A Question of Sustainability
Earth and Space Sciences
Year 7

This unit has been developed to meet the needs of Year 7 teachers. It is currently in draft form. Any feedback via the Moodle is appreciated.
http://dlb.sa.edu.au/pmssmoodle/

Science: Year 7 Unit – Earth and Space Science: A Question of Sustainability

Links to the Australian Curriculum

Achievement Standard

By the end of Year 7, students describe techniques to separate pure substances from mixtures. They represent and predict the effects of unbalanced forces, including Earth's gravity, on motion. They explain how the relative positions of the Earth, sun and moon affect phenomena on Earth. ***They analyse how the sustainable use of resources depends on the way they are formed and cycle through Earth systems.*** They predict the effect of environmental changes on feeding relationships and classify and organise diverse organisms based on observable differences. ***Students describe situations where scientific knowledge from different science disciplines has been used to solve a real world problem. They explain how the solution was viewed by, and impacted on, different groups in society.***

Students identify questions that can be investigated scientifically. They plan fair experimental methods, identifying variables to be changed and measured. *They select equipment that improves fairness and accuracy and describe how they considered safety.* ***Students draw on evidence to support their conclusions. They summarise data from different sources, describe trends and refer to the quality of their data when suggesting improvements to their methods. They communicate their ideas, methods and findings using scientific language and appropriate representations***

Science Understanding

- Some of Earth's resources are renewable, but others are non-renewable
- Water is an important resource that cycles through the environment

Science as a Human Endeavour

- Science and technology contribute to finding solutions to a range of contemporary issues; these solutions may impact on other areas of society and involve ethical considerations
- Science understanding influences the development of practices in areas of human activity such as industry, agriculture and marine and terrestrial resource management
- People use understanding and skills from across the disciplines of science in their occupations

Science Inquiry Skills

- Identify questions and problems that can be investigated scientifically and make predictions based on scientific knowledge
- Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed
- In fair tests, measure and control variables, and select equipment to collect data with accuracy appropriate to the task
- Construct and use a range of representations, including graphs, keys and models to represent and analyse patterns or relationships, including using digital technologies as appropriate
- Summarise data, from students own investigations and secondary sources, and use scientific understanding to identify relationships and draw conclusions
- Reflect on the method used to investigate a question or solve a problem, including evaluating the quality of the data collected, and identify improvements to the method
- Use scientific knowledge and findings from investigations to evaluate claims
- Communicate ideas, findings and solutions to problems using scientific language and representations using digital technologies as appropriate

Links to General Capabilities

Literacy

The interdependence of science and literacy is demonstrated throughout this unit as students engage in a variety of different literacies of science. The language and literacy demands specific to the study of science develop along with scientific understanding and skills. This unit provides opportunities for students to develop their literacy skills as they:

- Engage in discussions and record their thinking, ideas and questions in journals
- Draw annotated diagrams
- Write written explanations of their science understandings using technical scientific terms

Numeracy

Within this unit students engage in tasks involving the collection, representation and interpretation of data from investigations. This unit provides opportunities for students to develop their numeracy skills in the following ways:

- Collection of data
- Analysis of data and drawing conclusions

Information and Communication Technology (ICT) Competence

Within this unit students' information technologies are used to research a science concept. Communication technologies offer opportunities for the communication and sharing of students' ideas and results both within and beyond the classroom. This unit provides opportunities for students to develop their ICT skills in the following ways:

- Use ICT to research information – search for websites with relevant information

Critical and Creative Thinking

Within this unit students are asked to pose questions, make predictions, solve problems through investigation, analyse and evaluate evidence and summarise information. Students are asked to think in new ways about observations of the world. This unit provides opportunities for students to develop their critical and creative thinking skills in the following ways:

- Determining the best way to present information
- Drawing conclusions from data gathered
- Reflecting on the sustainability of resources – developing an argument

Ethical Behaviour

Ethical behaviour is relevant to experimental science and the use of scientific information. Within this unit students apply ethical guidelines in the gathering of evidence, including considering the implications of their investigation on others, on the environment and on other living organisms. This unit provides opportunities for students to develop their ethical behaviour in the following ways:

- Working as part of a team on an investigation
- Gathering evidence to support their claims

Personal and Social Competence

Within this unit students further develop their teamwork skills by working together, sharing ideas and discussing their work. They develop self management skills such as planning effectively, following procedures and working safely. This unit provides opportunities for students to develop their personal and social competence in the following ways:

- Working together in teams to complete tasks
- Planning effectively

Intercultural Understanding

Within this unit students learn to value their own cultures and beliefs and those of others. They recognise commonalities and differences and cultivate respect between people. This unit provides opportunities for students to develop intercultural understandings in the following ways:

- Discussing the cultural perspectives related to the collection of minerals and access to water

Links to Cross-Curriculum Priorities

ATSI Aboriginal and Torres Strait Islander histories and culture

This priority involves understanding Aboriginal and Torres Strait Islander ways of interpreting and being in the world and appreciating that Aboriginal and Torres Strait Islander histories and cultures are intrinsically linked to living and learning in Aboriginal and Torres Strait Islander communities. The Australian Curriculum: Science provides opportunities for students to become aware that Aboriginal and Torres Strait Islander peoples have particular ways of knowing about the world and continue to provide significant contributions to developments in science. Within this unit students will:

- Engage in discussions around the cultural considerations with regard to mineral deposits and the mining of them

SUST Sustainability

Sustainability is concerned with the ongoing capacity of the Earth to maintain life. It aims to reduce our ecological footprint while simultaneously supporting a quality of life that is valued – the 'liveability' of our society. Scientific understanding and scientific inquiry processes help students to appreciate how people forecast change and plan the actions necessary to shape more sustainable futures, including the design, construction and/or management of the physical and social environment. This unit provides opportunities for students to develop an understanding of sustainability in the following ways:

- Discussions around sustainable and renewable resources
- Researching a resource and determining its sustainability
- Identifying things that impact on the sustainability of resources

Unit at a glance		Earth and Space Sciences
Phase	Lesson	At a glance
ENGAGE	**Lesson 1** **What is a resource?**	To capture students' interest and find out what they know about resources
	Lesson 2 **Birdseed and bead mining**	To capture students' interest and find out what students know about the mining of resources
EXPLORE	**Lesson 3 – Explore/Elaborate lesson (see note below)** **A Sustainable Resource Investigation**	To support students to plan and conduct a long term investigation into a sustainable resource
	Lesson 4 **The Earth's Resources**	To provide hands on, shared experiences of different resources
	Lesson 5 **What do we use?**	To provide hands on, shared experiences of exploring the resources we use
	Lesson 6 **Water**	To provide hands on, shared experiences of exploring the water cycle
EXPLAIN	**Lesson 7** **The Water Cycle**	To support students to represent and explain their understanding of the water cycle
	Lesson 8 **Earth's Water Distribution**	To support students to represent and explain their understanding of the distribution of water
	Lesson 9 **The Earth's Resources**	To support students' understanding of their chosen resource
ELABORATE	**Lesson 10** **Non-renewable Resource Investigation**	To support students to plan and conduct an investigation into the mining of non renewable resources
EVALUATE	**Lesson 11** **A Question of Sustainability**	To provide opportunities for students to represent what they know about sustainability and the Earth's resources

Teacher Note: You will note that this unit contains a sustainable resource investigation that is placed earlier in the unit than usual. The investigation is being introduced at this stage of the unit as it requires an extended period of time to complete. It will be an ongoing investigation that will be running throughout the unit. As you work your way through the unit the investigation will be running concurrently to the other activities students undertake. Students will require regular times to gather data. Students will use their results and engage in discussions and written tasks around the investigation at the Elaborate phase later in the unit.

Lesson 1: What is a Resource?

ENGAGE

At a Glance:
To capture students' interest and find out what they think they know about resources and their sustainability.

Assessment Focus:
Diagnostic Assessment is an important aspect of the Engage phase. This lesson will elicit what students already know and understand about resources and sustainability. This allows teachers to take into account students' existing ideas when planning future learning experiences.

Assessment Opportunities - Diagnostic Assessment:
- Participation in discussions
- Journal responses/self assessment
- Observation
- Questions and feedback

Science Outcomes:
Students will be able to:
- Record their current understandings of the following: resources, sustainability, renewable and non-renewable

Literacy Outcomes:
Students will be able to:
- Contribute to discussions
- Record journal responses to discussions

Equipment for the class:
- A display copy of the key question
- A display copy of the key words

Equipment for each student:
- Science journal
- A copy of Resource Sheet 1

Teacher background information

Resource

A resource is anything that can and is used to meet the needs and demands of humans e.g. plastic, oil, water.

A natural resource is anything produced from the Earth that is used to help meet the needs of humans e.g. solar energy, coal, forests.

Non-renewable

Natural resources can be sorted according to their renewability. A non-renewable resource is any resource that is formed over long periods of geological time. This includes minerals and fossil fuels. Since the formation of these resources is extremely slow they cannot be replenished once they have been used as they take too long to regenerate.

Renewable

A renewable resource can be regarded as a resource that can be replenished or regenerated in relatively short periods of time and can therefore be used and regenerated as needed. Examples of renewable resources include things such as plantation forests and wind power. If we cut down some trees to get wood to produce paper we can plant more trees to replace the ones that have been used.

Sustainable

Sustainability addresses the ongoing capacity of Earth to maintain all life. Sustainability is living within the limits of what the environment can provide. It is the ability of something to be maintained or sustained over very long periods of time. If something is sustainable it should be able to continue for ever. Sustainable patterns of living meet the needs of the present without compromising the ability of future generations to meet their needs. Actions to improve sustainability are both individual and collective endeavours shared across local and global communities. They necessitate a renewed and balanced approach to the way humans interact with each other and the environment.

Renewable vs sustainable

A renewable resource is only sustainable if we do not consume the resource at a greater rate than we can produce it. A fish population is a sustainable resource but only if we do not consume the fish at a rate quicker than they can reproduce and grow. For fish stocks to be sustainable we need to consider things such as how many we take from the ocean, the rate at which they reproduce, the stage of life of the fish we are allowed to capture, the time of year we can catch them and even where we can and cannot take them from. If we catch a lot of juvenile fish or females during the breeding season we may deplete the fish stock to such a point that it is no longer sustainable.

Possible Resource List

The Ocean	Timber	Glass
Wind	Fish	Steel
Sun	Tidal power	Rubber
Natural gas	Geothermal	Aluminium
Coal	Soil	Bio mass
Oil	Rocks	Salt
Uranium	Water	Crops
Sand	Gold	Iron
Plastic	Animals – cows, sheep,	
Diesel	Water	
Methane	Petrol	

Preparation

Organise a display copy of the key question - ***What is a resource and what factors help determine its sustainability?*** Ensure there is space available alongside or around the key question to record responses throughout the unit.

Organise display copies of the key words - **resource, sustainable, renewable and non-renewable.** Ensure there is space around them to record thoughts and responses throughout the unit.

