Below Our Feet – Year 1

The ground and the area below it is an amazing mixture of soil, rocks, plant matter, and animal populations including both vertebrates and invertebrates that depend on the ground for survival. Minerals including coal are mined from the surface and below the ground. Most of the items that we use in our everyday life are manufactured from materials that are directly or indirectly dependent on the ground. Trees from which we obtain wood for building and for manufacturing paper need healthy soil for growth while plastics are manufactured from oil that has formed from fossilised deposits.

This resource has been produced to align to the content descriptions of the Australian National Science Curriculum for Year One 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 tasks which develop the students' understanding of the content; and a set of learning outcomes as the basis for the lesson. When considered together, the lessons' outcomes represent unit outcomes that align with 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 One, 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 of **Below our feet** have been identified to match the topic. These 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 One 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 tasks.
- 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).
  - 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 tasks, including content-related material and guidance for the use of pedagogical tools.

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

Unit-level Content Descriptions

The following table identifies, for each of the three strands of the Australian National Science Curriculum, the Year One content descriptions that are directly relevant to this unit. Additionally, each of the identified content descriptions has been selected in the context of the topic 'Below our feet', 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 (SIS) Answer questions by participating in different types of guided investigations including using tools. (SIS) Represent and communicate observations and ideas in a variety of ways such as oral and written language. (SIS) Compare observations with those of others (SIS)	Understand that people use science in everyday life e.g. finding out about soil and its uses, making decisions about the use of materials, based on the properties of materials. (SHE)	Understand that living things live in different places where their needs are met (SU) Pose questions about features of the local environment that are of interest and affect students' lives (E) Explore the local environment and develop understandings about physical features of the local landscape including the ground, and describe and classify natural features and resources (E) Explore the natural environment's physical features that can be used by people and animals as materials. (E)

Unit Outcomes

Based upon the Achievement Standard statements for Year One 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 One, students infer simple cause-and-effect relationships from their observations and experiences, and begin to link events and phenomena with observable effects. They observe changes that can be large or small and happen quickly or slowly. They explore the properties of familiar objects and phenomena, identifying similarities and differences. Students begin to value counting as a means of comparing observations and are introduced to ways of organising their observations.

Literacy Outcomes

In Year One, students communicate with peers, teachers, known adults and students from other classes. They engage with texts for enjoyment, as well as some texts designed to inform and texts to be used as models for constructing their own texts. Informative texts present a small amount of new content about topics being studied in other areas of the curriculum, a small range of language features including simple and compound sentences, some unfamiliar vocabulary as well as illustrations and diagrams that support the printed text. Students create texts including informative texts that include procedures and recounts.

Numeracy Outcomes

In year One, students develop proficiency in using numbers from one to one hundred and measure and compare dimensions by using uniform informal units of measurement. They represent data with objects and drawings where one object or drawing represent one data value and describe the displays of data.

Unit Planner

Phase	Lesson	Lesson-level Content Descriptions	Assessment of Lesson Outcomes
Engage	Lesson 1 Amazing materials	Students suggest what objects and materials can be found in their school environment and the materials that the objects are made of.	Diagnostically assess whether students are able to write or draw what they think that they know about materials.
Explore	Lesson 2 Scratching Around	Students explore leaf litter to find out about it and what is in it.	Formatively assess whether students are able to share their groups' findings about what is in leaf litter.
Explore	Lesson 3 A shovelful of soil	Students collect and explore soil samples to find out what soil consists of.	Formatively assess whether students are able to produce an annotated drawing of soil and write a sentence about soil.
Explore	Lesson 4 Rocks, stones and shells	Students devise their own categories to sort and classify rocks, and shells and describe the characteristics of each group and some individual specimens.	Formatively assess whether students are able to add extra drawings to their subset and articulate reasons for each inclusion.
Explore	Lesson 5 Material search	Students search for and identify materials that are visible in their school and local environment.	Formatively assess whether students are able to give reasons why particular objects are made of specific materials.
Explain	Lesson 6 What's under the ground?	Students use the information about features of the local environment that they have discovered in the Explore phase, to form explanations about where materials come from, focusing particularly on materials that come from under the ground.	Formatively assess whether students are able to draw a simple flowchart to show the production process of a material that they are familiar with.
Elaborate	Lesson 7 Getting it out	Students investigate ways of extracting objects from a tray of sand or soil without using their bare hands.	Formatively assess whether students are able to complete the investigation planner by writing or drawing about what happened in the investigation.
Evaluate	Lesson 8 Materials on show	Students make a class Big Book with flaps showing how materials are used in their home or school and where the materials come from.	Summatively assess whether students are able to produce a page for a Big Book about sources and uses of materials.

Engage

Lesson 1: Amazing materials

In this lesson, students will:

- suggest what objects can be found in their school environment and the materials that the objects are made of.

