Barren or Bountiful – Year 2

Natural environments and their features including water, soil and vegetation can be effected both positively and negatively by natural events e.g. flooding, windstorms, and fire and by human activity including development for housing and commercial purposes including mining and agriculture. Prior to large-scale development occurring, Environmental Impact Statements are prepared to ensure best practice in land management and the ongoing sustainability of the natural environment.

This resource has been produced to align to the content descriptions of the Australian National Science Curriculum for Year Two students. It incorporates the 5Es instructional model to scaffold the learning of science. This resource suggests a sequence of lessons aligned to the 5Es (Engage, Explore, Explain, Elaborate and Evaluate). For each lesson in the sequence, the resource provides: a set of lesson-specific content descriptions; step-by-step guidance and support for classroom activities which develop the student's understanding of the content; and a set of learning outcomes anticipated for the lesson. When considered together, the lessons' outcomes represent unit outcomes that align the standards of achievement defined in the National Curriculum.

Resource Overview

This resource has been designed to align to the content descriptions of the Australian National Curriculum for Year Two, with a particular focus upon Science. The resource includes the following elements, presented approximately in the order of appearance through this document:

- Those Australian National Science Curriculum content descriptions which are directly relevant to the topic *Barren or Bountiful* have been identified to match the topic. These content descriptions form the basis of this unit, and are referred to as the **unit-level content descriptions**.
- Based upon the unit-level content descriptions, a set of **unit outcomes** is defined. These outcomes have been phrased using similar language and expectations as defined in the Achievement Standard for Year Two found in the Australian National Science Curriculum. These outcomes include not only those related directly science, but also those related to literacy and numeracy (i.e., how language and maths is used in science).
- The phases of the 5Es instructional model[1] have been used to sequence the lessons proposed in this unit. For each phase, one or more lessons are used to address the instructional aims of each phase. A **unit planner** is provided which summarises the correspondence between the phases of the 5Es instructional model, the sequence of lessons, the lesson-level content descriptions, and the assessment of learning outcomes.
- Provision of suitable **content summary**, including links to external resources, which may be used to guide the teacher's development and application of classroom activities.
- For each lesson:
  - One or more unit-level content descriptions are selected and refined with further detail to form the basis of the lesson, and are referred to as the **lesson-level content descriptions**.
  - A set of **lesson outcomes** is defined which complement the lesson-level content descriptions and which support the evaluation of the unit outcomes.
  - Elaboration of the **content matter** covered in the lesson.
  - A **preparation list** of those resources and activities that should be prepared prior to the lesson.
  - Proposition of a step-by-step **task sequence** for the lesson, and where appropriate the splitting of lessons into two or more **sessions**.
  - The integration of diagnostic, formative and summative **assessment tasks** into each lesson's task sequence, such that suitable evidence is generated by which to evaluate the achievement of the lesson's outcomes, and ultimately the unit's outcomes.
  - Suggestions of possible ways of **linking to other learning areas**, including Mathematics, English and ICT (i.e., other activities that would complement and support the achievement of outcomes proposed in this unit).

[1] Bybee, R.W. (1997). Achieving Scientific Literacy: From purposes to practical action. Portsmouth, NH: Heinemann.

- Provision of **classroom resources** used in the suggested task sequences (including summaries of useful websites, black line masters, wall charts etc.).

- Provision of **additional resources** which may assist the design and delivery of classroom activities, including content-related material and guidance for the use of pedagogical tools.

Unit-level Content Descriptions

The following table identifies, for each of the three strands of the Australian National Science Curriculum, the Year Two content descriptions that are directly relevant to this unit. Additionally, each of the identified content descriptions has been re-phrased in the context of the topic 'Barren or Bountiful', and so together constitute the unit-level content descriptions that are the basis for learning in this unit.

Science Inquiry Skills	Science as Human Endeavour	Science Understanding
Respond to and pose questions and make predictions about familiar objects and events (SIS) Represent and communicate observations and ideas in a variety of ways such as oral and written language and drawing. (SIS)	Develop understandings that people use science in their everyday lives including when caring for their environment and living things. (SHE) Identify the ways humans manage and protect resources such as caring for water supplies (SHE-E)	Identify Earth's resources and how they are used in a variety of ways. (SU) Develop the understanding that living things grow and change. (SU) Recognise that living things have predictable characteristics at different stages at different stages of development. (SU-E) Consider what might happen to humans if there were a change in familiar available resources e.g. water, soil, vegetation. (E)

Unit Outcomes

Based upon the Achievement Standard statements for Year Two found in the Science, English and Mathematics Australian National Curricula, the following science, literacy and numeracy outcomes for this unit have been defined.

Science Outcomes

In Year Two, students describe the components of simple systems such as stationary objects subjected to pushes or pulls, or combinations of materials and show how objects and materials interact through direct manipulation. They observe patterns of growth and change in living things and describe patterns and make predictions. They explore the use of resources from Earth and are introduced to the flow of matter when considering how water is used. They use counting and informal measurements to make and compare observations and begin to recognise that organising these observations in tables make it easier to show patterns.

Literacy Outcomes

In Year Two, students communicate with peers, teachers, students from other classes and community members. They engage with texts for enjoyment, as well as texts designed to inform and persuade, and texts to be used as models for constructing their own texts. Informative texts present new content about topics being studied in other areas of the curriculum, and include language features such as varied sentence structures, some unfamiliar vocabulary as well as illustrations and diagrams that both support and extend the printed text. Students create a range of texts including reports and expositions.

Numeracy Outcomes

In Year two, students collect, check and classify data and create displays of data using lists, tables and picture graphs and interpret the displays. They interpret simple maps of familiar locations and identify the relative positions of key features. Students compare and order shape and objects based on length, area, volume and capacity.

