosystems
- Timber is used for building, shelter and fuel
- Oxygen comes from trees (all plants)
- Trees remove carbon dioxide from the air
- Trees protect the soil
- Marine organisms clean sewage from the sea
- Wetlands, mangroves and estuaries help clean water
- Plants help remove salt from the soil.

FoM Lends: Nil

School Provides: Collage materials

Survival of the cutest

We bring attitudes to our relationships with animals that are not founded on reason or reality. Certain animals are seen as being attractive or cuddly. Others are perceived as cunning, creepy or even evil. These feelings are reinforced in all cultures by folklore and literature. These attitudes often distort conservation polices because some animals are seen as defenceless or pathetic while others cause revulsion or are seen as cruel.

People are conditioned to look after human babies. A baby's features such as big head, big eyes, bulging forehead, chubby cheeks all act as triggers to adult feelings. Animals which show similar characteristics provoke similar feelings. If students are to have a balanced attitude towards animals and their conservation then they need to respect them on their own terms rather than as imitation humans.

Show the students a range of animal pictures, for example, crickets, fly, lizard, dingo, rabbit, wombat (from Gould League *Food Webs, Classification and Biodiversity Kit*). Students use words to describe the animal pictures. Discuss why the words were chosen. What is the students' evidence for their reactions?

(Adapted from *Environment*, 1998, pp. 20-27)

Students list facts about each of the animals. Do these facts help persuade or change the students attitudes to these animals? Can other students add any other facts to the list? Do they agree or disagree with the facts? Discuss the role of the cutest animals compared to that of invertebrates. Invertebrates are extremely important and undervalued animals. Many are responsible for maintaining ecosystem health. Is our dislike or misunderstanding of many invertebrates justified? Why do we know more about the cute animals? Why do they receive more media attention and protection?

Discuss the lists of sponsored animals at Taronga Zoo. Why are some animals more popular for sponsorship than others? Do the students agree with the list? What animals would the students prefer to sponsor?

After this article appeared in the newspaper more than 200 people responded to the plight of the unloved animals. Gail, the brush tailed phascogale, proved the most popular being adopted by 25 new 'zoo parents'. Readers pledged a total of $7000.

(Source 'Just Wild about Gail', *The Sun Herald*, 12 Dec 1999, p. 49)

FoM Lends: Gould League *Food Web, Classification and Biodiversity Kit* (in *Earth Alive* resource kit)

School Provides: Nil

ZOO SPONSORSHIP

	The Unloved Taronga Zoo's bottom ten sponsorship money spinners (1999)		Public Favourites Taronga Zoo's top ten sponsorship money spinners (1999)
1	Dholes (wild dogs)	1	Elephants
2	Agoutis (guinea pig like animals)	2	Giraffes
3	Binturongs (like sloths)	3	Tigers
4	Tapirs	4	Chester the White Tiger
5	Tuatara (NZ lizards)	5	Meerkats (after they appeared in *The Lion King*)
6	Tarantulas (spiders)	6	Koalas
7	Rattlesnakes	7	Bilbies
8	Frilled Lizards	8	Wombats
9	Giant tortoises	9	Orangutans
10	Brush-tailed phascogales	10	Gorillas

(Source 'Why no-one loves Gail', *The Sun Herald*, 5 Dec 1999, p. 31)

Animal adaptations

Look at the animal pictures in the Gould League *Food Web, Classification and Biodiversity Kit*. Choose species the students are most likely to be familiar with. Try to match the animals with the most suitable habitat from the *Habitat Pictures Kit.* Some animals can belong to more than one habitat type.