Lesson outline
Key words: resource, sustainable, renewable, non-renewable

ENGAGE

1. Introduce the students to the key question that will be the focus throughout this unit – ***What is a resource and what factors help determine its sustainability?*** Identify the key words in the question from the list above and give each student one of the key words to focus on - resource, sustainable, renewable and non-renewable. Students will be asked to complete a 4-2-1 strategy to support and guide them in their discussions.

> **Teacher Note:** The 4-2-1 strategy is a tool to assist students to engage in discussions. It provides a structure for students to follow.
>
> **4** – Individually generate four words/phrases that capture the most important aspects of the learning experience. Share with your group and compile a list of the words you have in common
>
> **2** - From this list decide on two words/phrases that you all agree capture the most important aspects
>
> **1** – Determine the one word/phrase that best represents the most important learning of the experience
>
> Adapted from http://its.guilford.k12.nc.us/act/strategies/FourTwoOne.htm,

> **Teacher Note:** This activity is working towards developing the students understanding of the key words. At this stage students may have limited knowledge about their word. If this is the case they simply work with whatever information they have.

2. Begin the 4-2-1 strategy by asking students to individually record four words or phrases that they think capture the most important elements of their key word.

   Place students in groups of 4 according to the key word they have been given. These groups share their four words or phrases and then work together to decide on two words or phrases that they all agree capture the most important aspects of their key word.

   Once they are in agreement the groups need to determine one phrase or statement that best describes their current understanding of the key word they were given.

3. Meet as a class and share these current understandings around the key words. Share a couple of different dictionary definitions of the words with the class and give each group time to meet again and see if they wish to make any further changes to their understanding of the key word. Ask each group to produce a display copy of their understanding. These definitions can be added to, changed or modified as the unit progresses and students understandings develop further. Have students record these definitions and/or their current understanding in their science journals.

4. Explain to the students that you would like them to collect newspaper articles relating to the Earth's resources throughout the duration of the unit. These articles can be kept in a scrap book or as part of a display in the classroom. The articles can form the basis of class discussions, shared reading texts or simply be read by students during reading time. Ask the students to look through newspapers to find anything they think is relevant to the topic of resources and sustainability.

   It may even be worth bringing the daily paper into the classroom and having a different student responsible for checking through it each day. When they find something that is related to the topic they can then share it with the rest of the class before sticking it in the appropriate place in the classroom.

ENGAGE

5. After developing a class definition of a resource give students time to individually brainstorm a list of the different resources used in daily life.

6. Once they have completed their list give them time to organise/group these items in some way. At this stage they can use whatever criteria they like to sort the items. Once the items have been grouped have students return to their groups of four and share their lists discussing the similarities and differences between them. These grouped items can then be recorded in students' science journals.

7. Meet together as a class to develop a class list of resources. Have this list on display throughout the unit. It will be referred back to at later stages throughout the unit. Revisit the definitions developed earlier in the lesson around the key words and ask students to identify which of these resources they think are sustainable, which are renewable and which are non-renewable? This could be recorded on the list and displayed.

8. Give each student a copy of Resource Sheet 9 and introduce them to the final assessment task. Give them time to read through the requirements and ask any questions. Explain to them that they are being given the final assessment task now so that they can keep this in mind when researching information on a particular resource throughout the unit.

> **Teacher tip:** At this stage it is not an in depth discussion about what the final presentation may look like, it is simply to introduce the students to the fact that they will need to be gathering information throughout the unit in preparation for the final presentation.

9. Ask students to choose a resource from this list that will become a focal point for their learning throughout the unit. Make it clear to them that the resource they choose now is the resource that they will be investigating further and presenting a two minute argument on as part of the final assessment. You may choose to allow students to work individually or as a pair.

> **Teacher tip:** Try to get a wide range of resources being investigated to develop a richer learning environment for the students.

Lesson 2: Birdseed mining

ENGAGE

At a Glance:

To find out what students think they know about resources and factors that may affect their sustainability by using birdseed and beads to represent the resources being mined.

Assessment Focus:

Diagnostic Assessment is an important aspect of the Engage phase. This lesson will elicit what students already know and understand about resources and mining and factors that may affect their sustainability. This allows teachers to take into account students' existing ideas when planning future learning experiences.

Assessment Opportunities - Diagnostic Assessment:

- Participation in discussions
- Journal entries
- Photographs/video sequences

Science Outcomes:

Students will be able to:

- Engage in discussions around factors that impact on the mining of resources

Literacy Outcomes:

Students will be able to:

- Contribute to discussions
- Record their understanding in an appropriate written format

Equipment for the class:

- Large containers of a mix of bird seed and beads for the students to access
- A display copy of the monetary value of different seeds and beads (see example page 12)
- A variety of different containers. There should be enough containers so that each team has access to at least one container. These containers need to be of different sizes and depth e.g. plastic cups, long tall cylinders, flat paper plates, foil trays etc.
- Containers for the storage of mined minerals
- A bell or something similar to attract attention

Equipment for each team:

- One container
- Access to the bird seed and bead mix
- Tweezers
- Teaspoons
- Plastic cup
- A copy of Resource Sheet 1
- Large foil baking tray (optional)

Equipment for each student:

- Science journal

Teacher Note: This activity could be quite messy as it involves digging through bird seed and beads. The mess could be contained by completing the task outside or placing the containers inside large foil baking trays which can then catch any spills.

Teacher background information

ENGAGE

Mining often involves complex processes in which large amounts of the Earth's crust are removed for relatively small amounts of useful resources.

Using the bird seed and bead mix is a way for students to engage in a form of mineral (seed and bead) recovery and the issues presented to them are representative of some of the issues faced by the mining industry.

Placing different dollar values on some of the seeds and beads demonstrates to students that not everything is of the same value. Some things are of greater value than others due to a variety of contributing factors.

- A greater consumer demand for the resource
- A greater perceived investment potential.
- Ease of extraction and processing
- Availability of the resource

Mining does not continue until all the resources have been extracted. It usually only continues whilst it is still economically viable to do so. Companies do not take all the resources due to cost, environmental and demand factors. Sometimes it is not economically viable to recover all of the resource from the ground so it is left where it is.

Resources are not distributed evenly throughout the Earth. Some resources are accessible and it is economically viable to recover them whilst other pockets of the same resource may be too difficult to access so therefore they are not mined. The cost of transporting the raw materials to a processing site must also be taken into consideration when deciding if something is economically viable. Resources are not always located in easily accessible sites close to processing plants.

Other implications for mining may include:

- Government rules and regulations
- Whether or not the land is of cultural significance to Aboriginal people,
- Heritage listings
- Historical significance
- Whether it is located near major communities which may make access difficult.

Preparation

Organise a couple of large containers of bird seed and bead mix by mixing a couple of bags of small coloured beads through the bird seed. There needs to be enough for each cooperative learning team to have at least one cup worth.

Teacher Note: By mixing the beads through the bird seed it is representative of the fact that minerals are not evenly distributed throughout the Earth or even accessible for mining purposes.

Identify five or six key seeds or beads and place a monetary value on them e.g. sunflower seeds may be worth $1, shiny gold beads may be worth $10. The value of these items needs to be relative to the total number of items. For example the more of an item there is the less it should be worth. Organise a display copy of this information so that students can easily see each item's value. See the example below.

	**Gold sequins**	**$500 each**
	**Pink sequins**	**$50 each**
	**Green shells**	**$75 each**
	**Coloured beads**	**$40 each**
	**Sunflower seeds**	**$1 each**
	**Corn**	**$5 each**
	**Millett**	**$10 each**
	**Sorghum**	**$1 each**
	**Barley**	**$1 each**

ENGAGE

Organise different containers around the room for the depositing of the minerals once they have been mined. Ensure these deposit points are located at a variety of different places – some close to where the students are working and some further away.

Teacher Note: The different locations for the depositing of the materials is representative of the fact that once resources are mined they need to be transported somewhere for processing. Resources are not always located close to where they will be processed so transportation is required. This can add to the cost of the resource.

Lesson outline

Key words: resource, sustainability, distribution, viability, renewable, non-renewable

1. Organise students into cooperative learning teams and identify roles. Explain to them that they are about to be involved in a mining activity and that the bird seed and bead mix represents the resources they are mining. Display a copy of the monetary value of the different seeds and beads and explain that teams will be given 15 minutes mining time to recover as many of the prized resources as possible. They will be able to use only the tools provided to mine the resources – hands are not allowed.

Teacher Note: The time limit is representative of the fact that mining does not continue until all the resources have been extracted it usually only continues whilst it is still economically viable to.

2. Ask teams to choose a container from the supply of containers and to fill it with the bird seed and bead mix. These containers will be representative of the environment that the students will be mining.

Teacher Note: Using containers that are different in size and shape is representative of the different locations that minerals and resources are located. Some resources are easily accessible and others are much more difficult to recover due to their location. That is why decisions are made not to mine some resources as it is not economically viable to do so. The students will find that it may be difficult to extract some of the resources they are looking for.

3. Give students time to mine for the resources. This involves using only the equipment provided to search through the bird seed and bead mix looking for items of value and removing them. Stress the need for care and precision when mining. Once the valuable items have been removed students need to take what they have mined and take it to the recording table to have their deposits verified by the teacher or a student who has been chosen to act as the banker.

Teacher Note: The need for care and precision when working is representative of the fact that mining companies need to consider the environment when retrieving resources. They cannot simply go in and take whatever they want, however they want. Groups could be fined for environmental destruction (a messy work site).

ENGAGE

4. Once the banker has verified the value of the minerals and it has been recorded on Resource Sheet 1 the student then needs to deposit the minerals in the appropriate location. Students need to pay particular attention to the value of that item at the time of delivery as that is what they will be paid for the item. This means students may wish to mine a particular resource and hold on to it for a while to see if its value increases. Once they have reached the banking table they cannot return to their mine site until the resources have been processed even if the price drops while they are there.

Teacher Note: The use of photographs and videos would be an excellent way to keep a record of student work throughout this task. These photographs could be displayed in journals and students could provide annotations about what is happening in each photo. It could assist them in the answering of questions at the end of the lesson.

5. As students are engaged in the mining exercise update information regarding the changing values in the resources they are mining. This could include things such as:

   - The value of …… has increased to …… due to a high demand for the resource
   - Oversupply of …… means the value has now dropped to …….
   - We need more …… to supply the manufacturing industry so the value has increased to …….
   - Technological advancements make the mining of …… more economically viable so it has now dropped to …….
   - New scientific benefits of … have now been discovered so the demand for …… has increased. It is now worth…….

   Remember to change the information on the display showing the value of different resources and alert the students to this change as it will impact on what they are mining for and how much they are being paid for that resource. A bell or something similar could be used to signal a change in price.

Teacher Note: The introduction of changing values during the mining task is representative of the fact that the value of resources is constantly changing due to supply and demand. When things are in high demand and are easily accessible the price of the commodity may decrease. When things are harder to access and the demand is high the value of the resource may increase.