Unit Planner

Phase	Lesson	Lesson-level Content Descriptions	Assessment of Lesson Outcomes
Engage	Lesson 1 What's wrong here?	Students participate in a task that simulates the extraction of minerals from a mine site and the rehabilitation of the site after the completion of the mining process.	Diagnostically assess whether students are able to articulate what they know about factors that affect the conditions of landscapes.
Explore	Lesson 2 Plants around us	Students collect data pertaining to plants in the schoolyard and immediate environment, and map the location of plant species while finding out about the needs of plants.	Formatively assess whether students are able to use a map and complete a record sheet about at least one of the features on the map.
Explore	Lesson 3 Growing in the garden	Students develop understandings about conditions necessary for plant growth by planting and caring for vegetable seedlings and native plant seedlings.	Formatively assess whether students are able to record data about plant growth.
Explore	Lesson 4 Rubbish in the river	Students develop understandings about maintaining healthy waterways by participating in a role-play about water pollution.	Formatively assess whether students are able to write and draw at least one way of keeping water clean and give reasons why water should be kept free of pollution.
Explore	Lesson 5 Let's go mining	Students participate in a task that simulates the extraction of minerals from a mine site and the rehabilitation of the site after the completion of the mining process.	Formatively assess whether students are able to make a list of suggested guide-lines for the extraction of minerals from the ground and give reasons for the inclusion of each guide-line.
Explain	Lesson 6 Webs and chains	Students develop explanations about the interrelationships in environments and the interdependence of factors that impact on the maintenance of healthy sustainable environments.	Formatively assess whether students are able to create food chains as interactive learning experiences for other students to engage in.
Elaborate	Lesson 7 Can we clean it?	Students further develop their understanding about water pollution and how some types of pollutants can be removed.	Formatively assess whether students are able to complete the '*Making water clean'* task sheet, evaluating the effectiveness of the groups' water filters that were designed, constructed and tested.
Evaluate	Lesson 8 Healthy Environments	Students show their understanding of sustainable healthy environments by producing annotated drawings of healthy environments, including a list of guidelines for the maintenance and sustainability of the environments.	Summatively assess whether students are able to produce two annotated drawings (before and after) and a list of guidelines for the maintenance and sustainability of healthy environments.

Engage

Lesson 1: What's wrong here?

In this lesson, students will show what they think that they know about factors that may affect the condition of landscapes.

Lesson-level Content Descriptions

Students will be using prior knowledge and understandings to suggest reasons why landscapes might appear barren. Factors that students suggest might include land use, lack of water, changed purpose of the land, and erosion due to wind and rain. In suggesting what they think, students will be beginning to informally identify the Earth's resources, how the resources impact on landscapes and how the resources are used.

Lesson Outcomes

Science Outcomes	Literacy Outcomes
Identify Earth's resources and how they are used in a variety of ways. (SU) Consider what might happen to humans if there were a change in familiar available resources e.g. water. (E)	Participate in pair, group and class speaking and listening situations including informal conversations, class discussions and presentations. (E) Brainstorm topics, contribute ideas and acknowledge the ideas of others.

Content Matter

(212) Bosak 'A habitat is where living things live. It's more than a home- it's more like a neighbourhood. For an animal, a habitat includes all the land an animal needs to hunt, gather food, find a mate and raise a family. Different combinations of ecosystem LAWS (light, air, water and soil) together with variations in climate and topography create different habitats. A shady area supports different species of trees and shrubs than an area in bright sunlight. Pure air helps growth but polluted air retards it or stops it. Less water creates a desert while more water creates a marsh. Poor soil supports only certain plants and rich soil produces greater growth."

"An environment is anything that surrounds something else. A drop of pond water is a very small environment in the large environment of the world. Other examples of environments include a flowerpot, a tree, a city block, a campground, a river and a country. The way you define an environment at any given time depends on your perspective, attitude, interests and needs."

Preparation List

Preparation prior to lesson

- Source images
- Ensure that the purpose of the Engage phase occurs throughout the lesson.

Equipment

- Images (photographic or drawn) of barren landscapes including animals or people in need e.g. lack of shade or shelter, landscape strewn with rubbish, cattle near an empty water trough- class set and set per group
- Images (photographic or drawn) of bountiful landscapes
- Post-it notes- two different colours
- Class table with three headings (image, what's wrong here, what can we do)

Task Sequence

1. Ask students to identify describe features and appearance of the natural environment they can see from either the classroom window or a vantage point in the schoolyard. List what students identify and describe.

2. Ask students what they like about the environment that they are focusing on and what they dislike and their reasons for liking or disliking aspects of the environment. Explain that it is acceptable for them to say what they dislike.

3. Show the students an image of a barren environment and ask them what might be wrong with what is shown in the image. Write each response on a separate post-it note and place each post-it note on the image as a way of modelling what you expect the students to do when they begin working in groups.

4. Place the image and the responses in the first column of the table.

5. Tell the students that they will be working in groups, looking at images, and discussing and recording what they think is wrong in each of the images. Explain that it is important to write each idea on a separate post-it note and to place the post-it notes on the corresponding images.

6. When the students have completed the task, ask them to share their ideas about the images with another group.

7. As a class, discuss and record what could be done to improve the environments shown in the original image that the whole class talked about, and write students' ideas on different-coloured post-its to those used in step five.

8. Students return to their groups and follow step seven with their groups' images.

9. Collate groups' responses by adding the images and the two sets of post-its to the class table.

10. Show students the images of bountiful landscapes and discuss with students the differences between the images of bountiful and barren environments and ask students to suggest possible reasons for the differences. Record their responses.

11. Explain to students that during the unit of work they will be exploring factors that impact on environments.

Links to Other Key Learning Areas and Cross Curricula Priorities

- Narratives about environments and the impact of various factors on environments. See additional resources for possible titles.
- Visual Arts- paint or draw contrasting environments e.g. before and after pictures.