Ask the students to identify the features of an animal that indicate it has adapted to a certain habitat. Look at ears, snout, limbs, size, tail, groups (social structure). Examples of adaptations are:

Adaptation	Kangaroo	Possum
Ears	Long to help detect predators	Short to avoid damage from branches
Snout	Long to keep eyes above grass when grazing	Short to allow good sight line when climbing
Limbs	Back legs heavy and strong for jumping	Short and powerful for climbing
Size	Large to avoid predators	Small to allow climbing on branches
Tail	Heavy to balance when jumping	Curly to grip branches
Groups	Large for protection	Small to avoid breaking branches

(Source Gould League, 1999, pp. 32-33)

FoM Lends: *Habitat Pictures Kit*, Gould League *Food Web, Classification and Biodiversity Kit* (in *Earth Alive* resource kit)

School Provides: Nil

Classifying biodiversity

Discuss why we need to classify. Classification involves grouping organisms according to the characteristics that they have in common. Organisms that have been classified are easier to find, easier to talk about, and easier to study. The items in a supermarket are classified into groups. Why? Imagine walking into a supermarket that didn't group or classify its products. What would it be like? How would you find the products you need?

Classify the animals recorded on the *Bio Survey* worksheets (WS 5) into broad groups, eg, birds, reptiles, mammals, amphibians, fish, invertebrates. The invertebrate group may need to be further subdivided, eg, insects, spiders, praying mantids, grasshoppers, moths and butterflies.

Graph results. Which group is the largest and smallest? What is the total number of animals found? Which species were the most common? Why?

FoM Lends: Nil

School Provides: Completed *Bio Survey* worksheets (WS 5)

Bio comparison

This activity provides students with an opportunity to compare their original survey results with those from another site.

Visit a 'natural' site either in the local area or another site further away, for example the Field of Mars Reserve. Conduct a biodiversity survey using the same methods as used previously.

Compare the plants and animals found in the natural area to those found at school. Are they the same or different? Did the students find the same number of animals in both sites? Which site had the greatest amount of biodiversity? What would help explain the differences? Remind the students that the greater the variety of plants, the greater the variety of animals.

FoM Lends: Set of specimen boxes, set of *Invertebrate Identification Charts* (in *Earth Alive* resource kit)

School Provides: *Bio Survey* worksheets (WS 5)

Extra biodiversity surveys

Whenever possible provide the students with an opportunity to conduct regular surveys of vertebrate and invertebrate animals such as birds, reptiles, mammals and insects. Discuss: How would we find out about animals that we can't see? What evidence could we look for? Additional surveys could be conducted at the students' homes providing a broader picture of biodiversity in the local area.

Please note: Native vertebrates (eg, lizards) are protected by law and cannot be trapped without appropriate licences.

FoM Lends: Set of specimen boxes, set of *Invertebrate Identification Charts* (in *Earth Alive* resource kit)

School Provides: Student designed traps, soft paint brushes for collecting invertebrates, *Bio Survey* worksheets (WS 5)

Our place in the past

Read the students the story *My Place* by Nadia Wheatly which shows changes in an area then discuss how the students' local area has changed. What was the local area like in the past? Schools often have aerial photos of the local area. Grandparents may also have photos or be a good source of information. Perhaps the local bush was larger, or the coast was not covered with houses or the native grasslands were thick. Or, perhaps the local area is in better shape now than it was 50 years ago.

The class could make two maps or pictures of a section of the local area. One map or collage represents today, the other represents the past. Ask the students: What is different about the two maps or pictures? How do these differences impact on local biodiversity?

(Adapted from *Clockwork*, 1997, p. 26, http://home.vicnet.net.au/~clokwork/pdf/BigHand.pdf)

FoM Lends: Nil

School Provides: Guest speakers, old photos, maps, aerial photos, *My Place* by Nadia Wheatly