6. Students continue to mine for the resources until the allocated time is up. Once they have tallied their final profits compare the profits across all groups in the class. Ask each team to discuss the following questions:
   - What might account for the differences between the amounts of money each team raised?
   - Are the resources renewable or non-renewable? Why?
   - How evenly were the resources distributed throughout the groups? How might this relate to the distribution of the Earth's resources?
   - What other things should be considered when mining for resources?
   - How has doing this task changed how you see things in regards to the mining of resources? How does this relate to what you have learned today?

7. Meet together as a class to share some of the responses to the previous questions. Ask students to record five points from the discussion in their journals. Encourage them to use the key words in their written responses and to respond to the key question - ***What is a resource and what factors help determine its sustainability?*** Record any new information or ideas on the key question display.

ENGAGE

A completed example of Resource Sheet 1

Names				
Resource		**Total**	**Value**	**Total value**
Type of resource	**Number of resources recovered**			
Sunflower seeds	𝍸 ||	7	$1	$7
Gold sequins	|	1	$500	$500
Sunflower seeds	|||	3	$10	$30
Millet seeds	||	2	$10	$20
				$557

Extension

Metallic items could also be mixed through the bird seed and bead mix. Students could use the money they have made from the mining of minerals to purchase new tools such as magnets and sieves to assist them in the recovery of the minerals.

This would link well with the separation of materials covered in the Chemical Science unit.

Birdseed and Bead Mining Tally Sheet

Names				
Resource		Total	Value	Total value
Type of resource	Number of resources recovered			

Lesson 3: A Sustainable Resource Investigation

EXPLORE/ELABORATE

Teacher Note: There are two investigations within the Elaborate phase of this unit. One investigates a non-renewable resource and the other investigates a renewable resource. The sustainable resource investigation is being introduced at this stage of the unit as it requires an extended period of time to complete. As you work your way through the unit this investigation will be running concurrently to the other activities students undertake. Students will require regular times throughout the unit to gather data. Students will use their results and engage in discussions and written tasks around the investigation at the elaborate phase later in the unit.

At a Glance:
To provide opportunities for students to investigate the sustainability of a resource.

Assessment Focus:
Summative assessment of the investigating outcomes is an important aspect of the Elaborate phase. It involves monitoring students' developing skills and understandings of the Science Inquiry Skills and the investigative process.

Assessment Opportunities – Summative Assessment:
- Participation in discussions
- Journal entries
- Presentation of investigation (in the Elaborate phase at the end of the unit)

Science Outcomes:
Students will be able to:
- Identify questions that can be investigated scientifically
- Plan, organise and conduct a long term investigation
- Summarise data and use scientific understandings to identify relationships and draw conclusions
- Communicate ideas, findings and solutions to problems using scientific language

Literacy Outcomes:
Students will be able to:
- Contribute to discussions
- Organise and present information in an appropriate format

Equipment for each team:
- A packet of fast growing seeds such as cress
- Cotton wool/paper towel
- Plastic plates

Equipment for each student:
- A copy of the scenario the investigation is based around – Resource Sheet 2
- A copy of Resource Sheet 3a, 3b and 3c. You may want to photocopy 3b and 3c as an A3 page so that there is more space for recording information.
- Science journal

Teacher Note: As part of the investigation students may choose to use another seed type or compare different seeds. You may decide to provide a variety of different seeds or the one seed type and ask students to supply other seeds if they wish to use them.

Teacher Background Information

Sustainable

Sustainability addresses the ongoing capacity of Earth to maintain all life. Sustainability is living within the limits of what the environment can provide. It is the ability of something to be maintained or sustained over very long periods of time. If something is sustainable it should be able to continue for ever. Sustainable patterns of living meet the needs of the present without compromising the ability of future generations to meet their needs. Actions to improve sustainability are both individual and collective endeavours shared across local and global communities. They necessitate a renewed and balanced approach to the way humans interact with each other and the environment.

This lesson enables students to develop an investigation into the sustainability of growing a particular type of seed. Students will be asked to investigate what requirements are needed to grow and maintain a sustainable crop of cress (or other seed type of their choice). It **is not** about growing seeds through the whole of their life cycle and then replanting seeds that have been generated through the growing of the initial crop. It **is** about determining what needs to be done to grow a crop of cress so that there is a continuous supply of cress available for a pre determined number of days.

> **Investigable question:** What needs to be done to ensure there is a constant supply of cress for 10 consecutive days allowing for at least 2 bales of cress per day?

In preparation for the successful completion of the investigation students will need to consider the following questions and undertake mini investigations prior to setting up their investigation into the investigable question.

- How long do cress seeds take to germinate and grow ready for harvest?
- How many seeds do you need to grow to get enough for two bales of cress?
- What constitutes a bale of cress?
- What conditions are best for growing cress seeds?

Teacher Note: These are all things that need to be tested **prior** to starting the investigation itself. The information from these questions will provide students with more direction for the final investigation.

Teacher Note: There is the opportunity for a class discussion around what constitutes a bale of cress. You could tell the students that a bale of cress is created by collecting enough pieces of 4cm cress and tying them with a piece of string so that the bale is at least 2 cm across. See photos below as an example. Or you could allow the students to determine what they think would be a reasonable amount for a bale of cress through their earlier mini investigations. This introduces the concept of controlling variables as the amount of cress collected by each team needs to be the same to keep the investigation fair.

Preparation

Organise the equipment needed for each cooperative learning team and an appropriate, safe place to keep the seeds as they are growing.

Organise copies of the planning sheets for each student – Resource Sheet 3a, 3b, 3c and the scenario – Resource Sheet 2.

Teacher Note: Resource Sheet 3d is not needed until the end of the investigations. Once all the data has been collected and recorded students will be asked to use graphs and tables to represent what has been harvested each day and how it was maintained.

Lesson Outline

Key words: questioning, predicting, planning, fair testing, variables, sustainable

1. Organise students into cooperative learning teams and present them with the scenario around the investigable question – Resource Sheet 2. Ask students to discuss exactly what it is they think the scenario is asking them to do. What are the main elements that need to be included in the investigable question?
    - Constant supply
    - 10 consecutive days
    - At least two bales of cress per day

    Introduce students to the investigable question and highlight the key pieces of information

2. Share these responses with the class and ensure all teams are clear about the requirements. By the end of the investigation (at the end of the unit) teams should be able to:
    - Provide a record of their activity within this investigation. For example on what days did they sow seeds? When did they water? How much did they water? When did they harvest the crop? How much did they get? What problems were there? How were they solved?
    - Provide a detailed plan of what is involved in growing a sustainable crop which provides a continuous supply of two bales of cress for 10 days in a row.

3. Once teams are clear on the requirements give them time to discuss their initial thoughts on what they think will need to be done to successfully achieve the task. What mini investigations may they need to undertake first in order to get the information necessary for the main investigation? In what order might they need to complete these mini investigations?
    - How long do cress seeds take to germinate and grow ready for harvest?
    - How many seeds do you need to grow to get enough for two bales of cress?
    - What constitutes a bale of cress?
    - What conditions are best for growing cress seeds?

4. Meet together as a class and go through Resource Sheet 3a and 3b with them. Discuss what sort of information could be recorded in each section. Work through these sections with the students giving them the time necessary to discuss their responses to each section in their teams before recording the information necessary.

Teacher Note: In order to develop a timeline of what needs to be done to successfully complete this investigation students will need to have a very clear idea of when the whole investigation needs to be completed. They will need their information from this investigation by the time they start the Elaborate phase of this unit. An example of what the timeline might look like has been included below.

EXPLORE/ELABORATE

5. Teams will then need to be given time to set up their main part of the investigation and then some time each day (ten minutes) to work through their plan and record the necessary information for their records. Information can be recorded on Resource Sheet 3c or students could establish pages in their journals. Remind students that photographs would be an excellent way of keeping records of what is happening. Students will have the remainder of the unit to complete this investigation so will need to follow their timeline for this to occur. They will be given time towards the end of the unit to organise their records, analyse the investigation and the data they collected and use their results to engage in discussions and written tasks around the investigation.

<u>An example of a possible timeline</u>

The timeline shown below is an example of a reverse timeline. Students start with the final completion date and work backwards from there listing the things that need to be done and the length of time they think they will need to complete it.

How are you going to investigate this?
What information will you need before you can start?
What things will you need to do first?
Develop a timeline of events that clearly shows what you will be doing and when you will be doing it in order to successfully complete the task

Date	What we will do	What we will need to do	
Friday Wk 7	Have all data gathered and all of the investigation completed	Complete record sheets Print photos	Record info daily about the plant growth and how we are managing it
Tues Wk 7	Completion of the 10 days harvesting	Complete record sheet Harvest seeds daily	
Fri Wk 5	Begin the 10 day growing cycle	Set up growing conditions Organise seeds Organise daily record sheet	
Fri Wk 4	Find out how long cress seeds survive before being harvested – do we need to grow a new batch each day or can we grow enough for several days harvesting	Grow some seeds and see how long they stay alive with just watering	
Wk 3	Find out how long cress seeds take to germinate ready for harvest Find out at what size cress is ready to harvest	Grow some seeds Record how long they take to grow ready to harvest	

A Sustainable Scenario

Australian scientists are currently researching ways to develop more sustainable crops and food sources to help feed our nation in a way that has minimal impact on the environment.

You have been employed by the CSIRO Plant Industry Division to investigate a new crop - *Lepidium sativum* and the conditions necessary for its successful, long term growth. Scientists are looking to determine whether or not the crop is sustainable and will meet the minimum feeding requirements.

This new crop needs to be germinated, grown and harvested within a short period of time and be able to sustain the harvesting of two bales every day for at least 10 days for it to be economically viable.

Your task is to work with your team of scientists to determine if this new crop - *Lepidium sativum* is going to meet the requirements put forward by the CSIRO. At the end of your investigation you will need to prepare a report based on the data you collect and your final conclusions.

S Tainable
Director
CSIRO Plant Industries

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S Tainable
Director
CSIRO Plant Industries

A SUSTAINABLE RESOURCE INVESTIGATION PLANNER

Name:_____ **Date:**_____

Other members of your team:_____

What question are you investigating?

What needs to be done to ensure there is a constant supply of cress for 10 consecutive days allowing for at least two bales of cress per day?

What do you think you will find out? Explain why.

Give scientific explanations for your prediction(s)

What equipment/resources will you need?

Use dot points

How are you going to investigate this?

What information do you need to know before starting the investigation and during the investigation?

Develop a timeline of events that clearly shows what you will be doing and when you will be doing it in order to successfully complete the task

Date	What we will do	What we will record

Record Keeping and Data Collection				

Use this page as a way of keeping a record of what you do towards your investigation. Date each entry and include as much detail as possible.

PROCESSING AND ANALYSING DATA

What were the results of your investigation? How can you represent your results in a way that others can easily understand? What is the data you collected to support your claim?

How successful was your investigation and how do you know? How could this investigation serve as a model for the production of crops?

Lesson 4: The Earth's Resources

EXPLORE

At a Glance:
To find out what students think they know about different resources.

Assessment Focus:
Formative Assessment is an important aspect of the Explore phase. It involves monitoring students' developing understanding and giving feedback that extends their learning.

