YEAR 2
EARTH'S RESOURCES

Australian Curriculum Earth Science activities

with links to other subjects.

PALMS
PRIMARY AUSTRALIAN LITERACY MATHEMATICS AND SCIENCE

Santos & ESWA supporting earth science education

EARTH SCIENCE WESTERN AUSTRALIA

Santos

YEAR 2- Teacher Introduction

The Primary Australian Literacy Mathematics & Science (PALMS) Program aims to enrich and support the teaching of earth science from Kindergarten to Year 5 across Australia. This will be achieved by providing, within the mandated Earth and Space Science curriculum, hands-on activities integrating aspects of Chemical Sciences, Physical Sciences and Biological Sciences as well as relevant components of English, Mathematics and other subjects into teaching packages.
These teaching packages will be made available at www.palms.edu.au.

Earth's resources, including water, can be used in a variety of ways.

Activities marked **PPP** (PALMS PARENT POWER) are ones you may wish to send home with the students to do with their parents or by themselves. They replay the concepts recently covered in Science. Studies demonstrate that if a student describes what they have learned to another, they deepen their own understanding and retain it longer.

YEAR 2- Teacher Introduction

Topic No.	Topic	Activities	Student Worksheet	Subjects	Page No.
2	Water (Above ground)	Making Rain	X	Science	6 + 11
		Water Always Flows Downhill	X	Science	7 + 11
		Rainwater Collectors	X	Science	8 + 13
		Collecting Rainfall		Science, Mathematics & Geography	10
	Water (Under-ground)	Water Level		Science	14 + 21
		Moving water	X	Science	15 + 21
		Groundwater supplies	X	Science & Geography	16 + 22
		Recharge	X	Science - Critical thinking	19 + 23
	Water (Transfer to point of use)	Gravity Feed		Science	24
		Height Increases Water Pressure/Rate of Flow	X	Science	27 + 30
		Height Affects Water Flow	X	Science & Mathematics	28 + 31

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YEAR 2- Teacher Introduction

Topic No.	Topic	Activities	Student Worksheet	Subjects	Page No.
2	Water Treatment (Small Scale)	Springs, Wells Dams and Bores	X	Science & History	33 + 37
		Settling and Decanting Water	X	Science	34 + 38
		Testing Water From Different Sources		Science	36
	Water Treatment (Large Scale)	Sand Filtering		Science	39
		Filtering Water		Science	40
	Precious water	Essential Water	X	Science & Health	42 + 48
		Worth its Weight in Gold	X	Science, Mathematics & History	43 + 49
		A Young Bush Hero		History	46
	Saving Water	Saving School Water		Science	51
		PPP - Water Saving at Home	X	Science & Mathematics	53

YEAR 2- Teacher Introduction

Topic No.	Topic	Activities	Student Worksheet	Subjects	Page No.
2	Water (Aboriginal Pers-pective)	A Sign for Water	X	Science, History, & English	54 + 59
		Petroglyph Design	X	English	57 + 60
		Way to Water		Geography & Art	58
3	Soils (Introduction)	Soil Recipe		Science	62
		Senses and Soils	X	Science & English	65 + 68
		What Do We Use Soils For?	X	Science & English	66 + 69
	Soils (Humus)	Humus in Soils	X	Science & Mathematics	70 + 73
	Soils (and Worms)	Willie the Worm	X	Science & Drama	74 + 80
		Worm Farm (option)		Science	75
	Soils	Save Our Soil Poster	X	Science & English & Art	84 + 85
		Fishbone	X	Science	86 + 87
		PPP - Good Soil and Bad Soil	X	Science	88

YEAR 2- Teacher Introduction

Topic No.	Topic	Activities	Student Worksheet	Subjects	Page No.
4	Clean Air	Dust in Air		Science	90
		Pollution and Lung Problems		Health	91
		Dust in the Air	X	Science & Health	92 + 96
		Smoking Signs	X	Science & Health	95 + 97
5	Minerals	Everyday Uses		Science	98

Australian Curriculum
Earth & Space Science

Earth's resources, including water, can be used in a variety of ways.

Elaborations

- Identifying the Earth's resources including water, soil and minerals, and describing how they are used in school.
- Describing how a resource such as water is transferred from its source to its point of use.
- Considering what might happen to humans if there were a change in a familiar available resource, such as water
- Identifying actions at school such as turning off dripping taps, can conserve resources

Major concepts also included

Being, becoming, belonging
Critical thinking

PALMS
PRIMARY AUSTRALIAN LITERACY MATHEMATICS AND SCIENCE

Santos & ESWA supporting earth science education

YEAR 2- Teacher Introduction

Maths
Number sequences. Fractions (halves, quarters & eighths, Compare & order shapes & objects. Collect, check & classify data. Interpret simple maps of familiar locations. Gather & check data.