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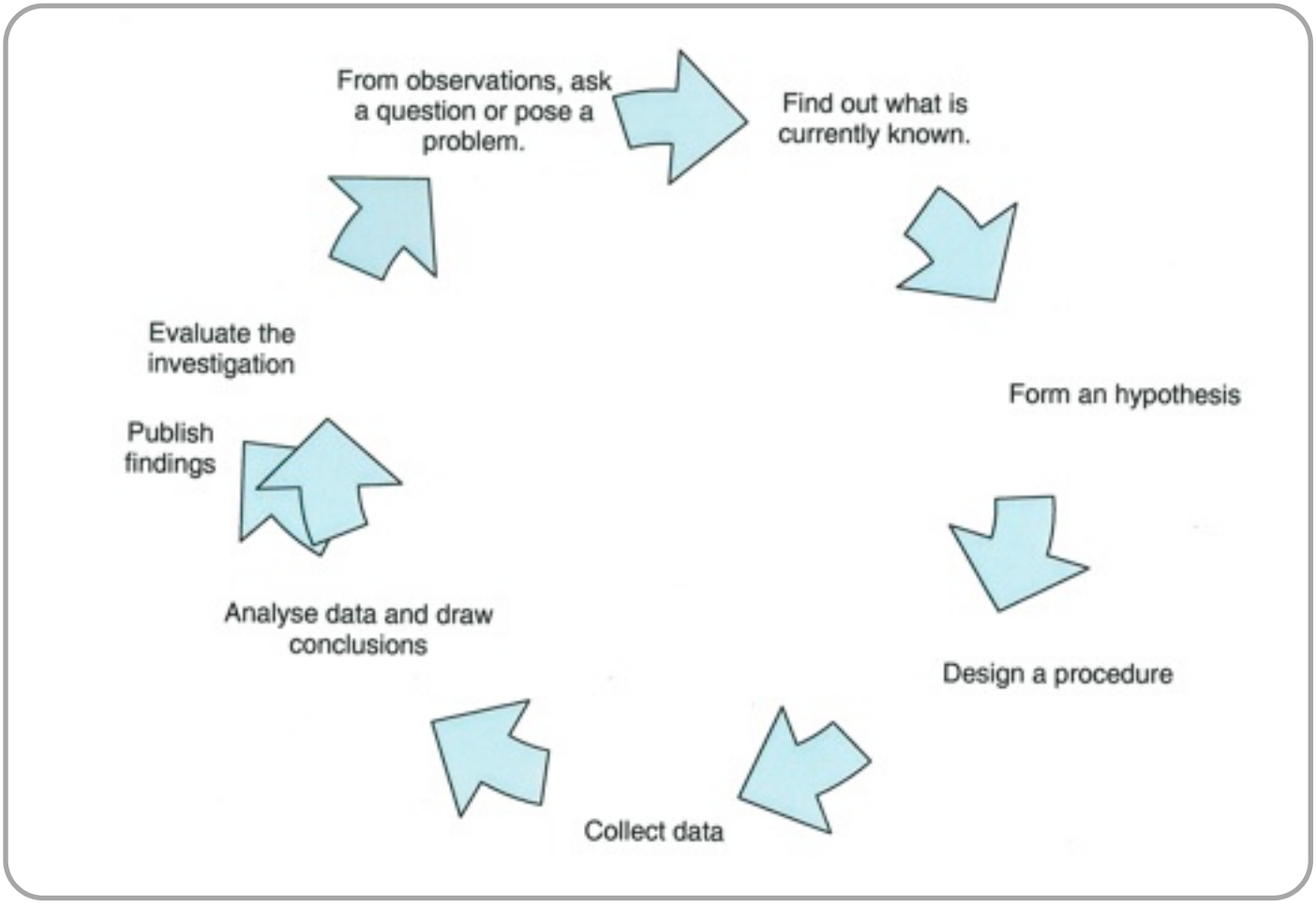
CONDUCTING SCIENTIFIC INVESTIGATIONS

Reproduced from: Curriculum K-12 Directorate, NSW Department of Education and Training (Dec 2005) *Investigating Scientifically: Support for Stage 3 Teachers* - www.curriculumsupport.education.nsw.gov.au/primary/scitech/investigate/docs/invest_st3.pdf

The investigating scientifically process involves students using the processes of observing, questioning, planning, predicting, testing, collecting, recording and analysing data to draw conclusions in order to develop a better understanding of the world around them, relying heavily on first hand information.

Observing and Exploring

(Ask questions, pose problems, find out what is currently known)



1. Teacher leads the class in a brainstorming session to help the students define the question that they will investigate, eg *How can we keep the hot chocolate warm?*

What do we know about keeping things warm? What additional information do we need to find?