Assessment Opportunities – Formative Assessment:
- Participation in discussions
- Journal entries
- Completed research pages
- Feedback and questioning

Science Outcomes:
Students will be able to:
- Record their current understandings of different resources

Literacy Outcomes:
Students will be able to:
- Contribute to discussions
- Participate in a hot potato exercise and record their understandings

Equipment for each student:
- An A3 piece of paper
- Science journal
- Access to the internet or appropriate reference materials

Teacher Background Information

Non-renewable

Natural resources can be sorted according to their renewability. A non-renewable resource is any resource that is formed over long periods of geological time. This includes minerals and fossil fuels. Since the formation of these resources is extremely slow they cannot be replenished once they have been used as they take too long to regenerate.

Renewable

A renewable resource can be regarded as a resource that can be replenished or regenerated in relatively short periods of time and can therefore be used and regenerated as needed. Examples of renewable resources include things such as plantation forests and wind power. If we cut down some trees to get the wood to produce paper we can plant more trees to replace the ones that have been used.

Renewable vs Sustainable

A renewable resource is only sustainable if we do not consume the resource at a greater rate than we can produce it. A fish population is a sustainable resource but only if we do not consume them at a rate quicker than they can reproduce and grow. For fish stocks to be sustainable we need to consider things such as how many we take from the ocean, the rate at which they reproduce, the stage of life of the fish we are allowed to capture, the time of year we can catch them and even where we can and cannot take them from. If we catch a lot of juvenile fish or females during the breeding season we may deplete the fish stock to such a point that it is no longer sustainable.

Preparation

Organise an A3 sheet of paper for each student. Even if some students have chosen the same resource to investigate they will need an A3 piece of paper each.

Organise access to the internet or resources from the library for students to use for part of this lesson.

Lesson outline

Key words: resource, sustainability, renewable, non-renewable

1. Ask the students to work with a partner and spend five minutes developing a list of questions about their resource that they would like to find answers to. Share these questions with the class and create a class list of possible questions. Possible questions include:

    - Where is it found?
    - How is it formed? Is it a natural or processed resource?
    - What is the supply like?
    - How important is it to our survival or the maintenance of our current lifestyle?
    - Is it renewable, non-renewable or sustainable?
    - How do we get it?
    - What is it used for?

2. Give each student a piece of A3 paper and ask them to record the name of their resource across the top. (This is the resource that they have chosen to investigate throughout the unit.) Give them some time to record everything they already know about their particular resource. They may use the questions developed earlier as a guide to the sort of information they could record. Ask students to rate their current level of understanding about their resource as level 1 - I have a lot of knowledge about my resource; level 2 – I have some knowledge about my resource or level 3 – I have limited knowledge about my resource.

3. Once they have completed this part of the task students will participate in a Hot Potato exercise.
    - **Hot potato** involves students starting with a particular question/topic and then giving them a short period of time to record their responses on the piece of paper. At the end of the time period the pieces of paper are passed on to the next group and students receive a new question to consider. Prior to doing any new recording they spend time reading the comments that are already on the sheet from the previous group or individual. Students then add any new information which will support or deepen the understanding around the concept or question.

4. Students are asked to clearly display their A3 sheets on their desks and then move to the table next to them. They should now be in front of a different resource sheet. Give them time to read what the other person has written and then add any new information that they know about that resource.

    Repeat this process three or four times so that students have the opportunity to add information to several different sheets within the room. Students then return to their original sheet to look at the information that may have been added by others.

5. Give the students time to share their sheets. This sharing time could be an informal opportunity for students to move around the room and see what other people have recorded. It is also another opportunity for students to add more information.

6. Provide students with time to further investigate their particular resource using reference materials including the internet. Revisit the final assessment task so students are clear about the sort of information they may be looking for in their research. Can they find answers to the questions used earlier this lesson? Can they find any other interesting or relevant information?

7. From their research did they find answers to all the questions? If not, why not? Revisit the definitions created earlier in this unit and ask students to consider how their resource fits with these definitions. Record their thinking in journals.

8. Ask students to now reconsider their level of knowledge about their resource. Are they now a 1, 2 or 3? Record three interesting facts about their resource, two things they know now that they didn't know before and one thing they would still like to find out.

9. Provide students with the time to share this information with others in the class. This sharing could be done as a stay and stray exercise where students form two concentric circles. They share their 3-2-1 facts with the person opposite them and then the people in the inner circle all move one person to the right while the people in the outer circle stay still. This then gives them a new person to share their information with. This process can be repeated as many times as you like. Record any new information or ideas on the key question and key words displays.

Lesson 5: What Do We Use?

EXPLORE

At a Glance:
To find out what students think they know about resources and how we use them.

Assessment Focus:
Formative assessment is an ongoing component of the Explore phase. It involves monitoring students' developing understanding and giving feedback that extends their learning.

Assessment Opportunities – Formative Assessment:
- Participation in discussions
- Completed flow chart

Science Outcomes:
Students will be able to:
- Demonstrate their understanding of the different resources needed to complete particular tasks
- Develop an understanding of the distribution and use of the Earths' resources

Literacy Outcomes:
Students will be able to:
- Contribute to discussions
- Complete a flow chart showing resources used to complete a daily task

Equipment for the class:
- An A3 copy of the quote on Resource Sheet 4. You may want each student to have an individual copy of this quote to use in their journals.
- Access to the list of different resources generated earlier in the unit

Teacher Background Information
The current world rate of use of many resources is not sustainable. If this continues it means that future generations will not have access to the resources we have available to us today. Unsustainable resource use can also cause environmental damage. Scientists are currently researching more sustainable production and consumption methods. This involves looking at things such as alternative energy sources, ways to increase the productivity of resource recovery and cleaner, more efficient technologies.

There is currently a global inequality in the consumption and use of resources. Information from the World Bank Development Indicators in 2008 shows that the wealthiest 20% of the world account for the private consumption of 76.6% of the Earth's resources whilst the world's poorest 20% consume just 1.5%. The following websites contains other statistics about the consumption of resources around the world.

http://www.globalissues.org/issue/235/consumption-and-consumerism

http://www.worldwatch.org/node/810

Lesson outline
Key words: resource, sustainability, renewable, non-renewable

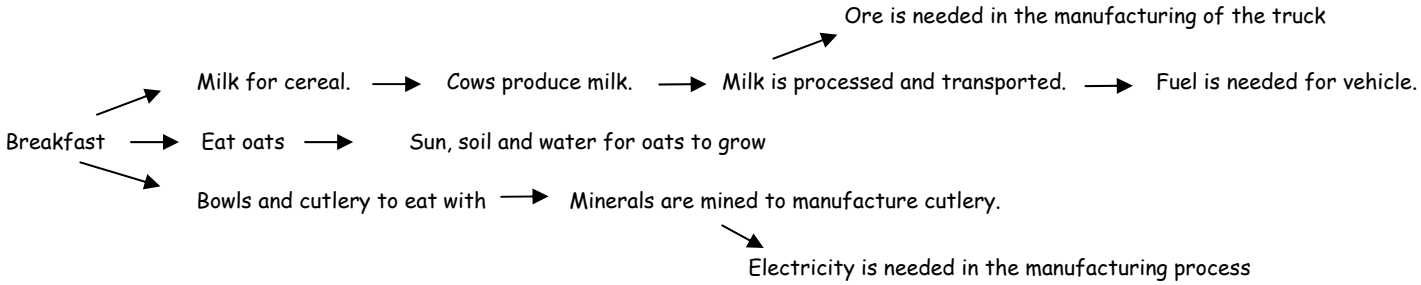
1. Remind students of the key question - ***What is a resource and what factors help determine its sustainability?*** Revisit the key points recorded in response to the question and the key words.

2. Explain to students that they are about to track the resource used in an everyday activity. Initially this will be done as a class and then students will be asked to create their own flowcharts of resources used.

EXPLORE

3. Revisit the list of resources generated earlier in the unit and ask the students to identify which of these resources they think may have been needed to help produce the breakfast that they had this morning. Make a list of these resources on the board and ask each student to explain their thinking behind why that resource was important in the production of their breakfast.

4. As a class start to create a flowchart of resources like the example below. This example does not include all resources used to produce breakfast. It can and should be extended by students if they choose the breakfast option to use later in the lesson.



5. Once students understand the concept and have made sense of the example ask them to choose a daily task or activity of their own and complete a resources flow chart for this activity.

6. Display and share the completed flow charts and discuss the number of resources that are needed to enable us to complete an everyday task. Engage in discussions around how this may vary from country to country. For example what might a flow chart for breakfast look like if you lived in a developing nation? How many resources do you think we use on a daily basis compared to a developing nation?

7. Share the quote on Resource Sheet 4 with the class. What do they think it means? Organise the class into three groups – 20%, 20% and 60% to represent the numbers in the quote. Have 100 counters to disperse amongst the three groups according to the statistics in the quote. The top 20% get 76.6 counters, the bottom 20% get 1.5 counters and the remaining counters go to the 60% of students in the middle group. Explain to the students that the counters represent the resources used throughout the world and the consumption of them. How does this link back to the resources flow chart and the discussion they had comparing countries? What are the possible implications?

8. Ask the students to talk with a partner in response to the following questions
    - What was it like from your perspective?
    - What would it be like from someone else's perspective?
    - How does this task link back to the birdseed and bead mining task?

9. Try to determine what might be some reasons for the worldwide consumption of resources to be like this? Why is it so inequitable? Should it be more equitable? What might some consequences be if we were to insist on a more equitable consumption of resources?

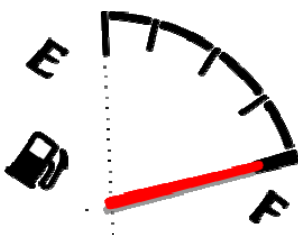
10. Give students time to record responses to discussion questions in their journals.

Extension
Other curriculum links

Write a short piece (200 - 250 words) on what life would be like without their resource e.g. life without electricity. These pieces could be the focus for English lessons and could be developed into fully edited pieces of work which can be assessed from a written text perspective.

Students could create a pie graph to graphically represent the figures in the quote.

“The wealthiest 20% of the world accounts for 76.6% of total private consumption. The poorest fifth just 1.5%”



Source: World Bank Development Indicators 2008

Lesson 6: Water

EXPLORE

At a Glance:
To find out what students think they know about water and the water cycle.

Assessment Focus:
Formative assessment is an ongoing component of the Explore phase. It involves monitoring students' developing understanding and giving feedback that extends their learning.

Assessment Opportunities – Formative Assessment:
- Participation in discussions
- Journal entries
- Network response sheet – Resource Sheet 6

Science Outcomes:
Students will be able to:
- Follow a scientific procedure
- Record and develop their current understanding of the water cycle

Literacy Outcomes:
Students will be able to:
- Contribute to discussions
- Read a procedural text

Equipment for each team:
- A large, clear bowl
- A small glass
- Cling wrap
- An orange coloured soft drink
- A small rock or lump of plasticine

Equipment for each student:
- Science journal
- A copy of Resource Sheets 5 and 6

Teacher background information
The water cycle is the simplest natural cycle on Earth and the water we have here on Earth is constantly recycled over and over again.. The sun's heat evaporates the water from the oceans, rivers and lakes. Millions of litres of water vapour rise into the atmosphere as a clear and colourless gas.