Additional Resources

Narratives (that could be used throughout the unit)

- The Lorax (Dr Seuss)
- The Tin Forest (Helen Ward and Wayne Anderson) ISBN 1-84011-311-1
- The Story of Rosy Dock (Jeannie Baker) ISBN 0-09182811-2

- Where the forest meets the sea (Jeannie Baker) ISBN 0 7445 1305 7
- If the world were a village (David J Smith) ISBN 1-74114-815-4
- If the earth were a few feet in diameter (Joe Miller) ISBN 0867-13-054-7
- Secrets of the rainforest (Dailan Pugh and Margaret Dunkle) ISBN 1-875657-11-8
- The last tree (Mark Wilson) ISBN 9780734409867
- Window (Jeannie Baker) ISBN 0-09-918211-4
- Oi get off our train (John Burningham) ISBN 0 09 985 340 X

Explore

Lesson 2: Plants around us

In this lesson, students will:

- collect data pertaining to plants in the schoolyard and immediate environment, and map the location of plant species while finding out about the needs of plants.

Lesson-level Content Descriptions

In the Engage phase, students considered images of landscapes and suggested what did not appear to be right in each image, then suggested ways of improving the landscapes. The first lesson in the Explore phase provides the opportunity for students to look at plants in their schoolyard and immediate environment and to begin identifying plants and their needs and how plants' needs are satisfied by the plants' locations in the schoolyard and immediate environment. In mapping the location of plants, students are engaging in the beginning stages of the Environmental Impact Statement process where the environment and its features are assessed and documented prior to any redevelopment or new development.

Lesson Outcomes

Science Outcomes	Literacy Outcomes	Numeracy Outcomes
Develop the understanding that living things grow and change. (SU)	Represent and communicate observations and ideas in a variety of ways such as oral and written language and drawing. (SIS)	Develop fluency with writing numbers in meaningful contexts. (E) Identify simple maps of familiar locations and identify the relative positions of key features. (UN) Understand that we use representations of objects and their positions such as on maps, to describe places. (E)

Content Matter

Plants can be classified as either native (to Australia) or introduced species. Plants classified as introduced, exotic or feral species may have been introduced deliberately e.g. for crops in a developing agricultural industry, ornamental plants to replicate botanical gardens from other countries and may also have been introduced by non-Indigenous people as reminders of the countries from which they came to Australia. Introduced plants may also have been brought into Australia accidentally e.g. in seed stock or in general imports and personal luggage.

Introduced plants may also enter Australia by natural means e.g. tidal motion when seeds are washed ashore and when birds eat plant parts and excrete the seeds in faeces.

Mapping the location of plants serves a range of purposes including students describing and identifying the plants, and exploring the conditions in which the plants are growing e.g. shade, type of soil, amount of moisture, interdependence of plants on each other (epiphytes). As a long-term study project that could continue beyond the duration of this unit, students could plot plant growth, the stages in the growth of plants including flowering, seed production and dispersal and the effect of seasonal changes on plants e.g. whether the plants are deciduous or evergreen. Plants could be labelled and information about the plants entered on a database so that information can be shared with the school and local community. Students' actions in exploring and finding out about the types of plants in the immediate environment, assist in developing students' awareness of plant species in both the wider environment and in various types of natural environments e.g. desert, rainforest, woodland.

Preparation List

Preparation prior to lesson

- Source resources about other natural environments, including environments that students may not be familiar with
- Develop a database that students can add information to, as they learn more about plants, their locations, needs and characteristics.
- Find out if a person in the local community is available to share knowledge about plants, with the class
- Source resources (including plant samples if possible) about plants that are grown for agriculture or animal production in the local area.

Equipment

- Assorted maps
- Google earth map
- Diagrammatic map (enlarged) of the school
- Diagrammatic map of the school per group
- Resource sheet # 2 /1

Task Sequence

1. Review the Engage lesson where students suggested why landscapes may have become barren, and students' proposed ways of changing the condition of the landscapes featured in the images.
2. If students mentioned plants in lesson one, ask students what they know about plants and the role of plants in contributing to healthy environments.
3. If plants were not mentioned during the discussions in lesson one, ask students whether they think that plants are key factors in improving environments and ask them to give reasons for their responses.
4. While inside the classroom, ask students what they know about the plants in the schoolyard and list their responses.
5. Show the students several maps (of any type) and ask them what information maps can provide for us.
6. Show the students a Google Earth map or similar aerial photograph of the school and ask students to indicate and describe any plants that are visible on the map.
7. Show the students the diagrammatic map of the school and tell them that as a class they will be creating a map showing plants in the school and immediate environment.
8. Tell the students that they will be working in groups, drawing and/ or writing plants on the map and then using the information from each map to create a class map.

9. As a class, decide what types of plants will be included e.g. trees, flowerbeds.
10. Show the students the resource sheet and tell them that they are expected to complete a resource sheet for at least one of the plants that they have included on their map.
11. Groups work outside to add information to their maps, then as a class create a class map.
12. Ask students why they think that particular plants are in particular areas, the possible uses of the plants and what conditions are best for the plants' growth.
13. Discuss with the students about how plants are named and explain that during the unit of work, they will be setting up a simple database where they can record plants, special features of the plants and images.
14. As individuals, students draw and write several points about at least one of the plants that they observed while outside, and include information about the possible uses of the plant and how the plant might change throughout the year.
15. Conclude the lesson by discussing how plants help to create and maintain healthy environments and how maps show us the location of plants in case we need to make temporary changes to our environment e.g. construction projects, pipes being laid.