A mind map could be used in the brainstorming session to help students clarify what they know and what they need to find out. For example, *Will insulation keep our coffee from going cold? Does the type of cup affect heat loss? Does the starting temperature of the hot chocolate affect the heat loss? Does the size of*

the cup affect heat loss? Does the material the cup is made from affect heat loss?

Students may be guided to conduct *research* from secondary sources such as books, CD ROMs, Internet etc. to find out about concepts such as *heat transfer, temperature, and sources of heat...*

Once the research is completed students should share their understandings by contributing in a class discussion. Teachers may guide the students during the class discussion to ensure the relevant and correct scientific concepts and language are used. For example, *Energy is transferred from a body of high temperature to one of a lower temperature. Energy can be transferred through all materials even through empty space. Convection is a process by which energy is transferred in liquids or gases. Conduction is the process through which energy is transferred through solids.*

2. As a class, brainstorm possible investigations that can be constructed to solve the problem or answer the questions. (This can be done by either creating a new mind map or adding the new knowledge to the initial mind map.)

Hypothesising and Predicting

(Define a problem that can be investigated scientifically)

Students with teacher assistance develop a hypothesis related to their chosen investigation. Students should be guided to identify the relationship between the independent and dependent variables.

Example hypotheses:

Foam cups will keep hot chocolate warmer than paper cups.

Smaller mugs will keep hot chocolate warmer than larger mugs.

Insulated mugs will keep hot chocolate warmer than non-insulated mugs.

Tall mugs will keep hot chocolate warmer than short mugs.

Devising and Testing

(Describe a procedure for collecting data, identify appropriate equipment to carry out the procedure)

Discuss with students how they could make their investigation fair.

Students should identify the variables that could affect the results of the investigation, and therefore, need to be kept constant. Students should be able to identify the independent variable and the dependent variable. E.g., *The variables would include such items as the size of mug, shape of mug, composition of mug, initial temperature, water impurities, quantity of milk, ambient temperature, and instruments used to measure temperature*.

Discuss with students how they could ensure their investigation is reliable. E.g.: *Is what I have chosen to measure and the way that I measure it able to be repeated/replicated with consistent results? Can the students repeat their investigation? Would they need to replicate the investigation? How many times should students repeat or replicate their investigation?*

Provide the students with a procedure proforma. *(E.g., Earth Alive Conducting an Investigation* worksheet WS 3)

Explain or discuss with students the experimental procedure and the process for collecting data and the equipment needed to conduct the investigation.

Alert students to possible risks involved in conducting their investigation and ensure appropriate risk management procedures are followed.

Note: *Depending on the student's level of development, Stage 3 students should be encouraged to develop the procedure for their investigation independently.*

Collecting and Recording Data

(Use the procedure and equipment to collect and record data)

Students conduct their investigation in pairs or small groups with guidance. Teachers should demonstrate/ model to students the importance of making accurate and precise measurements.

Note: *Depending on the level of development of the students, the teacher may provide a proforma for the students or allow the students to independently develop their own method of recording their observations. (Eg, Earth Alive Bio Survey* Worksheet WS 6)

Analysing and Drawing Conclusions

(Reach a conclusion which is communicated to others)

Once all the data is collected, a careful and systematic analysis should be conducted to identify if the evidence gathered supports the hypothesis. Students should analyse the collected data as well as evaluating the procedure and instruments used in their investigation.

Constructing graphs is one method of analysing the student's data. Spreadsheet applications assist in producing effective graphs once the data has been entered.

Teachers should discuss with students the various types of graphs and assist students to choose an appropriate graph to best represent their data, ie, column graphs for discontinuous data, line graphs for continuous data.

Teachers may lead the class in a discussion to describe trends and patterns in the student data. Reference should be made to the hypothesis: *Do the trends support the hypothesis? What scientific explanation is there for the results?*

Evaluate the investigation by identifying possible sources of error and suggest improvements to the investigation. Students/teachers can suggest further investigations arising from the results.

Teachers and students jointly, or students independently, write a conclusion.