As this water vapour is moved by the winds back over the land and up over mountains it rises and cools turning back into water droplets and forming clouds. This process is known as condensation. These droplets fall back to earth as precipitation. Some of this water enters the soil (infiltration) where it may be used by plants. Through the process of transpiration the water contained in the plants is converted to vapour and returned to the atmosphere where the cycle continues. The water in the soil that is not utilised by plants permeates the soil where it eventually becomes groundwater and is contained in aquifers. The remaining water runs off the surface of the ground and flows into rivers, lakes and oceans and the process starts all over again.

EXPLORE

http://www.sawater.com.au/SAWater/Education/OurWaterSystems/The+Water+Cycle.htm contains a useful labelled diagram

http://www.teachers.ash.org.au/jmresources/water/cycle.htm (this links to a website with lots of links to the water cycle)

http://www.epa.gov/safewater/kids/flash/flash_watercycle.html

http://www.actewagl.com.au/education/_lib/Flash/Water_cycle/water.swf

http://earthguide.ucsd.edu/earthguide/diagrams/watercycle/index.html

Evaporation
Evaporation is a process where water is converted from its liquid form to a vapour form. This enables the water to be transferred from the land into the atmosphere. The rate of evaporation depends on temperature, wind speed and humidity.

Transpiration
Transpiration is the process where the water stored in plants is changed to vapour and released in the atmosphere.

Condensation
Condensation is the process where water changes in state from a vapour to a liquid.

Precipitation
Precipitation is any form of water that falls to the Earth's surface. Different forms of precipitation include rain, sleet, snow and hail.

Groundwater
Groundwater is water that has 'gone' underground. If you travel underground you would eventually reach an area where all the rock around you is soaked with water. This is the saturated zone and is called an aquifer. Some of the precipitation that falls onto the ground soaks into the ground and flows down into the aquifer. The height of the water in this zone is known as the water table. The height of the water table can vary from place to place. Sometimes it is shallow or sometimes it is very deep.

Aquifer
An aquifer is a body of rock or sediment that stores and transmits large amounts of groundwater. When the underground water deposits are large enough to be considered sustainable for use, they are known as aquifers. The water is stored in the spaces between the particles that make up the rocks and the sediment. The rocks and sediment in an aquifer must be both permeable and porous. Porosity is the measure of the amount of space within the rock and permeability is the measure of how easily the water moves through the porous material. Aquifers are **not** giant underground lakes and rivers.

Run off
Water that does not infiltrate the ground runs off across the surface. This run off contributes to streams and rivers where it will eventually flow into lakes or the ocean.

Infiltration
Infiltration is when the water that falls as precipitation enters the soil. This water then becomes ground water and is stored in aquifers.

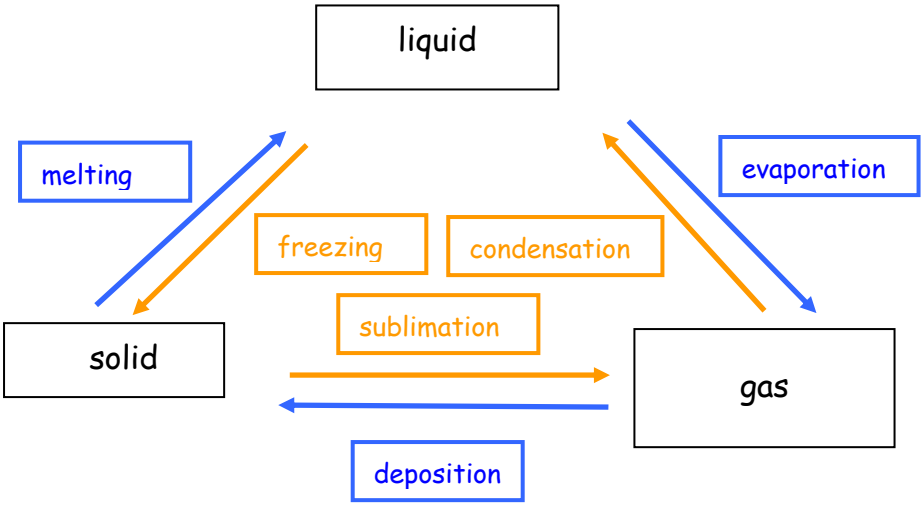
Distillation

EXPLORE

Distillation is a process used to separate substances based upon the different conditions required to change them from one state of matter to another. For example to separate two different liquids the liquid can be heated to force the components apart as they change from a liquid to a gas state at different temperatures. In this process the gas is collected and condensed back to a liquid. Crude oil is distilled to produce petrol. Crude oil is heated and because the different components have different boiling points they are able to be separated using heat. The same is true when distilling alcohol and water. Ethyl Alcohol (the type in alcoholic beverages) boils at a little over 78°and water boils at 100°. This means because of the different boiling points they can be separated through distillation.

The Solar Still

By following the procedure on Resource Sheet 5 students are creating a solar still which produces distilled water from the soft drink. The distillation process separates the water from the other components of the soft drink by heating the water to the point at which it evaporates and leaves the other components behind in the solution. The evaporated water condenses on the plastic cling wrap and returns to a liquid state. These droplets of water are directed into the glass jar sitting inside the bowl where they are collected. The end result is a jar of distilled water and the other components of the solution – sugar and flavourings etc are left behind in the original bowl. This liquid will be darker in colour and have a stronger sugar concentration.



The above representation shows the link between the water cycle and the three states of matter. It also includes the science terminology involved in changing from one state of matter to another.

Preparation

Ensure all equipment is readily accessible to students. If students are notified in advance then each team could become responsible for sourcing their own equipment from home.

Lesson outline

Key words: water cycle, evaporation, condensation, precipitation, solid, liquid, gas, resource, sustainability, renewable, non-renewable

1. Organise students into cooperative learning teams and explain that water is a resource critical to the survival of all living things and that water moves through a cycle. Remind them of the key question - ***What is a resource and what factors help determine its sustainability?*** Ask them to consider if water is a renewable or non-renewable resource? Is it sustainable and what factors help determine its sustainability.

2. Ask students to record what they already know about the main features of the water cycle?

EXPLORE

> **Teacher Note:** This will then help direct how much time you need to spend on this to ensure all students have a sound understanding of the key components of the water cycle.

3. Share these understandings with the class and explain to them that they are about to undertake an activity which simulates the water cycle in action within a closed system. Provide each team member with a copy of Resource Sheet 5 and give them time to read through the procedure and discuss any concerns.

4. Meet as a class to ensure all teams have a sound understanding of the procedure involved and any safety implications that may apply. Ask students to predict what they think will happen and reasons why. Record this information in journals and share with the rest of the class or in small groups.

5. Provide the teams with the time necessary to follow the procedure and set up the activity. Observe what is happening over time, reminding students that this activity will take time and the cooler the weather is, the longer it will take to have any effect. This could become a discussion point.

> **Teacher Note:** This activity obviously works best on days with direct sunlight.

6. Once results have been observed, collected and recorded in journals give each student a copy of Resource Sheet 6. Explain to students that they will have three minutes per question to record their responses. These responses are intended to be quick responses to assist them in the discussion stage of this task. Provide students with the three minutes per box necessary to complete the sheet.

> **Teacher Note:** Some other possible examples of the water cycle in students' lives include:
> - In the bathroom when the mirrors and windows steam up
> - In a car when the inside of the windows steam up
> - Boiling a kettle. If the kettle is boiling near a window or cupboard surface you can often see the condensation appearing.
> - Evaporation of water from ponds and swimming pools during periods of warmer weather
> - Glasses fogging up in particular conditions
> - Condensation trails behind aeroplanes (contrails)

7. Once the sheet is completed ask students to find someone that they have not spoken to that day and discuss their responses to the first prompt question on Resource Sheet 6. Students can add any extra information to their notes as they are engaging in the quick discussion. After a predetermined amount of time signal the class to find someone else that they haven't spoken to that day,

   With the new partner ask the students to discuss the responses to the second of the prompt questions. Repeat this process until all of the prompt questions have been discussed.

   Meet together as a class and randomly ask students to share their thoughts and responses to the prompt questions.

Teacher note: Discuss how this closed system can be used as a survival technique. How could you use the principles of the activity you have just completed to help you get water if you are lost with no access to a water source?

Students could be presented with the scenario of being lost with no access to a water source and a limited supply of materials. Can they use those materials to set up a closed environment that they might construct if they were lost and didn't have any access to a water source? What could they do?

www.csiro.au/scope/activities.htm This is a video link showing the activity in action. Go to **chemistry – distillation** to view the video. It may be useful if things don't go as planned or as a way of ensuring all students have the same idea of how to follow the procedure.

Extension

Set up a scientific investigation trying other water based drinks or the same drink using different sized containers, different weather conditions etc.

Distilling Water

Equipment

- A large glass bowl
- A small drinking glass
- A bottle of orange coloured soft drink
- Cling wrap
- A lump of plasticine/small rock

Procedure

1. Pour 750 ml of soft drink into the bowl.
2. Place the glass in an upright position in the centre of the bowl. The top of the glass should be lower than the rim of the bowl but higher than the level of the soft drink.
3. Place the cling wrap over the top of the bowl and ensure it is tight and well sealed.
4. Place the lump of plasticine in the centre of the cling wrap. This should form a slight depression in the cling wrap. Ensure the plasticine is directly over the centre of the glass.
5. Place the bowl outside in bright sunlight or in the warmest spot you can find.
6. Leave the bowl in place for several hours and observe what happens.

Networking Session Prompt

What happened? Why do you think it happened?	How accurate were your predictions? What else happened that you didn't predict?
How does this activity relate to the water cycle?	**What other examples of the water cycle have you experienced or seen in your life?**

Lesson 7: The Water Cycle

EXPLAIN

At a Glance:
To find out what students think they know about water and the water cycle.

Assessment Focus:
Formative Assessment is an important aspect of the Explain phase. It involves monitoring students' developing understanding and giving feedback that extends their learning.

Assessment Opportunities – Formative Assessment:
- Participation in discussions
- Think, Pair, Display,Share representation
- Annotated diagram or movement story
- Journal entries

Science Outcomes:
Students will be able to:
- Demonstrate their understanding of the water cycle through an annotated diagram/movement story/storyboard

Literacy Outcomes:
Students will be able to:
- Contribute to discussions
- Complete an annotated diagram/movement story/storyboard

Equipment for the class:
- A large copy of each of the key words

Equipment for each student:
- Science journal

Teacher background information
Water cycle
The water cycle is the simplest natural cycle on Earth and the water we have here on Earth is constantly recycled over and over again.. The sun's heat evaporates the water from the oceans, rivers and lakes. Millions of litres of water vapour rise into the atmosphere as a clear and colourless gas

As this water vapour is moved by the winds back over the land and up over mountains it rises and cools turning back into water droplets and forming clouds. This process is known as condensation. These droplets fall back to earth as precipitation. Some of this water enters the soil (infiltration) where it may be used by plants. Through the process of transpiration the water contained in the plants is converted to vapour and returned to the atmosphere where the cycle continues. The water in the soil that is not utilised by plants permeates the soil where it eventually becomes groundwater and is contained in aquifers. The remaining water runs off the surface of the ground and flows into rivers, lakes and oceans and the process starts all over again.