Lesson-level Content Descriptions

Students are introduced to the concept that materials are used to make objects and that the object's purpose will determine what materials are used to make it. Conversely the materials used to make objects, will also determine the potential use of the objects. The lesson commences with students looking at familiar objects then extending their experiences to include unfamiliar objects. As students may have trouble distinguishing between objects, and materials that objects are made of, the lesson will focus on students becoming aware of a range of materials.

Lesson Outcomes

Science Outcomes	Literacy Outcomes	Numeracy Outcomes
Respond to and pose questions and make predictions about familiar objects (SIS)	Represent and communicate observations and ideas in a variety of ways such as oral and written language. (SIS)	Represent data with objects and drawings where one object or drawing represents one data value. (ACMSP262)

Content Matter

Knowledge and understanding

Everything that we use is made of materials. Materials can be either natural or processed and include metal, wood, plastic, rubber and various types of fabrics. Students when the first hear the word 'materials' may think of fabrics, cloth and wool but with a range of structured learning experiences, can develop their understanding of the variety and use of materials. Initially students may not be able to distinguish between objects and the materials that have been used to make the objects, so constructing statements such as 'this is a cup and a cup is made from metal' will assist students in developing an understanding of materials. Student can then add a 'because' clause e.g. 'cups can be made of metal because metal does not break.' In doing this, students are working from objects to materials and then to identifying and verbalizing the properties of materials.

Preparation List

Preparation prior to lesson

- Prepare a table with three columns and headings- Object, Use, Materials
- Retain the list on display for use in lesson five.
- Ensure that the purpose of the Engage phase occurs during the lesson.
- Collect several unusual objects (e.g. from home) to show children. Objects might be things that students do not recognize easily.
- To ensure a variety of objects for students to select and show, it may be advantageous to place some extra everyday objects around the classroom e.g. cup, cooking utensils, tools, and toys.
- Task sequence step four- it may be worth considering giving children letters of the alphabet to direct their looking as in a treasure hunt or asking them to find something with particular attributes e.g. big, small, rough, smooth.

Equipment

- Collection of unusual objects to show students
- Class table for recording students' ideas.

Task Sequence

1. Ask students to look around the classroom and to think of two things that they can see. List some of their ideas on the white-board.

2. Ask several students at a time to select something from within the classroom and bring it to show to the whole class. For each item, write and /or draw the object in the first column of the table then ask students what they think the object is used for. List their responses in the second column.

3. After each student has had the opportunity to bring something to be listed, remind students of the objects, by showing one at a time and asking them what materials they think that the object is made from. Accept all responses, as one of the purposes of the Engage phase is to find out what students think they know.

4. Take the students outside and tell them that they will not be collecting objects but will be using their eyes to find objects in the school environment and that the objects can be any size. Students are expected to write and / or draw that they find.

5. While outside, use what students have found, as ideas for a game e.g. ' guess what I can see, I can see something that is……' with either the students or teacher orally constructing statements for others to complete.

6. Return to the classroom and list objects that the students have found, in the table format and ask students for ideas to complete the second and third column of the table.

7. Use the information from the materials column of the table to make a tally of the number of objects made from each material.

8. Ask students, as individuals, to write or draw what they think they know about the materials listed in the column.

Links to Other Key Learning Areas and Cross Curricula Priorities

- Technology (design) use of appropriate materials for specified objects
- History- types of materials available at certain periods in time e.g., when grandparents were young.

Explore

Lesson 2: Scratching around

In this lesson, students will:

- explore leaf litter to find out about it and what is in it.

Lesson-level Content Descriptions

Having looked around the schoolyard as part of lesson one, students will be focusing on features of the natural environment to find out about natural materials and their significance in our eco-system. Students will predict what they might find in leaf litter, collect specimens for identification and realise the importance of causing minimal disturbance to leaf litter.

Lesson Outcomes

Science Outcomes	Literacy Outcomes	Numeracy Outcomes
Understand that living things live in different places where their needs are met (SU) Pose questions about features of the local environment that are of interest and affect students' lives (E) Compare observations with those of others (SIS)	Represent and communicate observations and ideas in a variety of ways such as oral and written language. (SIS) Engage in conversations and discussions using active listening behaviours, showing interest and contributing ideas, information and questions (ACELY 1656)	Represent data with objects and drawings where one object or drawing represents one data value. (ACMSP262

Content Matter

Leaf litter has many functions including providing shelter and being a food source for a range of both vertebrates and invertebrates. As plants shed their foliage or begin to break down at the end of their growth cycle, their parts become what is known as leaf litter. The leaf litter covers the soil and helps to protect soil from erosion and losing excess moisture. As the leaf litter decomposes, nutrients are returned back to the soil. Leaf litter can support populations of millions of microscopic organisms including fungi and bacteria, in addition to supporting populations of invertebrates e.g. ants and beetles, and small vertebrates e.g. frogs and skinks. When bio-prospecting, entomologists might sieve leaf litter so that the sieve retains the plant matter and the small insects pass through the sieve's holes and are collected for further recording and study to assess the extent of animal populations in specific habitats. Pit traps, embedded in the ground can also be set up to harmlessly catch small animals including insects that fall into the traps.