The information gained from this investigation may lead to a design and make activity, e.g., designing a more efficient mug.

Publishing and Presentation

Students should be encouraged to present their investigation to an audience.

Presenting their findings provides students with an opportunity to reinforce and showcase their learning. It can also provide the teachers with a valuable assessment opportunity.

Presentations may be made through the construction of a scientific report, scientific poster, or electronic presentation, eg, web page, slide show etc.

A presentation tells a story of an investigation. Students' presentations, regardless of their form, should aim to inform the audience about:

- What they investigated
- Why they were interested in the investigation
- How they did the investigation
- What they observed
- What the observation/results mean
- Why the results are important
- What they have learned
- What they may do next.

The report can be grouped under the following headings: hypothesis, background, materials, procedure, results, discussion and conclusion, bibliography.

Ensure that students are guided through the process of acknowledging sources of information, such as books, web sites and people that contributed to their investigations.

EARTH ALIVE

STUDENT WORKBOOK

NAME: _____

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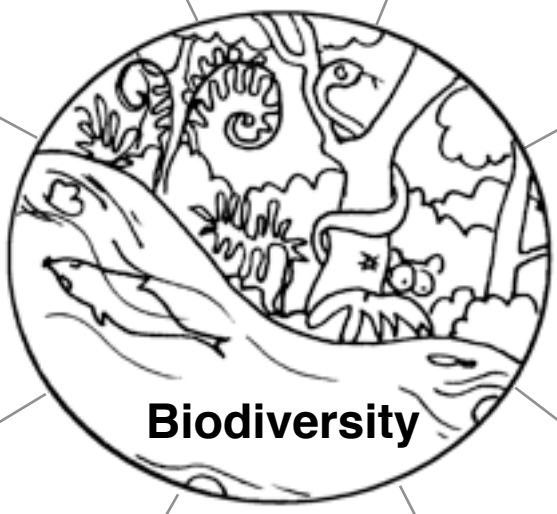
NEW SOUTH WALES
DEPARTMENT
OF EDUCATION
AND TRAINING

BIODIVERSITY MINDMAP

WS1

What do you know about biodiversity?



BIODIVERSE PLAYGROUND DATA SHEET

WS2

What is the biodiversity of the school grounds?
How many different species of plants can you find in each layer? Do not include turfed areas, eg. ovals. Sketch leaf shape, flowers, seeds or bark for each species to show the differences.

	AREA:	**AREA:**
No. of species of **TREES** 	Tally Sketches No.	Tally Sketches No.
No. of species of **SHRUBS** 	Tally Sketches No.	Tally Sketches No.
No. of species of **GROUND COVERS** 	Tally Sketches No.	Tally Sketches No.
ANIMAL EVIDENCE eg, droppings, chewed leaves, scratch marks, webs, footprints, trails 	List	List

CONDUCTING AN INVESTIGATION

WS3

Group members _____

Introduction - I am going to investigate _____

Prediction - What do I think will happen? _____

_____

Why I think it will happen _____

Hypothesis _____

_____

What am I going to do? _____

_____

_____

_____

_____

How will I make it a fair test?

Change _____

Keep the same _____

Measure _____

What equipment will I need?

_____

_____

_____

_____

_____

_____

_____

Data Recording - use the Bio Survey Data Sheet (WS5)

WS3 cont.

Results - What happened? What did I learn from this investigation?

Discussion

Was this what was expected? If not, why not? How can these results be used to improve or change?

Scientific investigation method from: K-6 SciTech, Curriculum K-12 Directorate, NSW Department of Education and Training, November 2004

TRAPPING INVERTEBRATES

WS4

Here are some ideas for trapping invertebrates at home and at school.

Pit-fall Traps

A pit-fall trap is used to trap small animals living in leaf litter.

Materials needed

Soft drink bottle, plastic bag, scissors or craft knife

Method

- Cut around the top of the bottle just below where it starts to narrow. This should provide both a capture container and a funnel. Place the plastic bag in the capture container ensuring the top of the bag sticks out. Place the funnel, pointed end down, into the bag and container.
- Dig a hole in the soil and place the pit-fall trap into the hole. Replace the soil around the bottle. The top of the trap should be level with the ground. After 24 hours remove the funnel and extract the plastic bag. The animals in the bag should be moved into a more secure container for closer examination.
- Return animals to the capture area after examination.