EXPLAIN

http://www.sawater.com.au/SAWater/Education/OurWaterSystems/The+Water+Cycle.htm contains a useful labelled diagram

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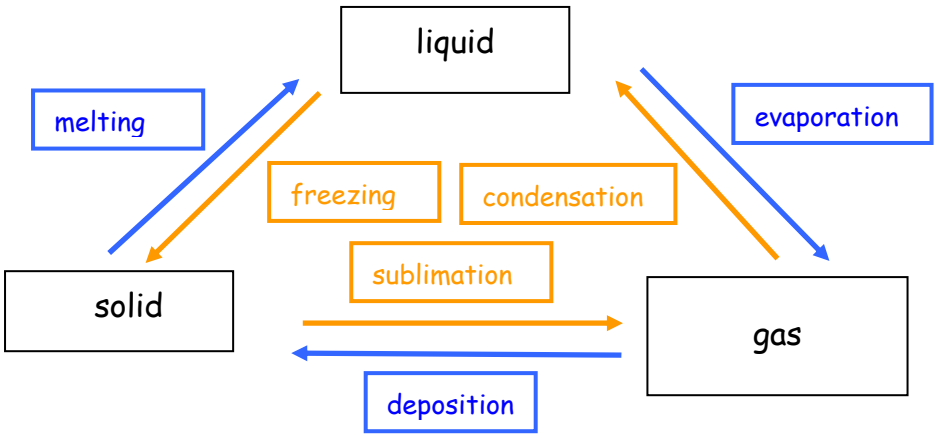
http://www.epa.gov/safewater/kids/flash/flash_watercycle.html

http://www.actewagl.com.au/education/_lib/Flash/Water_cycle/water.swf

http://earthguide.ucsd.edu/earthguide/diagrams/watercycle/index.html

http://www.sawater.com.au/SAWater/Education/OurWaterSystems/The+Water+Cycle.htm

http://www.derm.qld.gov.au/waterwise/education/index.html



The above representation shows the link between the water cycle and the three states of matter. It also includes the science terminology involved in changing from one state of matter to another.

Evaporation
Evaporation is the process where water is converted from its liquid form to a vapour form. This enables the water to be transferred from the land into the atmosphere. The rate of evaporation depends on temperature, wind speed and humidity.

Transpiration
Transpiration is the process where the water stored in plants is changed to vapour and released in the atmosphere.

Condensation
Condensation is the process where water changes in state from a vapour to a liquid.

Precipitation
Precipitation is any form of water that falls to the Earth's surface. Different forms of precipitation include rain, sleet, snow and hail.

Groundwater
Groundwater is water that has 'gone' underground. If you travel underground you would eventually reach an area where all the rock around you is soaked with water. This is the saturated zone and is called an aquifer. Some of the precipitation that falls onto the ground soaks into the ground and flows down into the aquifer. The height of the water in this zone is known as the water table. The height of the water table can vary from place to place. Sometimes it is shallow or sometimes it is very deep.

EXPLAIN

Aquifer
An aquifer is a body of rock or sediment that stores and transmits large amounts of groundwater. When the underground water deposits are large enough to be considered sustainable for use, they are known as aquifers. The water is stored in the spaces between the particles that make up the rocks and the sediment. The rocks and sediment in an aquifer must be both permeable and porous. Porosity is the measure of the amount of space within the rock and permeability is the measure of how easily the water moves through the porous material. Aquifers are **not** giant underground lakes and rivers.

Water table
The water table is the upper limit of the saturated zone of water found below the surface. The height of the water table can vary from place to place. Sometimes it is shallow or sometimes it is very deep.

Run off
Water that does not infiltrate the ground runs off across the surface. This run off contributes to streams and rivers where it will eventually flow into lakes or the ocean.

Infiltration
Infiltration is when the water that falls as precipitation enters the soil. This water then becomes ground water and is stored in aquifers.

Distillation
Distillation is a process used to separate substances based upon the different conditions required to change them from one state of matter to another. For example to separate two different liquids the liquid can be heated to force the components apart as they change from a liquid to a gas state at different temperatures. In this process the gas is collected and condensed back to a liquid. Crude oil is distilled to produce petrol. Crude oil is heated and because the different components have different boiling points they are able to be separated using heat. The same is true when distilling alcohol and water. Ethyl Alcohol (the type in alcoholic beverages) boils at a little over 78°and water boils at 100°. This means because of the different boiling points they can be separated through distillation.

Preparation
Organise a large copy of each of the key words to be used for display purposes.

Lesson outline
Key words: water cycle, evaporation, transpiration, condensation, precipitation, run off, infiltration, ground water,

1. Revisit the activity involving the distillation of water in a closed system completed in the last lesson. Place students in pairs and explain to them that they are going to engage in a Think, Pair, Display, Share task.

    a. **Think**: Provide students with time to individually reflect on the previous task of distilling water. What was it they did? What happened and why? What are the main features of the water cycle?

    b. **Pair:** Organise the students into pairs and ask them to share their thoughts and responses to the questions with each other. Give them five minutes to prepare a written/visual display of their idea of the main features of the water cycle.

    As a class look at the key words identified at the start of this lesson and ask students if they can place any of these words into their visual representation of the water cycle e.g. what is condensation and at what stage of the water cycle does it fit? At this stage they may not understand the meaning of all of the words.

EXPLAIN

c. **Display:** Display the visual representations around the room and provide students with the opportunity to walk around the room and take a look at the other examples.

d. **Share:** Get students to collect their visual representations and organise the pairs into groups of four. Ask them to share their representations and explain to the group why they placed the labels in the places they did. What key words were missing from their representation? What would they need to add to the diagram so that they are able to include all of the key words? What changes would they now make to their diagram?

2. Meet together as a class and discuss the meanings of the key words and where they fit within the water cycle. Use the representations of the students to co-construct a class representation of the water cycle using all of the key words.

3. Once you have discussed each of the key words and created a class representation ask the students to choose one of the following ways to represent their new learning.

   - Create an annotated diagram of the water cycle using the key words

   An **annotated diagram** is a representation used to illustrate particular functions of parts of an object. The diagram includes an accurate drawing, a title, a date and notes to help explain each part. A line or arrow connects the annotation to the part it describes. In this case students draw diagrams showing what happens to water as it moves through the cycle. They include annotations (notes) to help explain what is happening.

   Or

   - Work in small groups to create a movement story which explains the water cycle and what happens within it.

   A **movement story** is a representation of the water cycle through movement. Groups of students act out what happens to the water as it moves through the cycle.

   Or

   - Make a storyboard showing the features of the water cycle

   A **storyboard** is used to identify key events and represent them in sequential order. It includes a title, drawings showing important details, descriptive captions and numbers to indicate the sequence of the steps.

4. Share annotated diagrams/movement stories/storyboards with the rest of the class.
   - Does their representation pick up on the cyclical nature of water?
   - Does their presentation make clear connections between all the elements of the cycle?
   - Have they included all of the key words?
   - Is the use of the key words scientifically accurate?

5. Record a response to the following in journals.

   - What are the similarities and differences between the distillation process you completed and the water cycle?

Below are some websites that may help further develop students understanding of the water cycle.

EXPLAIN

http://www.teachers.ash.org.au/jmresources/water/cycle.htm (this links to a website with lots of links to the water cycle)

http://www.epa.gov/safewater/kids/flash/flash_watercycle.html

http://www.actewagl.com.au/education/_lib/Flash/Water_cycle/water.swf

http://earthguide.ucsd.edu/earthguide/diagrams/watercycle/index.html

http://www.sawater.com.au/SAWater/Education/OurWaterSystems/The+Water+Cycle.htm

http://www.derm.qld.gov.au/waterwise/education/index.html

Teacher note: http://tinyurl.com/6lhgaqk a game that involves students taking on the role of a drop of water within the water cycle. It is another way of physically involving students in the features of the water cycle.

Extension

Have students create their own games involving the water cycle as a way of demonstrating their understanding and challenging their thinking.

Lesson 8: Earth's Water Distribution

EXPLAIN

At a Glance:
To find out what students think they know about the distribution of water throughout the world.

Assessment Focus:
Formative Assessment is an important aspect of the Explain phase. It involves monitoring students' developing understanding and giving feedback that extends their learning.

Assessment Opportunities – Formative Assessment:
- Participation in discussions
- Journal entries
- Visual representation

Science Outcomes:
Students will be able to:
- Explain how water is distributed throughout the world
- Identify factors that impact on the sustainability of water

Literacy Outcomes:
Students will be able to:
- Contribute to discussions
- Complete a visual representation of the distribution of water throughout the world

Equipment for each student:
- Science journal
- Resource Sheet 7
- Sticky notes

Teacher background information
The first part of this lesson is for the students to develop an understanding of the distribution of the worlds' water. In what form is most of the water found in the world?

The second part of the lesson is looking at the inequity of water availability and use around the world.

Water distribution information
Water is a finite resource. The water the dinosaurs drank millions of years ago is the same water that falls as rain today. As it continuously goes through a cycle there should always be water available for consumption. This may change if we pollute the limited supply we have and it becomes unsuitable for human consumption or if we use water at a rate that is faster than it becomes available through the natural cycle.

Distribution of the world's water

- Just over 70% of our Earth is covered by water
- Of this 97% of all water on Earth is salt water in the oceans leaving 3% as fresh water
- Nearly 70% of that 3% fresh water is frozen in the ice caps of Antarctica and Greenland
- Most of the remaining fresh water is present as soil moisture or lies deep in underground aquifers and is not accessible for human use
- Less than 1% (0.3%) of the world's fresh water is found in lakes and rivers. This is where most of the water we use in our everyday life comes from.

Source: http://www.freedrinkingwater.com/water_quality/earth-water-distribution.htm

EXPLAIN

Access to water

Almost fifty per cent of the developing world's population – 2.5 billion people – lack improved sanitation facilities of which water is a necessary component, and over 884 million people still use unsafe drinking water sources.. In some countries half the population does not have access to safe drinking water and therefore suffers from poor health. Lack of clean water is responsible for many deaths on a daily basis.