Links to Other Key Learning Areas and Cross Curricula Priorities

- ICT- setting up and maintaining a plant database

Appendix

Resource sheet #2/1 Plant data

Plant's name	
Where it is	
What it looks like	
Big or small	
What it can be used for	
Type of leaves	
Flowers, seeds	

Labelled drawing of the plant

Explore

Lesson 3: Growing in the garden

In this lesson, students will:

- develop understandings about conditions necessary for plant growth by planting and caring for vegetable seedlings and native plant seedlings.

Lesson-level Content Descriptions

Having explored the location of plants in the schoolyard and immediate local environment and having indicated the location of plants on a map of the schoolyard, students have begun to develop understandings about the conditions necessary for successful plant propagation and growth. Students will be planting vegetable seeds, and observing and monitoring their growth. Vegetables have been chosen due to their relatively quick growth rate. Alternatively flowering plants could be used. Students will also be planting native seeds (if available) or transplanting seedlings and monitoring the seedlings' growth with the ultimate aim of the native plants being planted in the schoolyard or immediate environment as a way of demonstrating seed propagation of native species for potential re-vegetation programs to improve landscapes.

Lesson Outcomes

Science Outcomes	Literacy Outcomes	Numeracy Outcomes
Recognise that living things have predictable characteristics at different stages at different stages of development. (SU-E) Respond to and pose questions and make predictions about familiar objects and events (SIS)	Participate in pair, group and class speaking and listening situations including informal conversations, class discussions and presentations. (E) Brainstorm topics, contribute ideas and acknowledge the ideas of others. (E)	Compare and order several shapes based on length, area, using appropriate uniform informal units (Maths Content descriptions)

Content Matter

(408) Bosak "Plants need air, warmth, light, water and nutrients to grow. They make food using these things. Nutrients are generally obtained from the soil in which a plant grows. Either potting soil or soil direct from the ground can be used. If soil is dark and crumbly, the grass and other things that are growing in it look healthy and that soil contains earthworms, it's regarded as being good soil for growing plants."

"Water is necessary for proper germination of seeds. Water is also necessary for plant growth. However seeds and plants that get too much water may die. Too much water may cause a seed to rot instead of grow. A plant's roots may need water but they also need oxygen- too much water blocks the oxygen needed for growth.

Plants may need light to grow but seeds don't. Seeds are planted underground where it's dark. A seed grows because it uses its own stored energy. If the seed is kept in darkness it will grow a long stem in search of light. This long stem will often make the plant very hardy once it does develop into a seedling that needs light for photosynthesis."

Photosynthesis is a chemical process where plants convert carbon dioxide and energy from sunlight to products including glucose and oxygen. Plants use carbon dioxide and give out oxygen that is needed by animals and humans.

Preparation List

Preparation prior to lesson:

- Decide where seeds will be planted i.e. part of school garden or in containers e.g. pots, foam boxes
- Source seeds from Australian native plants
- Check that seeds are not toxic or that students do not have allergies to specific seeds e.g. some seeds (both introduced and native) can cause severe skin irritation
- Allow time at regular intervals for students to check and record plant growth.

Equipment

- Seeds (vegetable, flowers, native plants) per group- in labelled bags or containers
- Seed packet with instructions for planting or photo-copies of the seed packet
- Soil for planting (either garden bed or pots)
- Paddlepop sticks to mark location of seeds
- Gloves
- Spades, shovels etc
- Magnifying glasses to look at seeds prior to planting
- Rulers or arbitrary units of measurement to measure seeds and plant growth before and during growth process
- Recording sheet
- Container to carry water
- Containers to plant seeds in (optional)
- Digital camera to record growth of plants.

Task Sequence

1. Review lesson two where students mapped the location of plants and described the appearance and purpose of the plants.
2. Ask students what the plants might need for growth. Make a list of what students suggest.
3. Tell the students that they will be planting various types of seeds and observing and recording plant growth.
4. Give each group some seeds to explore including looking at, using a magnifying glass, measuring the seeds, and tracing around them. Students can also record what they think the plant will look like and what the plant will produce.
5. Discuss with students how people can buy plant seedlings and how young native plants can be planted to re-vegetate areas.
6. Ask students to predict what period of time the seed will take to grow into a plant.
7. Students plant their seeds and record the date and time of planting.
8. Students check the seeds at regular intervals to observe, measure and record stages of growth.

Links to Other Key Learning Areas and Cross Curricula Priorities

- Maths- graphing plant growth

Additional Resources

PrimaryConnections Plants in action resource

Appendix

Resource sheet #3/1 Our seeds

Look like this

size	size	size

Our seeds need

*

*

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*

This is what we think will happen

Planting our seeds (write and draw)

Resource sheet #3/2 What is happening to our seeds.

Day or date	What we can see	Other information (e.g. rain, watering)

Explore

Lesson 4: Rubbish in the river

In this lesson, students will:

- develop understandings about maintaining healthy waterways, by participating in a role-play about water pollution.

Lesson-level Content Descriptions

Having discussed possible causes of barren landscapes, and actions that can be taken to prevent landscapes from becoming barren, and to improve the condition of both man-made and natural environments, students, through their seed-planting task and monitoring plant growth, are realizing that water is essential for healthy, sustainable vegetation. In this lesson students will be discussing how we rely on clean water, and will be participating in a role-play to simulate how water can easily become polluted by both human and natural means.

Lesson Outcomes

Science Outcomes	Literacy Outcomes
Consider what might happen if there were a change in a familiar available resource such as water. (SU-E) Identify the ways humans manage and protect resources such as caring for water supplies (SHE-E)	Participate in pair, group and class speaking and listening situations including informal conversations, class discussions and presentations. (E) Brainstorm topics, contribute ideas and acknowledge the ideas of others. (E)

Content Matter

This lesson is based on telling a narrative where a fictitious river becomes polluted both through natural events and human actions including mismanagement of land. There are various versions of this story in use by environmental groups but it is recommended that teachers design their own story-line to accommodate factors that students may be familiar with, through resources including the Internet, storybooks and the media. See Resource Sheet #4/1 for ideas.