Preparation List

Preparation prior to lesson:

- Decide the best location (or several) within the school or adjacent natural environment for exploring leaf litter. Ensure that areas are not protected areas.
- Check for any student allergies to insects or vegetation.
- Source children's books about leaf litter, invertebrates and small vertebrates.
- Inform staff colleagues that for a short time there will be paddle-pop sticks marking specific areas where students have removed a small sample of leaf litter, and ask that their students do not move or remove the marker sticks.
- If necessary, modify the resource sheet to suit students' abilities and needs.

Equipment

- Magnifying glass per student
- Plastic pop-top bag per group
- Tweezers per student
- Paddle-pop stick per student
- Paddle-pop stick (to use as a marker) per group
- Texta pen per group
- Resource Sheet # 2/1 per group
- Spoon or small spade per group
- Plastic/ foam tray or white paper per group
- Images of organisms likely to be found in leaf litter (optional)
- Tools for handling leaf litter e.g. tongs (optional)

Task Sequence

1. Remind students of the focus of lesson one, particularly when the students went outside to find objects in their local environment.
2. Ask students whether they found any small objects, specimens etc, whether they think that things that they found were living or non-living and whether materials that they found were natural or processed.
3. Ask students what they think they might have found if they had only looked at the ground. Tell the students that they will be going outside and working in groups to look at what is on the ground. Ask students what they think might be on the ground and list their ideas. Suggest that students use their senses of sight, touch, smell and hearing to explore the leaf litter.
4. Go outside and find patches of leaf litter for students to look at and explore later in the lesson. Introduce the phrase 'leaf litter' and ask students what they think it means.
5. Ensure that students know the safety rules i.e. not handling leaf litter with their bare hands but using tweezers, paddle-pop sticks and other tools to handle it. Ask students to give reasons why they are not allowed to handle leaf litter with their bare hands.
6. Tell the students that it is extremely important that they work carefully and replace leaf litter where they find it. Ask students why they think that they need to replace the leaf litter in its original location.
7. Students explore leaf litter, and as a class talk about what they have found in the leaf litter.
8. Re-assemble students, share information about what they have found, and show students how to use a spoon or spade to take a sample of leaf litter.
9. Explain that each group will be collecting a sample to take back to the class then after looking at it closely, will be returning the sample to its original location. Give each group a paddle-pop stick and texta so that they can write their names on the stick and use it as marker in the ground to show where the sample came from.
10. Each group carefully collects a sample of leaf litter to take back to the classroom.
11. Students empty the leaf litter onto a white surface, use tweezers to spread it out and use magnifying glasses to look at it closely.
12. Students record what they find.
13. Students create a tally of what they have found and contribute their tally to compile a class tally.
14. Students share their findings then return the leaf litter to its original location.

Links to Other Key Learning Areas and Cross Curricula Priorities

- Maths- graphing data about what was found
- Literacy- using texts to find out about leaf litter, invertebrates and small vertebrates
- Visual Arts- producing drawings of what is found in leaf litter
- Indigenous perspectives- Indigenous knowledge of what is in leaf litter and its significance to Indigenous seasonal calendars/ Indigenous weather knowledge.

Additional Resources

Leaf litter by Rachel Tonkin (Angus and Robertson, 2006).

Appendix Resource sheet # 2/ 1 Our leaf litter

(sample; modify to suit students' needs and abilities)

Our leaf litter sample

It looks like_____

It smells like_____

It feels like_____

We can find

(Write or draw)

How many did we find?

Thing	How many

Explore

Lesson 3: A Shovelful of soil

In this lesson, students will:

- collect and explore soil samples to find out what soil consists of.

Lesson-level Content Descriptions

Students will be collecting soil, examining it closely and trying to determine what soil is composed of. They will then add water to their soil sample, leave it for at least a day then observe it again to find out if any of the components that were in their soil sample are suspended in the water or floating on the surface of the water and whether layers have formed within the sample.

There may be the opportunities for students to explore soil samples from different locations so that students can find both similarities and differences in soils.