Source: Unicef http://www.unicef.org/wash/ Updated: 9 February 2012

It is not that there is not enough water in the world to support everyone. It is the fact that water is not distributed evenly throughout the world. It is not always located were it is needed most. For example Canada has plenty of water for its population size while northern Africa suffers from constant shortage. There is not enough water to support the population and the water that is there is not always safe for human consumption or located in an easily accessible place. Even within a specific country such as Australia some parts can have plenty of water whilst other parts can suffer from lack of water.

http://www.youtube.com/watch?v=I9cwMOICI-A world vision water advertisement
http://www.youtube.com/watch?v=mP3ZYL0FjN0 world vision water advertisement

Preparation

Organise a copy of Resource Sheet 7 for each student

Lesson outline

Key words: sustainable, renewable, non-renewable, resource

1. Ask students to discuss the following questions with a partner.
   - Where is the Earth's water located?
   - In what forms does water exist?

   Meet together as a class to build a cumulative list of responses to these two questions.

Where is the Earth's water located?
- Rivers, lakes and streams
- Oceans
- Icecaps
- In underground aquifers
- Within animals and plants
- Soil moisture

In what forms does water exist?
- Solid – ice caps
- Liquid
- Fresh water
- Salt water
- Gas – water vapour

2. Give each student a copy of Resource Sheet 7 and the time necessary to read it through. Ask students to think about responses to the following questions.
   - What does this tell us about the amount of water we have available for human consumption?
   - Where is most of the world's fresh water located?
   - What are some of the implications of this information? What does this mean for the way we look after the water we have?

Possible implications

The majority of the world's water is not accessible for human consumption as it is frozen in polar ice caps or is found as salt water in the ocean.
Only a small amount of water is actually available for consumption. We need to look after this limited supply.

EXPLAIN

3. Organise students into cooperative learning teams and ask them to share their responses to the questions. Have them create a visual representation of the information on Resource Sheet 7. This may be in the form of column or pie graphs, as an annotated diagram or in any other way that the students can find to visually represent the distribution of the Earth's water.

4. Display these visual representations and then meet together as a class to discuss the factors that might impact on the sustainability of water. Link the discussion back to the key question – ***Is water a renewable or non-renewable resource? What factors help determine its sustainability?*** After the discussion ask students to record a response to this question in their journals.

5. View one of the following videos which look at the inequity of water availability and use around the world.
   http://www.youtube.com/watch?v=I9cwMOICI-A world vision water advertisement

   http://www.youtube.com/watch?v=mP3ZYL0FjN0 world vision water advertisement

6. Provide students with the opportunity to process their thinking through a Quick-Write task. Ask students to jot down their reflections on the following - How might things be different if water was distributed equitably throughout the world?

   A **quick-write** is an opportunity for students to reflect on what they are learning by engaging in a quick three minute writing task. It is a brief activity that can be inserted at almost any point within a lesson. Students are provided with a prompt which is selected by the teacher. They are then given a specified amount of time to collect their thoughts and jot down a response. This is then followed up with an effective strategy for the students to share their ideas.

7. Once students have completed their writing ask them to highlight three key points or ideas and record these on sticky notes which can then be displayed around the room. Students are then given the opportunity to go around the room reading the responses of others.

8. Conclude the lesson with an opportunity for students to share some of their thoughts and ideas with the class.

Extension

Students could investigate the costs involved in different sources of water and whether or not there is a difference in taste. Does the more expensive water source taste any different/better than the less expensive? Provide students with samples of water from different sources – tap water, filtered tap water, expensive bottled water, spring water etc and set up a blind taste test to see if they can identify the different types of water. Look at the costs of each source of water per litre. How much are we actually paying per litre for water? Is it worth it? What would it cost over five or ten years?

Websites that investigate the costs involved in bottled water

http://www.pacinst.org/topics/water_and_sustainability/bottled_water/

http://20somethingfinance.com/bottled-water-versus-tap-water/

DISTRIBUTION OF THE WORLD'S WATER

- Just over 70% of our Earth is covered by water
- Of this 97% of all water on Earth is salt water in the oceans leaving 3% as fresh water
- Nearly 70% of that 3% fresh water is frozen in the ice caps of Antarctica and Greenland
- Most of the remaining fresh water is present as soil moisture or lies deep in underground aquifers and is not accessible for human use
- Less than 1% (0.3%) of the world's fresh water is found in lakes and rivers. This is where most of the water we use in our everyday life comes from.

Source: http://www.freedrinkingwater.com/water_quality/earth-water-distribution.htm

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Source: http://www.freedrinkingwater.com/water_quality/earth-water-distribution.htm

Lesson 9: The Earth's Resources

EXPLAIN

At a Glance:
To support students' understanding about their chosen resource.

Assessment Focus:
Formative Assessment is an important aspect of the Explain phase. It involves monitoring students' developing understanding and giving feedback that extends their learning.

Assessment Opportunities – Formative Assessment:
- Participation in discussions
- Journal entries

Science Outcomes:
Students will be able to:
- Explain how their resource is formed
- Identify resources that can and are used again in some way
- Explain why a resource may not be sustainable
- Use scientific evidence to support an argument

Literacy Outcomes:
Students will be able to:
- Contribute to discussions
- Write a brief argument/response to a particular statement

Equipment for each student:
- Science journal to record information
- Access to resource material such as text books and the internet

Teacher Background Information

Renewable

A renewable resource can be regarded as a resource that can be replenished or regenerated in relatively short periods of time and can therefore be used and regenerated as needed. Examples of renewable resources include things such as plantation forests and wind power. If we cut down some trees to get the wood to produce paper we can plant more trees to replace the ones that have been used.

Sustainable

Sustainability is living within the limits of what the environment can provide. It is the ability of something to be maintained or sustained over very long periods of time. If something is sustainable it should be able to continue for ever. Sustainability is about meeting the needs of the present without compromising the needs of those people in the future that will also need access to the same resources some time in the future.

Renewable vs Sustainable

A renewable resource is only sustainable if we do not consume the resource at a greater rate than we can produce it. A fish population is a sustainable resource but only if we do not consume them at a rate quicker than they can reproduce and grow. For fish stocks to be sustainable we need to consider things such as how many we take from the ocean, the rate at which they reproduce, the stage of life of the fish we are allowed to capture, the time of year we can catch them and even where we can and cannot take them from. If we catch a lot of juvenile fish or females during the breeding season we may deplete the fish stock to such a point that it is no longer sustainable.

Preparation

Organise access to the internet or resources from the library for students to use for this lesson.

EXPLAIN

Lesson outline

Key words: cycle, resource, sustainable, renewable, non-renewable

1. Remind students of the key question - ***What is a resource and what factors help determine its sustainability?*** Revisit the key words and ask the students to share their understanding of the similarities and differences between the words renewable and sustainable. Share responses.

2. Revisit and discuss the fact that the class has been exploring water as a resource, looking at the water cycle and what might impact on the sustainability of water as an example. Now they are going to further investigate their own resource.

3. Give students the time needed to further investigate their chosen resource. Can they find information to help them answer the questions they developed earlier which may or not include the following:

    - How is the resource formed?
    - Is the resource able to be used again in some way?
    - Is the resource sustainable and is so what factors impact on its sustainability?

> **Teacher Note:** All of the information gathered from this research time will go towards assisting the students in the preparation of their argument as part of the final evaluate phase of the unit.

4. After appropriate research time ask the students to choose one of the following statements.

    "_____ is renewable so we can use as much as we want"

    OR "All the _____ that will ever be is right now"

    Students need to write a response to the statement in relation to the resource they have chosen. They need to include at least three key points to validate or justify their claims. They can agree or disagree with the statement and need to use scientific language and knowledge to support their arguments.

    Things to consider in the development of this written response may include

    - Is the resource renewable or non-renewable?
    - What does renewable mean?
    - What time scale is needed for the regeneration of the resource?
    - How does this link to sustainability?
    - How accessible is the resource?
    - How much of the resource are we consuming compared with how quickly and easily we can access it?

5. Organise students into cooperative learning teams and provide them with the opportunity to share their opinions in relation to the statements.

6. Present the following questions to the students.

    - How are renewable and sustainable the same?
    - How is sustainable different to renewable?

7. Ask them to work individually or with a partner to record their thoughts/ideas in response to the two questions. Provide students with an opportunity to share their responses with others. This could be done as a think, pair, share.

Lesson 10: Investigating Non-Renewable Resources

ELABORATE

At a Glance:
To provide students with the opportunity to develop an investigation into a non-renewable resource

Assessment Focus:
Summative assessment of the investigating outcomes is an important aspect of the Elaborate phase. It involves monitoring students' developing skills and understanding of the Science Inquiry Skills and the investigative process.

Assessment Opportunities –Summative Assessment:
- Participation in discussions
- Journal entries
- Investigation planner
- Investigation results and conclusions

Science Outcomes:
Students will be able to develop an investigation into non-renewable resources by
- Identifying questions appropriate for investigation
- Making predictions based on their current understandings
- Planning and conducting an investigation
- Summarising their data and representing their findings
- Evaluating their investigation
- Communicating their findings using scientific language

Literacy Outcomes:
Students will be able to:
- Communicate their findings in an appropriate form
- Use science terminology in their writing and discussions

Equipment for each team:
- Chocolate chip cookies – the type and number of cookies is dependent on the type of investigation being undertaken
- Sharp implements for the removal of the chocolate chips – paperclips, a drawing compass, tweezers
- Recording sheet – Resource Sheet 8

Equipment for each student:
- Journals

Safety Note: Make students aware of the potential hazards involved with working with sharp implements. Ensure appropriate safety concerns are identified and addressed.

Teacher Note: Students could be involved in making their own chocolate chip cookies for this investigation. This would be an opportunity to follow a procedural text, measure accurately and have a context for cooking.

Teacher background information

Mining involves complex processes in which relatively small amounts of useful resources are removed from the Earth's crust.

Using the chocolate chip mining investigation is a way for students to engage in a form of mineral recovery (mining chocolate chips) and the challenges they face in this investigation are representative of some of the issues faced by the mining industry.

Mining does not recover all of the minerals deposited in a particular area. Companies generally only continue extracting minerals whilst it is economically viable to do so. They do not take all the minerals due to cost, environmental and demand factors. Sometimes it is not economically viable to recover all of the resource from the ground so it is left where it is.

Resources are not distributed evenly throughout the Earth. Some resources are accessible and it is economically viable to recover them whilst other pockets of the same resource may be too difficult to access so therefore they are not mined. The cost of transporting the raw materials to a processing site must also be taken into consideration when deciding if something is economically viable. Resources are not always located in easily accessible sites close to processing plants.

Other implications for mining may include:

- Government rules and regulations
- Whether or not the land is of cultural significance to Aboriginal people,
- Heritage listings
- Historical significance
- Whether it is located near major communities which may make access difficult.

Preparation

Organise access to equipment that is needed for the investigation

Lesson outline

Key words: questioning, predicting, planning, fair testing, variables, resource, sustainability, distribution, renewable, non-renewable

1. Review students' current understanding with regards to the question - ***What is a resource and what factors help determine its sustainability?*** Revisit the class recordings in response to this question and spend time discussing the different activities they have done so far and how these have assisted in developing their understanding of the question.

2. Explain that the students will be working in cooperative learning teams to conduct an investigation into a non-renewable resource. This investigation involves investigating the distribution of the Earth's resources through the use of a chocolate chip mining activity. Present the students with the following investigations as an example of what might be possible.