Pooters

These devices allow students to 'suck' insects into a collection container.

Materials needed

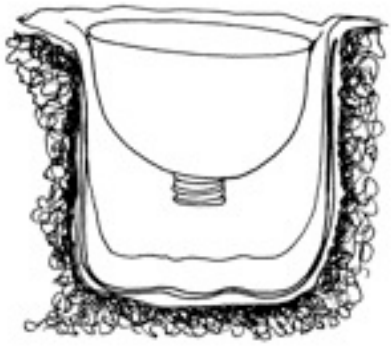
A clear plastic jar with a screw top lid, 'blue tac', fine netting. tape, pieces of hose

Method

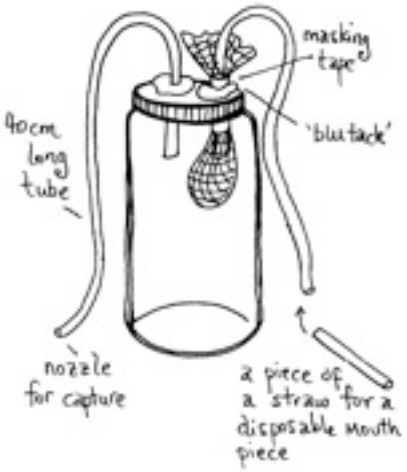
- Make two holes in the lid large enough to fit the hose. Place the lengths of hose into each hole. Place mosquito netting around the end of one hose inside the lid. Seal any gaps around the hose with 'blue tac'.
- To use the pooter, place one end of the hose above a small insect. Students suck on the hose with the fine netting on the inside end. The insect will be sucked into the jar. The fine netting stops the insect from being sucked into the student's mouth.
- Return animals to the capture area after examination.

TRAPS

PIT-FALL TRAP



POOTER



Trapping safety

Don't touch invertebrates with your hands. You might hurt them, or they might hurt you!

WS4 cont.

Sweep Netting

Collect flying invertebrates and those found in ground cover plants.

Materials needed

Dowel, netting, needle and thread or craft glue, coat hanger, tape

Method

- Pull the coat hanger into a round shape. Sew or glue the netting onto the hanger. Tape the coat hanger and the net to the dowel.
- Sweep the nets through a section of ground cover plants as you walk or try to catch flying invertebrates. Transfer animals to collection jars.
- Return animals to the capture area after examination.

Water Traps

These traps help catch flying invertebrates.

Materials needed

Ice cream container, water, detergent

Method

- Fill container half way with water, place a few drops of detergent in the water. This disrupts the surface tension so insects can't escape.
- Place the container outdoors. Check each 24 hours and collect any invertebrates that have been trapped in the water.

Berlese Funnel

A Berlese funnel works by slowly drying out a soil sample with a light which forces any resident animals into the container below.

Materials needed

2 litre soft drink bottle, 2 litre plastic milk bottle, a small sieve (the bigger the holes or slits, the better) or shade cloth or fly screen, desk light, black paint or dark cardboard or fabric.

Method

- Make a broad funnel from the soft drink bottle.
- Cut the milk bottle and use the base as a stand for the funnel and to collect the animals. Paint the base black or cover with dark cardboard or fabric to encourages animals to move into the base.
- Gently scatter 10 cm of soil and leaf litter in the sieve.
- Place a desk lamp with a 40 watt globe over the soil sample. The light will dry out the sample in 2-3 days resulting in most animals moving into the base. Collect the animals from the milk bottle base.