Lesson Outcomes

Science Outcomes	Literacy Outcomes	Numeracy Outcomes
Explore the local environment and develop understandings about physical features of the local landscape including the ground. (E) Understand that people use science in everyday life e.g. finding out about soil and its uses. (SHE) 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, (SIS) e.g. produce an annotated drawing of the soil and complete a sentence about soil. Engage in conversations and discussions using active listening behaviours, showing interest and contributing ideas, information and questions (ACELY 1656)	Measure and compare the capacities of pairs of objects using uniform informal units. (ACMMG)19)

Content Matter

(source Science is….Susan V Bosak)

“Soil is created as part of the rock cycle. Magma rises up from the depths of the earth and hardens. Erosion then wears the rock down. Eventually the rock is reduced to bits and washed by rains, rivers and streams into the ocean. Soil is the powdered rock part of the cycle. However soil is much more than bits of rock. Fertile soil is made up of a rich mix of organic matter. In general, soil is half air and half water (necessary for plants and animals to survive) and half recycling organisms (fungi, moulds, bacteria, earthworms), rock (mineral particles) and humus (black or dark substance made up of decaying leaves, wood and animal matter). The rock particles (result of erosion) in a soil determine the soil’s grain size, texture and pH. Humus is very important in soil, as it helps soil to hold water, improves air circulation, make soil easier to work with encourages the existence and multiplication of recycling organisms and helps store plant food.

The composition of soil gives it certain properties – however some soil characteristics such as compaction are affected more by environment factors than by composition. The major difference between hard and soft soil is the amount of space between particles- harder more compact soils have less space between the particles.

A certain degree of compaction helps soil to retain water and prevents erosion. However if the soil becomes too compact, water runs off and the soil cannot sustain plant and animal life. Soil compaction can be caused by humans including trampling on earth, and constructing roads where soil is covered and particles are pushed together causing a decrease in water and air levels that result in living organisms no longer being able to survive in the soil." These factors are taken into consideration when the development of roads, buildings and infrastructure is being planned.

Preparation List

Preparation prior to lesson

- Allow time a day after the lesson for students to observe what has happened in their jar and to draw a picture of it.
- Decide whether students will be wearing gloves while collecting the soil sample.
- Calculate how much water (dependent on size of jars) will be required.
- Mark 'third marks' on the bottle and use symbols e.g. star for 1/3, and circle for 2/3.

Equipment

- Spoon or small spade for digging soil
- Magnifying glass per student
- Tweezers per student
- Disposable gloves (optional)
- Plastic jar or wide-necked bottle with screw-top lid per group.
- White tray or paper
- Water
- Resource Sheet # 3/1
- Sample of soil to show students.

Task Sequence

1. Remind students about the focus of lesson two when they explored leaf litter.
2. Ask the students what they think is under the leaf litter (soil) and what might be in the soil. Record their responses.
3. Show the students some soil and ask them to describe it.
4. Tell the students that they will be digging up some soil, looking at it closely as they did with the leaf litter, then eventually adding water to it.
5. Students go outside and put soil into their containers to the first mark on the jar (one third).
6. Students empty the soil onto white paper and use tweezers, paddle-pop stick and magnifying glasses to explore the soil.
7. Students record what they observe then place the soil back in the container and are asked what they think might happen when they add water to the soil in the container.
8. Students add water to the second mark on the container (two thirds).
9. Students carefully shake the containers and leave them to stand for at least a day.
10. Students observe the containers' contents and produce an annotated drawing of the soil sample.
11. Retain the soil samples to be used as a reference in the following lesson.

Explore

Lesson 4: Rocks, stones and shells

In this lesson, students will:

- devise their own categories to sort and classify rocks and shells, and describe the characteristics of each group and some individual specimens.

Lesson-level Content Descriptions

Students will work in groups to classify rocks and shells and at the beginning of the lesson will be encouraged to classify the objects in as many ways as they can think of. The categories that students suggest might include colour, size, shape, texture.

Students will share their ideas and will be encouraged to talk about where they think that the rocks and shells might have come from, as well as their possible uses. Broad headings shells and rocks will be introduced with the opportunity for students to re-sort and to develop subsets within the broad headings.

Lesson Outcomes

Science Outcomes	Literacy Outcomes	Numeracy Outcomes
Explore the local environment to identify, describe and classify natural features and resources (E).	Represent and communicate observations and ideas about categories used for sorting and classifying, in a variety of ways such as oral and written language. (SIS) Engage in conversations and discussions using active listening behaviours, showing interest and contributing ideas, information and questions (ACELY 1656).	Represent data with objects and drawings where one object or drawing represents one data value. (ACMSP262)-count and record the number of specimens in each category.