(CP) Pollution in waterways may include litter discarded by humans. Litter including plastic bags and fishing line eventually becomes a hazard to wildlife both in the waterways and as waterways enter the ocean. An example is when turtles mistake plastic bags for food, ingest the bags, then suffer from a build-up of plastic that can either choke the turtles or cause buoyancy resulting in turtles floating on the surface and being unable to dive to search for food or to seek shelter from the sun or predators. Waste products including sewerage, chemicals and herbicides from human activities, and agricultural or industrial processes can also be a source of pollution in waterways, if the processes are not conducted safely.

Waterway pollution can also occur through natural processes including erosion from land that has been cleared without a buffer zone between it and the waterway, strong winds creating dust-storms and blowing dust into the water, and heavy rains or run-off during flooding.

Preparation List

Preparation prior to lesson

- Write a brief story-script to form the basis for the role-play.
- Decide on a suitable location for the role-play e.g. outside due to possible risk of water spillage.
- Prepare chart paper for making a list of the uses of water.

Equipment

- Large clear plastic container half-filled with water
- Containers of possible pollutants (see Resource Sheet #4/1 for possible ideas
- Large drawn map of the course of the fictitious river
- Role cards (optional) related to the containers of possible pollutants
- Plastic animals, toys, buildings etc to place on the map, to relate to aspects of the narrative
- Small plastic marine animals (ducks, fish etc)
- Two plastic bottles (one with clean water and one with dirty water)

Task Sequence

1. Remind students of the needs of plants and discuss with students whether they have had to water their plants.
2. Ask students to think of ways in which water is used and record their ideas.
3. Pose a 'what if' question – "what if we had no water?" and record their responses.
4. Discuss where the school's water supply comes from, and where students' home water supply comes from depending on where the students live.
5. Show the students the bottle of clean water and ask them to describe it, and then show the bottle of dirty water.
6. Pose a second 'what if' question – "what if our water was dirty?" and record their responses.
7. Ask students to suggest ways that water can become dirty and ask them for other words to describe dirty water (yucky, germs, pollution etc).
8. Show the students the bowl of clean water with the animals in it and ask them what animals need to survive.
9. Allocate roles to the students and explain the rules of the game, that as the story is told, students will in turn empty the contents of their container into the water.
10. Tell the story and allow time after each pollutant has been added to the water for students to reflect about what is happening to the water, and how it is changing. Show how each action relates to features on the map e.g. boating area, housing precinct, and farming area.
11. At the conclusion of the story, ask students to write and draw at least one way of keeping water clean, and give reasons why water should be kept free of pollution.

Links to Other Key Learning Areas and Cross Curricula Priorities

- English- class or students write their own narrative about water becoming polluted
- Performing Arts- students could dramatize the water story to perform for another class

Additional Resources

- PrimaryConnections Waterworks resource
- NRM Waterwise materials

Books

- My Place by Nadia Wheatley ISBN 0-582-81107-4
- One Well-The Story of Water on Earth by Rochelle Strauss ISBN 978 0 7333 2079 8

Resource sheet #4/ 1 Rubbish in the river

Begin the story by asking students where the river has its source, and indicate and label the source on the map.

Possible contents for containers

Students might also suggest possible pollutants.

Cooking oil- an oil spill e.g. from a boat motor

Dry dirt- dust blown in from the river

Plant pieces- vegetation blown off by strong winds or chopped down

Plastic bag pieces- humans' rubbish

Soapy water- camper washing in the river

Fishing line- line snagged on submerged rocks or trees

Soil- Run-off from a building site

Tissues- rubbish dropped in the river

Food colouring- chemical run-off e.g. herbicides used for spraying crops

Explore

Lesson 5: Let's go mining

In this lesson, students will:

- participate in a task that simulates the extraction of minerals from a mine site and the rehabilitation of the site after the completion of the mining process.

Lesson-level Content Descriptions

In previous lessons in the Explore phase, students have considered factors that can impact positively in maintaining healthy sustainable environments and are recognizing the critical role of factors such as vegetation and water in creating and maintaining healthy environments. Students then simulate mining to extract minerals and are presented with the challenge of restoring the mine site to its original condition.

Lesson Outcomes

Science Outcomes	Literacy Outcomes	Numeracy Outcomes
Consider what might happen to humans if there was a change in a familiar available resource such as land. (E)	Participate in pair, group and class speaking and listening situations including informal conversations, class discussions and presentations. (E) Brainstorm topics, contribute ideas and acknowledge the ideas of others. (E)	Collect, check and classify data (UN) Recognise usefulness of tally marks (E)

Content Matter

This task is based on a task known as Rocky Cake mine, that was published by the Australian Mining Industry Council in the Mineral Magic teaching kit in 1993.

The aim of the lesson is for students to extract the minerals then having done so, students are then directed to restore the 'land' to its original condition. It is extremely important that the students are not told about the land restoration stage until they have extracted the minerals. The task could then be repeated with a second batch of cakes when the students know that after extracting minerals they have to be able to restore the land.

The Rocky Cake Mine task can be varied in many ways to suit the ages and abilities of students. Variations may include allocating a monetary value to each 'mineral' that is mined, having the cakes decorated to simulate land cover etc.

Preparation List

Preparation prior to lesson

- Using a simple cake mix recipe, or supermaket fruitcake provide enough cake so that students can work individually or in pairs. Ensure that each piece of cake contains a variety of mixed fruit, nuts etc.
- Check for any student allergies to the ingredients being used and if necessary, make alternative arrangements.