TRAPS

SWEEP NET

WATER TRAP

BERLESE FUNNEL

BIO SURVEY DATA SHEET

WS5

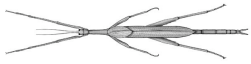
Date: _____ **Time:** _____ **Weather:** _____

Type of invertebrate	**AREA 1** No. of different species	**AREA 2** No. of different species	Type of invertebrate	**AREA 1** No. of different species	**AREA 2** No. of different species
 Alderflies & dobsonflies			 Earthworms		
 Ants			 Earwigs		
 Bees			 Fleas		
 Beetles incl. weevils			 Flies incl. mosquitoes		
 Caddisflies			 Grasshoppers, locusts, crickets, katydids		
 Centipedes			 Lacewings		
 Cicadas & hoppers			 Lice		
 Cockroaches			 Mayflies		
 Dragonflies & damselflies			 Millipedes		
SUBTOTAL:			**SUBTOTAL:**		

Illustrations by A Howells,©Australian Museum. Sourced from www.bugwise.net.au.

BIO SURVEY DATA SHEET

WS5 cont.

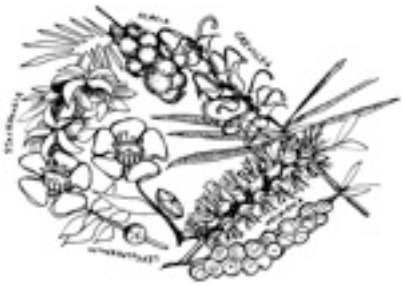
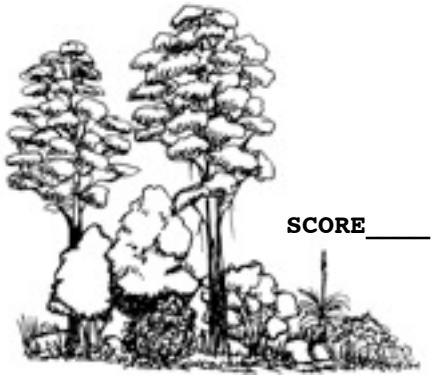
Type of invertebrate	**AREA 1** No. of different species	**AREA 2** No. of different species	Type of invertebrate	**AREA 1** No. of different species	**AREA 2** No. of different species
 Mites & ticks			 Spiders		
 Moths & butterflies			 Springtails		
 Praying mantids			 Stick insects		
 Pseudoscorpions or 'false scorpions'			 Stoneflies		
 Psyllids, aphids, scale insects, white flies			 Stylops		
 Sawflies			 Termites		
 Scorpion-flies & hanging-flies			 Thrips		
 Scorpions			 True bugs		
 Silverfish			 Wasps		
 Slaters			 Web spinners		
 Slugs & snails			**SUBTOTAL:**		
SUBTOTAL:			**TOTAL NO. OF DIFFERENT SPECIES:** (add all columns)	**AREA 1**	**AREA 2**

HABITAT SCORECARD

WS6

Rate the health of your school grounds. My group's area: _____

SCORING: None = 0, One or two = 1, A few = 2, Quite a few = 3, Lots = 4

TREES  **SCORE____**	**SHRUBS**  **SCORE____**	**GROUND COVERS** (not lawn)  **SCORE____**
FLOWERING PLANTS  **SCORE____**	**LEAF LITTER OR MULCH**  **SCORE____**	**PLANT LAYERS**  **SCORE____**
ROCKS OR FALLEN LOGS  **SCORE____**	**PONDS OR WATER**  **SCORE____**	**HOLLOWS OR NEST BOXES**  **SCORE____**

TOTAL SCORE _____

ACTION PLAN

WS7

What?
What are you going to do?

Where?
Area in school

When?
Time frame

How?
Steps involved

Who?
Class, parent helpers, council...

Why?
What is the purpose?

Evaluation
How did it go? What can be improved?

BIODIVERSITY THREATS

WS8

What threats to biodiversity can you see in the area you are studying?

- Write each **threat** you see.
- Work out the **problems** the threat creates for local biodiversity.
- Suggest some **solutions** that could reduce or manage each threat.

THREAT	PROBLEMS	SOLUTIONS

THREATS	CONSEQUENCES
Threats to local biodiversity can include cats, feral animals, weeds, vandalism, pesticides, littering and pollution, and clearing of bushland areas.	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