Content Matter

Knowledge and understanding

(Science is…. Susan V Bosak)

"To 'classify' objects is to arrange them into groups. Classification involves comparison, description and development of subsets, and helps people order and therefore better understand their world around them. (88) Classifying and identifying rocks involve the minerals within them. Rocks are made up of minerals but rocks themselves are not minerals. Rocks are mixtures of minerals. Some rocks are mostly one mineral with small amounts of other minerals. Other rocks contain equal amounts of several different minerals. Certain rocks are even made from other rocks that have been naturally cemented together. The minerals that make up rocks are usually found in the form of particles or grains. Sometimes the grains are too small to be seen even with magnifying glasses. " (395).

(CP) Shells are classified as molluscs with the phylum Mollusca being the second largest phylum based on the number of specimens classified as molluscs. Classes within the phylum Mollusca include Gastropoda, Bivalvia, Scaphopoda, Cephalopoda and Monoplacophora. Students might have had contact with both marine (aquatic) and land (terrestrial) molluscs. Molluscs that students might have encountered in everyday life include gastropods and bivalves. Characteristics of gastropods include a one-piece coiled shell, a head and a soft but muscular foot. Snails are classified as gastropods.

Characteristics of bivalves include two hinged shells encasing a soft body. Examples of bivalves include clams, cockles and oysters.

Preparation List

Preparation prior to lesson:

- Access rocks, shells and coal specimens for students to sort
- Ensure that specimens are safe to handle
- Source books about shells and rocks.

Equipment

- specimens for groups to sort
- magnifying glasses, one per student
- coal to show to class
- books about shells and rocks, at least one book per group
- one cloth bag to use as a feelie bag.

Task Sequence

1. Show the students a cloth bag and tell them that inside the bag there so something that they will be touching to try to work out what it is. Explain to students that there will be nothing in the bag that will harm them and that apart from this task, they should never put hands into bags, boxes or holes without knowing what is there.
2. Give the bag to a student and ask the student to describe what she can feel then to pass the bag to another student who might add to the description. Record the students' ideas, then show the specimen to the class.
3. Repeat steps one and two with a different rock or shell in the bag
4. Talk with the class about where they might see rocks and shells in their school and local community. Remind them of the lessons where they explored leaf litter and looked at soil samples.
5. Ask students to talk about what they can see in their settled soil samples and ask them whether any rock or shell specimens including small pieces are visible in the soil samples.
6. Explain to the students that in groups, they will be carefully looking at (using magnifying glasses) and classifying a bag of rocks and shells and that they can classify them however they want to. Students are expected to record their ways of classifying them or tell the teacher as he moves around the class.
7. When students have classified the specimens in several ways, talk with the class about what they did, categories that they used and then ask students to sort the specimens into two groups- rocks and shells. Students count and record how many specimens are in each group.
8. Ask students what common characteristics rocks have and about the common characteristics of shells.
9. Students then classify the rocks then the shells into subsets of their own choice and explain how they have classified each set into sub-sets. Students count and record how many specimens are in each sub-set.
10. Students draw one of the sub-sets of rocks or shells, and add two extra drawings to their subset, i.e. things that they think might belong in the sub-set and explain what they have drawn and why. Students can use resource books to look at illustrations of shells and rocks for both ideas and information.
11. Conclude the lesson by asking students whether they think that rocks and shells are materials and how they could be used.

Links to Other Key Learning Areas and Cross Curricula Priorities

- Literacy- read books about how natural materials are used
- Technology (design) – design something that can be made out of either shells or rocks
- SOSE/ The Arts- look at how shells are used in jewellery and body decorations in Aboriginal and Torres Strait Islander culture.
- Technology- how rocks and shells are used in our local community.

Additional Resources

www.oresomeresources.com/resources_view/resource/fact_sheet_coal/section/resources/parent//category/

Explore

Lesson 5: Material search

In this lesson, students will:

- search for and identify materials that are visible in their school and local environment.

Lesson-level Content Descriptions

Drawing together what students have explored in the previous three lessons in the Explore phase, students consolidate their understanding of materials, that they began to develop in lesson one, by adding examples of what they have discovered e.g. plant matter, shells, rocks and soil. Using this information, students begin to talk about where materials come from.

Lesson Outcomes

Science Outcomes	Literacy Outcomes
Explore the natural environment's physical features that can be used by people and animals as materials. (E)	Represent and communicate observations and ideas about rocks and shells in a variety of ways such as oral and written language. (SIS) Engage in conversations and discussions using active listening behaviours, showing interest and contributing ideas, information and questions (ACELY 1656)

Content Matter

Materials can be either natural or processed. Natural materials as their name suggests, can be defined as those that occur naturally in the environment and may include latex, wood and clay. Rocks and minerals including coal are natural materials. Processed materials have either been manufactured from other substances e.g. plastic from crude oil or have been made by modifying natural materials e.g. building timber from forest trees. There are links between natural and processed materials and students can determine the links and the amount and type of processing that changes the material into a different form. For example, sheep's fleece is a natural material that can be processed to produce wool suitable for knitting or weaving woollen fabric. In learning about and distinguishing between natural and processed materials, students become aware of production chains and the processes for changing a natural material into what might be classified as processed material.