Equipment

- Small cake/ muffin per student (see preparation for ingredients)
- Tweezers
- Small spoon
- Paddlepop stick per student
- Foam tray or plate per student
- Digital camera

Task Sequence

1. Review previous lessons by discussing how plants and water are factors that impact on healthy environments and ask students to suggest what might happen if either of these factors were lacking.
2. Ask students what they think they know about mining and the extraction of minerals and record their responses.
3. Show the students a cake and explain to them that it represents land with minerals in it.
4. Tell the students that they will be using tools to extract minerals (represented by fruit, nuts etc) and that as this is a science task, they are not allowed to eat any parts of their mine.
5. Students are also expected to sort the minerals that they extract, count the number of each specimen and record how much was extracted from their mine.
6. When students have completed steps four and five, discuss with the class what was extracted, the amount and how students managed to extract it.
7. Ask students to describe what is left from their mining venture and take digital photos for future reference.
8. Tell the students that as all or most of the minerals have been extracted from their particular mining sites, the landscape needs to be restored to its original state and ask students to attempt to do that.
9. Discuss students' reactions to the above direction and what they experienced when they attempted to restore the land to its original state, was this possible and if not, why not.
10. (Optional) Repeat the task using another cake or alternatively repeat the task as a class demonstration and discuss with students the differences in what they did in their first mining venture and in their second mining venture
11. As a class or working in groups, make a list of suggested guidelines for extracting minerals from the ground. Guidelines might include assessing and recording the appearance and features of the land prior to mining, using least intrusive ways of mining and ways of restoring the land to its original state.
12. Discuss with students the purpose of Environmental Impact Statements and the processes for compiling the EISs.

Links to Other Key Learning Areas and Cross Curricula Priorities

- Numeracy-Tallying and graphing amount of minerals extracted
- Numeracy- calculating the value of the extracted minerals
- Technology – following a design brief to design and construct a model (play-dough or soil) of an area with natural features including vegetation and a water source, to be mined.

Additional Resources

Information about Environmental Impact statements:

- Environmental Legislatives Procedures fact sheet
- Opencut Mining fact sheet
- Impacts Diagram worksheet
- Minesite Rehabilitation PowerPoint

Explain

Lesson 6: Webs and chains

In this lesson, students will:

- develop explanations about the interrelationships in environments and the interdependence of factors that impact on the maintenance of healthy sustainable environments, by participating in a Food Chain game.

Lesson-level Content Descriptions

In previous lessons, students explored the importance of water and vegetation in creating and maintaining healthy sustainable environments as well as how mining processes have the potential to impact either adversely or positively on the environment. They have experienced the necessity for thorough planning in whatever is being done in the area whether it be simple construction and maintenance projects or large-scale development. By participating in a food chain game, students develop understandings about how the loss or change in one element of a food web can impact negatively on an entire environment.

Lesson Outcomes

Science Outcomes	Literacy Outcomes
Consider what might happen to humans if there were a change in a familiar available resource e.g. soil, water, vegetation (E)	Participate in pair, group and class speaking and listening situations including informal conversations, class discussions and presentations. (E) Brainstorm topics, contribute ideas and acknowledge the ideas of others. (E)

Content Matter

(84) Bosak "All life is connected in delicate balances called 'ecosystems'. The interaction of biotic (living) and abiotic (nonliving) components creates an ecosystem. The interacting components within an ecosystem are so tightly knit that even if only one relationship is broken, the entire ecosystem may be threatened. All life exists within a thin shell of air, water, and soil called the 'biosphere.' The biosphere is Earth's life-support system, or the parent eco-system. A 'food chain' consists of a series of animals that eat plants and other animals. A plant is eaten by an animal which in turn is eaten by another animal which is in turn eaten by another animal and so on. One way of classifying animals is based on what they eat i.e. herbivores (plant eaters) or carnivores (meat eaters). Herbivores tend to be near the bottom of food chains."

As herbivores are dependent on plants, removing water (essential for the growth of many plants) from the food chain or web, can cause a shortage of plant matter available to herbivores, leading to a decrease in their population and hence the process continues through the food chain, having a negative effect on other animal populations.

Preparation List

Preparation prior to lesson

- Prepare a set of cards (one per student) to use in the Food Chain game, alternatively prepare cards as students are contributing their ideas about animals and plants and their positions in a food chain.

Equipment

- Cards with name and image of a plant or animal on each one
- Pegs to attach a card to each student
- Wool or string-long enough for students to hold onto when standing in a line
- Resources about animals and what they eat.
- Blank set of at least 12 cards per group
- String or wool per group.

Task Sequence

1. Brainstorm with students about plants and animals and what various animals eat, and list students' responses on chart paper.
2. For each animal that is suggested, work from the animal both up and down in a food chain e.g. kangaroo eats grass, dingo eats kangaroo, therefore food chain has three components.
3. Select a set of cards and pin a card to each student with the number of students corresponding to the number of cards in a set of Food chain cards.
4. Students stand in a line with the string in front of them.
5. Each student in the line holds tightly onto a section of string. Explain that the string is representing the food chain.
6. Select a student to let go of her section of the string and ask the other students in the food chain line to explain what will happen to them e.g. no food source means that the animal might not survive.
7. Introduce 'water' and 'soil' cards to the food chain and repeat steps three, four and five. Include cards labeled 'dirty water'.
8. Discuss with students the effect of removing links of food chains e.g.. lack of or decrease in amount of soil for plants to grow, lack of water and how lack of or a decrease in soil and/or water will affect the whole ecosystem. Relate the discussion to the lessons where students explored water pollution, the role of plants, and the need to mine land without causing environmental damage.
9. In groups, students write and draw on cards to create food chains and play the food chain game.
10. Each group shares its game with another group of students who tries to play it.
11. Discuss with the class how food chains become food webs, and construct a class food web using some of the cards that the groups have made.

Additional Resources

- Do an Internet search to find interactive food chain and food web games
- Construct food chains and webs based on a specific area e.g. park in local community, farming property, schoolyard

Elaborate

Lesson 7: Can we clean it?