    - Investigate the number of chocolate chips found in different brands of biscuit.

Teacher Note: Using different brands of chocolate chip cookies is representative of the fact that different regions of the Earth's crust and the different conditions in these regions results in the formation of different amounts of the same resource. Not all of the different brands of cookies will have the same amount of chocolate chips.

- Investigate whether or not chocolate chips are distributed evenly throughout biscuits within one packet?

ELABORATE

Teacher Note: Investigating the amount of chocolate chips distributed through several biscuits of the same brand is representative of the fact that resources are not evenly distributed throughout the Earth' crust or even throughout a particular region.

- Investigate the difference between caring for the environment when mining and not taking any care with the environment. How many chocolate chips can be mined without destroying the integrity of the biscuit? How many are left behind?

Teacher Note: Investigating how many chocolate chips can be mined and how many are left behind is representative of the fact that mining does not continue until all resources have been extracted. It usually only continues whilst it is cost effective to do so.

This investigation is also representative of the fact that mining companies do need to take the environment into consideration and therefore cannot always extract all the available resources. Sometimes it is not economically viable to extract all the resources that have been located.

- Investigate the relationship between the weight and size of the chocolate chips extracted. Does having more chocolate chips in a cookie mean more chocolate has been mined?

Teacher Note: Investigating the relationship between the weight and the size of the chocolate chips is representative of the fact that when mining, the minerals extracted can vary in weight and size. Just because you manage to extract 15 chocolate chips and your neighbour extracts only 8 does not necessarily mean that you have the most chocolate. It all relates to the size and weight of the individual chips.

3. Ask teams to choose an investigation of interest or even create an investigation of their own using the chocolate chip mining.

4. Give students a copy of Resource Sheet 7 and ask them to complete the investigable question and their predictions. Students can work as a team to identify the question and it would be good if they worked individually on their predictions and then shared them with their team.

5. Meet together as a class to share investigable questions and predictions. Ask students to then work with their cooperative learning team to complete the other parts of the planning section of the resource sheet.

6. Once you are happy with the completion of the planning section give students the time necessary to run their investigation and gather the necessary data to answer their investigable question. Explain to students that they will be expected to present a two page report to the class that includes:
    - An overview of their investigation - chocolate chip mining – What was your investigable question?
    - Their results and the conclusions that can be drawn
    - An explanation of how this relates to some or all of the following questions
        - The distribution of the Earth's resources?
        - What we choose to mine and what we choose to leave in the ground?
        - The environmental protection of regions?
        - Sustainability of resources?

- An overview of their investigation – growing a sustainable crop – What was your investigable question?
- Their results and the conclusions that can be drawn
- An explanation of how this relates to some or all of the following questions
    - What conditions are best to maintain a sustainable resource?
    - How long can you keep a sustainable resource growing?
    - What impacts on the sustainability of the resource?

Teacher Note: At this point students should also have the data and results collected from their investigation into the sustainable growing of cress seeds. This data and information will form part of the two page report. The report can include data tables, graphs and other visual representations that help students clearly communicate their findings.

INVESTIGATION PLANNER

Name:_____ **Date:**_____

Other members of your team:_____

What are you going to investigate?

Can you write it as a question?

What do you think you will find out? Explain why.

Give scientific explanations for your prediction(s)

How are you going to investigate this?

What procedure will you follow?

What things do you need to keep fair? Why? How will you do this?

What variables will you keep the same? Which variable will you change?

What equipment / resources will you need?

Use dot points

RESULTS

What were the results of your investigation? How can you represent your results in a way that others can easily understand? What is the data you collected to support your claim?

How successful was your investigation? What could you do to improve the investigation and the quality of the data you collected?

Lesson 11: A Question of Sustainability

EVALUATE

At a Glance:

To provide opportunities for students to represent what they know about resources and its sustainability.

Assessment Focus:

Summative assessment of the conceptual learning outcomes is an important aspect of the Elaborate phase. It involves monitoring students' developing skills and understanding of the scientific concepts.

Assessment Opportunities –Summative Assessment:

- Participation in discussions
- Journal entries
- Presentation to the class
- Development of the argument

Science Outcomes:

Students will be able to:

- Give details about their resource, how it is formed and what impacts on its sustainability
- Use scientific evidence to support an argument

Literacy Outcomes:

Students will be able to:

- Contribute to discussions
- Organise and present an argument/response on their particular resource

Equipment for each student:

- Science journal with recorded information
- Access to resource material such as text books and the Internet

Lesson outline

Key words: cycle, resource, sustainable, renewable, non-renewable

1. Remind students of the task they were presented with earlier in the unit on Resource Sheet 9 in regards to the final assessment task. Revisit the task and go through the main features of what is expected from them.

2. Develop criteria for success with the class. Go through criteria with the students before they start the task so they are clear about the expectations.

Things to consider

The resource	How well have you explained what your resource is, where it is located and how it is formed?
Sustainability	How well have you explained whether or not your resource is sustainable and your reasons for this opinion? How well have you explained what may impact on the sustainability of your resource? Is there anything we can do to make it more sustainable? Have you looked into alternatives?
The future	How well have you talked about what could or should happen in the future with regards to the use of your resource?

Information	How well does your information flow? Is it logical or does it jump from one idea to another? How clear is your information? How well did your audience understand?
Presentation	Do you speak clearly and at a reasonable pace for the audience to follow? How appropriate is your body language for the presentation How organised are you? Do you have all the props and resources you need?

3. Give students the time necessary to successfully complete the task and organise their information ready for presentation.

4. Share presentations with the class or a wider audience. This provides opportunities for peer and teacher assessment.

5. Ask students to complete a brief written response to the key question - ***What is a resource and what factors help determine its sustainability?***

A Question of Sustainability

Australia is moving toward using resources that are more sustainable and economically viable. As a member of a research team looking into resource sustainability you will be required to choose a resource that is of interest to you, research the sustainability and viability of that resource and present this information as part of a two minute presentation to the rest of the research team.

It is your job to determine, from your research, whether or not your resource is sustainable and should Australia be pursuing this resource as a resource for the future or should we be leaving the resource alone and looking for alternatives.

This presentation can be in whatever format you think works best. It could include an infomercial, a written argument, a poster, a PowerPoint or any other strategy that you think will effectively get your message across.

Things to consider as part of your presentation include:

- What is your resource?
- Where is it located?
- How is it formed?
- Is it sustainable? Why? Why not?
- How sustainable is it? Is it always going to be sustainable or are there things that we need to be doing to ensure its sustainability?
- What factors may impact on its sustainability?
- What could be done, if anything, to improve its sustainability?
- Should we be pursuing this resource or looking for alternatives? Why?
- Are there alternatives available?

Links to Learning		Beginning	Achieving	Advanced
Journal responses Participation in discussions Resource brainstorm Definitions of key words	**Science Understandings** Demonstrates an understanding of what a resource is and the difference between renewable and non-renewable	Attempts to explain what is meant by resource, renewable and non-renewable	Explains what a resource is and the difference between renewable and non-renewable resources	Clearly explains what a resource is and the difference between renewable and non-renewable with relevant examples to support their thinking
Participation in discussions Journal responses to questions Hot potato sheets Researched information	Describes and gives examples of resources and the things that impact on their sustainability	Able to list some different resources and can give two or three examples of things that can impact on an sustainability	Able to generate a list of resources and give detailed examples of things that can impact on sustainability	Can list a wide variety of different resources and can provide numerous detailed examples of things that impact on sustainability
Journal responses Participation in discussions Written response to statement and answer to questions – lesson 9	Explains the similarities and differences between sustainable and renewable	Attempts to explain the similarities and differences with little supporting evidence	Able to explain the similarities and differences and provides an example in support of their explanation.	Clearly explains the similarities and differences between the two and provides several examples in support of their explanation
Participation in discussions Journal responses to questions Networking session prompt Annotated diagram/movement story/storyboard	Describes the features of the water cycle	Describes most features of the water cycle	Able to describe the main features of the water cycle	Clearly describes the main features of the water cycle including examples and explains the interrelated nature of this cycle
Identify question for non-renewable resource investigation	**Science Inquiry Skills** Identify questions and problems that can be investigated scientifically	Bases an investigation on a question	Can identify a question suitable for investigation	Identifies several questions relating to the topic and selects one for investigation
Make predictions on the growth of cress seeds chocolate chip mining, soft drink distillation	Make predictions based on scientific knowledge	Makes predictions without providing supporting information	Makes predictions based on scientific knowledge – includes some supporting evidence	Makes predictions and clearly supports their thinking with scientific evidence
Drawing conclusions on the success of the two investigations Using data and information to draw conclusions from resource research Written report on investigations	Summarise data from investigations, and use scientific understanding to identify relationships and draw conclusions	Attempts to draw conclusions from data and evidence collected from investigations	Draws conclusions based on the data and evidence collected from their investigations and their own scientific understandings	Draws relevant, appropriate conclusions based on the data and evidence collected from their investigations

Participation in discussions Presentation of research into Written report on investigations Presentation on their resource	Communicate ideas, findings and solutions to problems using scientific language and representations using digital technologies as appropriate	Presents basic information with minimal scientific language Detail is lacking in some areas	Uses scientific language to clearly and accurately present information in an appropriate format. Includes all information relevant to the task	Excellent use of scientific language to clearly communicate their ideas and understandings Includes detailed information on all relevant parts of the tasks
Participation in discussions Journal responses Visual representations of distribution of water Quick write	**Science as a Human Endeavour** Describes ways in which science has influenced the development of practices in mining and water distribution, collection and sanitation	Attempts to describe ways in which science has influenced practice in mining and in water collection and sanitation	Gives an example of how scientific knowledge has influenced practice in mining and in water collection and sanitation	Gives several clear examples of how scientific knowledge has influenced practice in mining and in water collection and sanitation

Equipment

Birdseed – parrot mix works well

Beads or sequins

Tweezers

Large and small foil trays

Plastic teaspoons

A variety of different sized and shaped containers

Cress seeds (or other fast growing seeds)

Cotton wool

Plastic plates

Orange coloured soft drink

Clear glass bowl

Cling wrap

Small glass

Plasticine or small rock

Chocolate chip cookies

Sharp implements such as tweezers, paper clips, drawing compasses

Optional

Sieves

Magnets

References

http://www.dnr.state.wi.us/org/caer/ce/eek/earth/groundwater/watercycle.htm

http://www.teachers.ash.org.au/jmresources/energy/renewable.html

http://www.eco-pros.com/renewableresources.htm

http://water.org/water-crisis/water-facts/water/

http://www.catchmentdetox.net.au/

http://www.livestrong.com/article/195193-what-makes-a-resource-renewable-or-nonrenewable/

http://www.globalissues.org/issue/235/consumption-and-consumerism

http://www.freedrinkingwater.com/water_quality/earth-water-distribution.htm

http://ga.water.usgs.gov/edu/waterdistribution.html

http://www.csiro.au/Outcomes/Energy/Carbon-Footprint/Sustainable-Resource-Use.aspx