Preparation List

Preparation prior to lesson

- Using information about materials from lesson one, prepare a three-column table of materials that students have suggested. Column headings should be materials, used for and why. To assist students in reading information on the list, the list could include actual samples or images of materials.
- Source books about materials, and samples of materials that are familiar to students
- If possible, source a children's narrative about a character going for a walk or exploring somewhere. See *Additional resources* for possible titles. Alternatively compose a simple story about a character going for a walk, through an area where the use of a range of materials is noticeable.
- Set of cards with names (and illustrations) of materials on them, and space for students to write and draw what they find.

Equipment

- Clipboard (or piece of strong cardboard with peg or paper clip) per group
- Pencil per group
- Set of cards – enough for two per student.
- Spare cards to write additional materials on if additional materials are suggested by students.

Task Sequence

1. Review the list of materials that students thought of and listed in lesson one. Remind students of the definition of a material.

2. Remind students of lessons two, three and four and ask them to think of materials that they encountered in those lessons. Add ideas to the materials list.

3. Read or tell a narrative about a character going for a walk and ask students what the character saw. If students' ideas include objects, work from the ideas to materials by asking 'what do you think the ….was made of?' and add additional materials to the list.

4. Tell the students that they will be going for a walk outside and that each student will have two cards with the name of a material on each. Students will be looking for objects made from the materials that are on their cards and drawing or writing what object is made from the material e.g. metal- the rubbish bin in the lunch area is made from metal, or wood- the bower bird's bower is made from twigs.

5. When the task is completed, students share what they find and give their reasons for the choice of material for the objects that they found, with their responses being recorded on the table. Students also talk about whether the materials are natural or processed, and if processed, suggest the origin of the material.

Links to other Key Learning Areas and cross-curricula priorities

Technology – use of and suitability of materials for producing objects, simple flow-charts showing production of materials.

Additional resources

Books about walks or exploring:

- *Rosie's walk* by Pat Hutchins
- *Possum goes to school* by Melanie Carter
- Possum in the house by Melanie Carter.

Explain

Lesson 6: What's under the ground?

In this lesson, students will:

- Students use the information about features of the local environment that they have discovered in the Explore phase, to form explanations about where materials come from, focusing particularly on materials that come from under the ground.

Lesson-level Content Descriptions

As students review what they have discovered about both materials and features of their local environment, they sort materials according to where in the environment the materials are located e.g. under the ground or above the ground. Students begin to develop basic understandings about how raw materials are processed to make them suitable to use to produce everyday objects that are familiar to the students.

Lesson Outcomes

Science Outcomes	Literacy Outcomes	Numeracy Outcomes
Understand that people use Science in everyday life (properties and uses of materials) (SHE)	Represent and communicate observations and ideas about the location of materials, in a variety of ways such as oral and written language. (SIS) Engage in conversations and discussions using active listening behaviours, showing interest and contributing ideas, information and questions (ACELY 1656)	Represent data with objects or drawings e.g. Venn diagrams showing where objects are found, where one object or drawing represents one data value. (ACMSP 263)

Content Matter

"Every day millions of items are used that have been made from minerals. From an iPod to computers to electric cars these items are made by mining and processing minerals into metals and other materials. (OresomeResources fact sheet)"

(CP) Minerals are found under the ground. Other materials that students have discovered have their origins above the ground, e.g. building timber from trees and wool from sheep that eat grass growing in the ground. As students move through their schooling levels, they may begin to make connections between all material and their dependence on what is in the ground.

"Coal is a common fuel used worldwide mainly in the production of electricity. It is used for cooling, heating, powering machines, charging mobile phones and even electric cars. It is also used in furnaces to produce metals like steel and can be used in the manufacturing of plastics, explosives, fertilisers, cement, bricks and tiles. Coal is a sedimentary rock which formed millions of years ago from plant and mineral material accumulating in large areas of shallow lakes and swamps.

Over time, this plant matter was covered with sediments that formed heavy rock layers. The plant material began to rot to form spongy material called peat. As the water and gasses were squeezed out by the heavy rock layers above, the peat was cooked at great temperatures in the earth and coal began to form, first as brown coal (lignite) and then harder black coals as time went on (anthracite is the oldest type of coal)." (OresomeResources fact sheet)

Venn diagrams consist of two intersecting circles and can be used as a visual representation of sets of objects that may have common properties. As a conclusion to this lesson, students will be considering how they can represent what they think about 'material' locations, in the two circles on a Venn diagram with materials that students think can be found both under and above the ground be shown in the intersection of the circles.