In this lesson, students will:

- further develop their understanding about water pollution and how some types of pollutants can be removed, through designing, making and using filters to remove contaminants from water.

Lesson-level Content Descriptions

In the Explore phase, students participated in the River Pollution role-play where they found out about contaminants that might be present in waterways. When playing the Food Chain game, students discovered that a lack of water or dirty water could impact on food chains and webs, upsetting the natural balance of an environment.

The Elaborate lesson provides the opportunity for students to work in groups to investigate the effect of water filters, in removing some of the contaminants from water but not necessarily purifying the water for potable purposes.

Lesson Outcomes

Science Outcomes	Literacy Outcomes
Develop understandings that people use science in their everyday lives including when caring for their environment and living things. (SHE) Identify ways humans manage and protect resources such as caring for water supplies (E)	Participate in pair, group and class speaking and listening situations including informal conversations, class discussions and presentations. (E) Brainstorm topics, contribute ideas and acknowledge the ideas of others. (E)

Content Matter

(371) Even under the best natural conditions, water is not completely pure. It contains bits of sand, dirt, various salts, and tiny organisms- these must be filtered out. Pollution often makes water so dirty that filtering is only the first step in a complex purifying process. More disturbingly, some water can be so badly polluted that it is almost impossible to clean. When water isn't clean, not only humans are affected, but also plants and animals are affected. Some fish may be able to survive in polluted water but their bodies are filled with chemicals and it become dangerous for us to eat the fish."

(CP) This can result in ciguatera poisoning, transmitted through the food chain where small fish that may be carrying the ciguatera toxin, are eaten by larger fish that are then consumed by humans who contract ciguatera poisoning.

(Bosic page # TBA) "Water pollution also clogs up lakes and ponds, causes disease and destroys the beauty of natural areas. There are a number of stages involved in getting clean water. The natural water cycle involves evaporation and condensation- water in lakes and rivers is heated by the sun and evaporate into the air. The vapour condenses and forms tiny droplets around microscopic particles in the air, clouds begin to form. When the droplets become a certain size, they fall back to the ground as rain. Humans have added to the natural water cycle- water purification plants take in water from sources like lakes, rivers, or the ground. Water is filtered or purified (fluoride and/ or chloride may also be added)- pumping stations pump water into pipes, pipes carry water to homes and eventually waste water goes down the drain, sewer pipes carry water to the sewerage treatment plant, some contaminants like human waste are removed from the water before it is put back into the natural water cycle."

(CP) In everyday life we use filters and sieves e.g. when draining water from cooked vegetables or pasta, when running a pump in a swimming pool, having a filter on a tap to purify water for drinking and using nets to remove weed and debris from fish tanks.

Preparation List

Preparation prior to lesson

- Decide whether students will be limited to available materials for filtering or whether the task will be open-ended where students can request materials and equipment or bring some from home. Be aware of and sensitive to students whose parents may not be able to provide materials for various reasons.
- Ensure that throughout the lesson students are aware that water that may appear clear, is not safe to drink.
- Write a design brief to guide the students in deciding what they will use, and how they will conduct the filtering process.

Equipment

- Bottles of contaminated water (similar to what was created in the River Pollution game) or with other contaminants- one bottle per group
- Assorted strainers, net, sieves
- Funnels
- Sand, gravel
- Paper towel or coffee filter paper
- Class bottle of clear water as a control
- Additional bottle of dirty water as a control

Task Sequence

1. Remind students about the water that became polluted during the River story in lesson four.
2. Ask students to suggest reasons why polluted water can have a negative impact on the environment and refer specifically to the Food Chain lesson.
3. Show the students the bottle of dirty water and ask them how they think they could clean it.
4. Pour some of the water through a coarse sieve into a clear container and observe and discuss what happens.
5. Pour some of the water from the container through a finer sieve or some paper towel and observe what happens.
6. Explain to students that their task is to design a way of filtering the water to try to get the water as clear as the water in the class control bottle.
7. Ask students why they think that is it important to have a bottle of clear water to look at, as well as an extra bottle of dirty water (to compare their filtered product with the original dirty water plus ascertaining if their filtered water is as clear as unpolluted water).
8. Ensure that students know that even though their task is to try to remove contaminants from the water, the water will not be safe to drink due to bacteria that are present even though they can't be seen.
9. Show the students the task record sheet and assist them to write information on it.
10. Students design, make, use and evaluate the effectiveness of their filters.
11. When students have completed the task and the task record sheet, share and discuss findings as a class.
12. Talk to community members to find out how water from the town water supply, is purified to make it safe for drinking.

Resource sheet #7/ 1 Making water clean

We are trying to…….

This is what we will use

Material or equipment	Why we have chosen this

What we will do

1.

2.

3.

What the water looks like before we start- draw the bottle and what is in it

Making water clean

What happened?

We have finished and this is what the water looks like looks like. Draw it.

Did your filters work well?

Would you change the way of doing it?

If so, how would you change it and why?

Evaluate

Lesson 8: Healthy Environments

In this lesson, students will:

- show their understanding of sustainable healthy environments by producing annotated drawings of healthy environments, including a list of guidelines for the maintenance and sustainability of the environments.

Lesson-level Content Descriptions

The Evaluate phase provides the opportunity for summative assessment of the knowledge and understandings that students have developed during the unit. In producing annotated drawings and a list of guide-lines, students are expected to combine what they have experienced during the Explore phase, with understandings that they have developed particularly in the Explain phase and with what they have learned by extending their thinking in the Elaborate phase where they applied new knowledge to a science-based design task.