Preparation List

Preparation prior to lesson:

- Collect samples of materials
- Source and display books about materials
- Download *Finding Minerals* and *Minerals to Metal* readers.
- Prepare enlarged copies of Venn diagram and resource sheet #6/1.

Equipment

- Samples of various types of materials per group
- Samples of rocks, shells and coal per group
- Enlarged copy of Resource sheet #6/1
- Resource sheet # 6/1 per group
- Samples of materials for placing on the enlarged copy of the resource sheet
- Sticky tape per group
- Blu-tack to be used with enlarged copy of resource sheet
- Pop-top bags to hold individual rocks that will be placed on the enlarged sheet
- Class list of materials (compiled in lessons one and six)
- Enlarged Venn diagram to be used as a conclusion to the lesson
- Copies of *Finding Minerals* and *Minerals to Metal*.

Task Sequence

1. Direct students' attention to the list of materials that they have discovered around the school, both above the ground and in the ground.
2. Ask students where they think that materials can be found, and discuss with them about materials being on the ground, above the ground or under the ground.
3. Show the students one of the material samples and ask them where they think that it could be placed on the enlarged copy of the resource sheet. Ask the students to give a reason to justify their response then use Blu-tack to place the material on the class sheet.
4. Explain to students that they will be placing materials on a similar sheet to show what they know about the original location of the material.
5. When students have finished the task and shared how they grouped the materials, collate their responses onto a Venn diagram.
6. Discuss whether students think that some materials may be found in both places and place those materials on the intersection of the Venn diagram.
7. Ask students how they think that materials are processed and discuss with them some examples e.g. trees cut down, and made into timber, sheep's fleece spun and woven into cloth, dirt made into mud-bricks and minerals mined to be processed into metals.
8. Draw a simple flowchart to show a process.
9. Read *Finding Minerals* and *Minerals to Metal*, or similar books that show how minerals are processed.

Links to Other Key Learning Areas and Cross Curricula Priorities

- Technology- systems e.g. flow charts showing production
- Indigenous perspectives- use of natural materials by Indigenous people both now and in the past
- History –what materials were used by people of other generations e.g., grandparents, early western explorers
- SOSE- use of and availability of materials in other cultures and reasons for their use.

Additional Resources

Readers provided by the MCA:

- A Mine
- Finding Minerals
- Mine Machines
- Minerals to Metal
- When we Mine

Appendix Resource sheet 6/1

Above or under the ground

Resource sheet #6/1

Above or under the ground

Above
On the Ground
Below

Elaborate

Lesson 7: Getting it out

In this lesson, students will:

- investigate ways of extracting objects from a tray of sand or soil, without using their bare hands.

Lesson-level Content Descriptions

As students have developed understandings about materials that are found under the ground, they have the opportunity in the Elaborate phase to draw on their background knowledge and earlier experiences of using tweezers and paddle-pop sticks to think about and use other tools including toy machinery, to extract objects that are buried in sand or soil.

Lesson Outcomes

Science Outcomes	Literacy Outcomes
Answer questions by participating in different types of guided investigations including using tools. (SIS)	Represent and communicate observations and ideas in a variety of ways such as oral and written language. (SIS) e.g. using an Investigation planner Engage in conversations and discussions using active listening behaviours, showing interest and contributing ideas, information and questions (ACELY 1656)

Content Matter

"Underground mining is one method used to extract minerals from the earth. Where the ore is too deep for open-cut or strip mining, an underground mine is built. Entry to the mine is via a tunnel called a decline. This allows access to vehicles such as trucks or a mine railway to the underground mineralised area. Alternatively a lift or 'cage' can be used to transport miners and equipment to the various levels underground.

Coal is mined underground using a type of stope mining referred to as the room and pillar mining, which involves building tunnels in the coal seam to form roadways. These are then connected into each other to form rooms in a square or rectangular pattern. Pillars of coal are left behind to support the roof of the mine. These can be extracted at a later stage. One of the main pieces of equipment used in the room and pillar mining method is a continuous miner, which breaks the coal mechanically by using a long rotating drum which has picks around the outside. Coal is loaded onto shuttle cars and then onto conveyor belts which transport it to the surface." A longwall miner can also be used in the mining of coal underground. This moving machine has blades which shear the coal of the face of the coal seam.

Source - OresomeResources Underground Mining fact sheet.

Preparation List

Preparation prior to lesson:

- If using sandpit, divide it into sections
- Bury objects in the tray or sandpit
- Obtain copy of *Mine Machines*.
- Source narrative and factual texts about machines, and removing things from the ground, including stories such as *The Enormous Turnip*.