Lesson Outcomes

Science Outcomes	Literacy Outcomes
Understand that Earth's resources including water, are used in a variety of ways. Develop understandings that people use science in their everyday lives including when caring for their environment and living things. (SHE) Identify ways humans manage and protect resources such as caring for water supplies (E).	Participate in pair, group and class speaking and listening situations including informal conversations, class discussions and presentations. (E) Brainstorm topics, contribute ideas and acknowledge the ideas of others. (E)

Preparation List

Preparation prior to lesson

Nil

Equipment

- A3 paper per student

Task Sequence

1. Show students the images of barren landscapes, that were viewed and discussed in lesson one.
2. Review what students have experienced in each lesson and ask them how their experiences during the unit, could be applied to modifying the barren landscape.
3. Explain to the students that they are expected to produce two annotated drawings- a 'before' and 'after' drawing and a list of guidelines for the maintenance and sustainability of healthy environments.
4. Students work as individuals to complete the task for summative assessment purposes.

Additional Resources

Energy Efficiency in Homes fact sheet

Appendix 1: The 5Es Instructional Model

The Australian Curriculum: Science describes the discipline of science as an empirical way in which to answer interesting questions about the biological, physical and technological world in which we live. The answers to such questions then form the basis for our actions as we participate in the activities of the world. Importantly, science is perceived to be a dynamic organisation of ideas, formed through collaborative processes, and based upon humans' creative response to the world in which they live.

Thus, learning science should reflect those characteristics – student's should be encouraged to actively participate in this human endeavour as they collaboratively make sense of their own lived world, under the guidance of their teacher. Classroom experiences should nurture curiosity and creativity and develop a deep understanding of the world, upon which the student's future participation in activities may be based. Put simply, science inquiry should be the over-arching organiser of learning science.

Numerous more specific models of inquiry-based science learning have been proposed, including the 5Es model proposed by Bybee and which has seen numerous variations. In this unit, Bybee's model has been used as the basis for organising the material. A key feature of the 5Es model is that students actively, under the guidance of the teacher, make sense of experiences and thus develop conceptual understanding. That is, classroom activity reflects the nature of science practice. This is in contrast to more traditional science teaching, in which concepts are first presented by the teacher and then students participate in activities that put those concepts into action.

It should be noted that the model used to organise this material is only a guideline – this science material is the basis for good classroom teaching that is responsive to the particular needs of the students. Thus, whilst the materials present a generally linear sequence of learning activities, the teacher should be prepared to routinely return to previous activities and associated learning aims, and so traversing the 5Es model in a somewhat iterative fashion.

The 5Es model organises learning activities into five distinct phases: Explanation, Exploration, Explanation, Elaboration, and Evaluation. In the following sections, the variant of the 5Es model used in these science materials is presented. Specifically, each of the five phases is described, including the nature of the learning activities and outcomes expected in each phase. The structuring of the unit around these 5 phases is then summarised.

Phase 1: Engage
The general aim of the Engage phase is to spark the students' curiosity and to reveal their existing understanding of the concepts to be developed across the unit. Short activities are used with which to engage the students in the content matter and to start develop questions that may be addressed in the activities of future phases. Thus, in the engage phase assessment has a diagnostic nature and generates evidence upon which the teacher can draw to tailor future activities that will extend and/or refine the students' conceptual understanding.

Phase 2: Explore
The general aim of the Explore phase is to involve students in hands-on experiences of the scientific phenomena to be understood. The students will draw upon existing knowledge and understanding to conduct investigative activities that generate data which will be analysed and discussed in the Explain phase. These activities constitute formative assessment that focuses primarily upon investigative skills, which may then be further developed in subsequent activities of this and future phases.

Phase 3: Explain
The general aim of the Explain phase is to analyse the data generated in the Explore phase's investigative activities, to identify and discuss patterns or relationships in that data, and thus construct generalisations that advance their conceptual understanding. This analysis may focus upon a particular aspect or sub-set of the data or experiences, or may span all activities of the Explore phase. Hence, then Explore and Explain phases may be quite tightly linked as the students iteratively develop their conceptual understanding. To make such sense of the observed phenomena, the students may look to external sources, including expert scientific opinion. Such construction of meaning may involve significant scaffolding by the teacher to reveal, shape and formalise these generalisations. Key to this phase is the student's expression of their developing conceptual understanding, and thus this phase embeds the formative assessment of such conceptual understanding.

Phase 4: Elaborate
In the preceding phase(s), students have experienced the relevant phenomena, have gathered data, and have then formed generalising concepts that explain their observations and experiences. In the Elaborate phase, the students draw upon this new-found conceptual understanding to plan and conduct an investigation in a new, previously un-experienced context. This investigative activity should challenge students, and thus elaborate upon both their investigative skills and conceptual understanding. In terms of assessment, this phase of learning provides an opportunity for the teacher to summatively ascertain the investigative skills of the learner.

Phase 5: Evaluate
In this final phase of the instructional model, emphasis is placed upon the student expressing their conceptual understanding by way of some written, oral or visual artefact. Not only does this expression of understanding provide an opportunity to summatively assess the learner's conceptual understanding, it also provides an opportunity for the student to reflect upon their own learning.

In this unit, the engage phase is implemented in the first lesson. Subsequently, the students conceptual understanding of science, along with their procedural skills and broader understandings of science and its role in society, are progressively developed through iterations of explore and explain phases of activity. Embedded in these activities are opportunities for the teacher to formatively assess the students developing understanding. Then, with this newly developed understanding in mind, the students are presented with a new context in which to apply, with relative autonomy, their understanding as they solve a new problem – thus implementing the elaborate phase of the 5Es model. This application of knowledge is complemented by the creation of one or more artefacts, through which the learner is able to critically express their conceptual understanding, thus implementing the evaluate phase of the model. Similar to the iterative explore and explain phases, these latter activities embed opportunities for the teacher to make summative assessments of the learners procedural, conceptual and broader understandings of science.