Equipment

- Tray of sand or soil per group or school sand-pit divided into sections
- Assorted tools e.g. tongs, shovels, tweezers, solid cylinders for boring holes
- Sieves and strainers
- Objects to bury in the sand e.g. rocks, toys, Lego, marbles, blocks
- Enlarged investigation planner for whole-class use
- Investigation planner (Resource Sheet # 7/1) per group
- Toy machinery e.g. grader, tractor, excavator, truck.
- Images of machinery used in mineral extraction (optional).

Task Sequence

1. Remind students about materials that are found below the ground.
2. Ask students to suggest ways that objects might be removed from below the ground.
3. Tell the students that there are some objects buried in sand and that their task is to work out the best way of removing the objects without using their hands.
4. Ask students to suggest ways to remove the objects.
5. Show the students the tools and talk about how each tool or each machine could be used.
6. As a class, write and draw on the enlarged copy of the investigation planner.
7. Give each group a selection of tools and machines and an investigation planner.
8. Students need to begin writing or drawing on the investigation planner before beginning the task, and after completing the task, write or draw what happened.
9. After students have participated in the task, share what they did and found out, and complete the class investigation planner.
10. Read *Mine Machines* (a factual text) as well as reading a narrative about extracting things from the ground.
11. Discuss with students their experiences with machines in the local community including how the machines can move things.
12. Complete the lesson by asking students to draw about how they extracted the objects, and write sentences or label their drawing.

Links to Other Key Learning Areas and Cross Curricula Priorities

- Technology- design a way of extracting materials from the ground
- Literacy- read narratives and factual texts, write a class big book about moving or extracting something large
- History/ SOSE – find out how things were moved before the development of today's machinery.

Additional Resources

PrimaryConnections Push and Pull (Australian Academy of Science)

http://www.sparklebox.co.uk/cll/fairy/turnip.html - to print a copy of The Enormous Turnip

OresomeResources Underground Mining fact sheet.

Books

Mike's Birthday Bulldozer by Mike and Nan Bodsworth

Mike's Bulldozer and the Big Flood by Mike and Nan Bodsworth

Evaluate

Lesson 8 Materials on show

In this lesson, students will:

- make a class 'Big Book' with fold-up flaps showing how materials are used in their school or home and where the materials come from.

Lesson-level Content Descriptions

Contributing to a class Big Book provides students with the opportunity, as individuals to demonstrate what they have learnt about materials, their uses and their original location. Students will be scaffolded in preparing pages for the book by looking at a cardboard resource with flaps, '*Mining helps make your house* ' and an interactive game based on the print resource. Students' understanding of this type of book as a means of communicating what they know, will be developed by exposure to picture books with lift-up flaps.

Lesson Outcomes

Science Outcomes	Literacy Outcomes
Realise that science is used in everyday life e.g. materials that we use. (SHE)	Represent and communicate observations and ideas in a variety of ways such as oral and written language. (SIS) e.g. constructing and using text and visual literacy to convey ideas. Engage in conversations and discussions using active listening behaviours, showing interest and contributing ideas, information and questions (ACELY 1656).

Preparation List

Preparation prior to lesson:

- Play the interactive house game to decide the best way of utilizing it in the lesson. See additional resources for link
- Source books with flaps (narratives or factual texts) as models of how foldout flaps can conceal and convey information as components of texts.
- Decide how to set up the A3 sheets to best suit the students and their competencies.

Equipment

- Books with lift-up flaps as part of the text.
- A3 paper per student
- A4 Paper for draft
- Paper to make lift-up flaps
- Glue
- Pencils, textas etc
- Access to computer/ interactive white-board to show students the '*Mining helps make your house'* game
- Copies of cardboard *'Mining helps make your house'* resource.
- Tables from previous lesson about material, uses, origins etc.

Task Sequence

1. Read any type of children's book with flaps to the students and while reading, emphasize opening and closing the flaps, including asking students what they think is under the flaps.
2. Show the students some additional books with flaps and ask them what is so special about the structure of the books.
3. Explain to students that as their final task in the unit, they will each be making a page with flaps to show what they have learnt about materials, their use and their original locations, and that the pages will form a big book to share with other classes. The book will focus on the school.
4. Review with students what they have learnt from tasks in each phase of the unit.
5. Ask students for ideas of what they could draw and write on and under the flap. Include photographic images in the book.
6. Show the students the cardboard resource and play the interactive game.
7. If necessary assist students with writing a draft as the assessment focus is on finding out about the understandings in science that students have developed, with lesser emphasis on students' ability to use language.
8. Students write and draw on the A3 pages that are collated to form a big book.
9. Students can also suggest headings and text that can be added to the book to link the ideas throughout the book.
10. Share books with another class or the school community.

Links to Other Key Learning Areas and Cross Curricula Priorities

Literacy- structure and conventions of a book including factual texts.

Additional Resources

http://www.oresomeresources.com/media/flash/interactives/mining_makes_your_house/

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.