History
Pose questions using past sources
Impact of changing technology

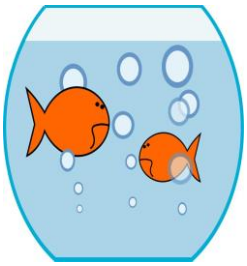
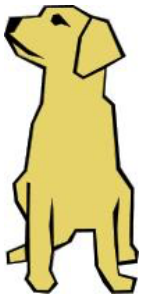
Drama
Students involved in creative play through a structured activity. Explore characters through stories.

Geography
Connections – Where did it come from & how did it get here? Connections of people in Australia to other places in Australia, to countries in the Asian region and across the world.

Essential Resources - Teacher's Notes

A resource is anything that is useful. It does not need to be an economic resource. Some resources are ***essential*** – living things cannot exist without them. Clean air, clean water, light, soil to grow food, and shelter. Some animals also need parental care.

Write ***essential*** resources that are needed by these living things below.

			
Air	Air	Air	Air
Water	Water	Water	Water
Food	Food	Food in soil	Food
Shelter (bowl)	Shelter (kennel)	Shelter (pot)	Shelter (home)
Light	Care	Light	Family

What are the four resources that are essential to all these living things?

Air Water Food Shelter

What other (non-essential) resources might they also need?

Other fish	Company	Wind and bees	Other people
Weed to hide in	Vet	Gardener/ Farmer	Doctors/nurses
	Toys	Drainage	Dentists
	Exercise		Schools/teachers

We must share Earth's resources with all other living things.

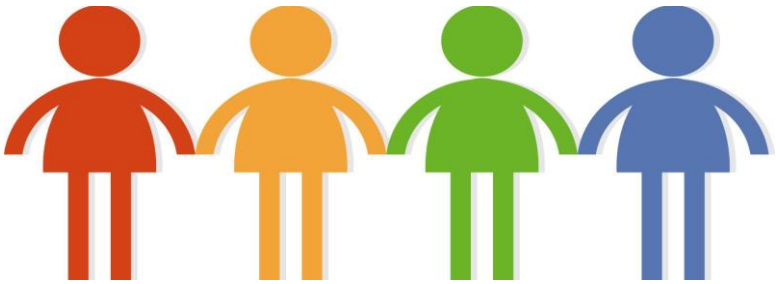
PALMS
PRIMARY AUSTRALIAN LITERACY MATHEMATICS AND SCIENCE

Essential Resources - Teacher's Notes

Resources for your day

Name and draw 4 non-essential resources you have used since you woke up this morning.

Answers will vary



Should people also be counted as resources? Yes. People look after each other and train children to become useful as adults.

Your school as a resource for you - Think, pair, share

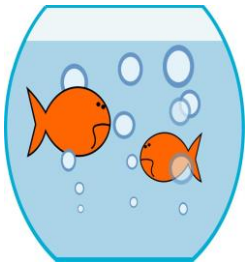
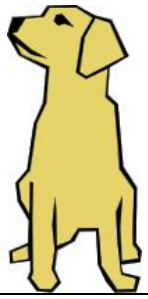
How can your school teach you to become a more resourceful person?
It can teach you to :
Read, write, count, measure, be polite, be patient, understand road safety, learn the rules of sports, help people, cook, understand which foods to eat, and know more about the world we live in.

Name _____

Essential Resources - Student Worksheet

A resource is anything that is useful. It does not need to be an economic resource. Some resources are ***essential*** – living things cannot exist without them.

Write ***essential*** resources that are needed by these living things below.

What are the four resources that are essential to all these living things?

_____

What other (non-essential) resources might they also need?

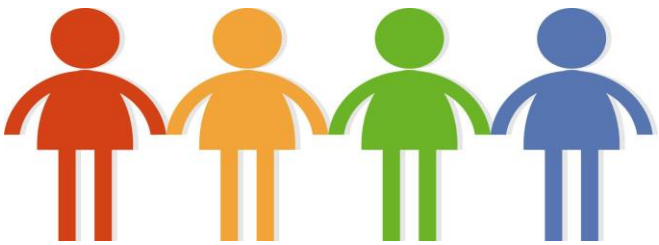
Name _____

Essential Resources - Student Worksheet

We must share Earth's resources with all other living things.

Resources for your day

Name and draw **4 non-essential** resources you have used since you woke up this morning.



Should people also be counted as resources? _____

Explain why_____

_____

Name _____

Essential Resources - Student Worksheet

Your school as a resource for you - Think, pair, share

How can your school teach you to become a more resourceful person?
It can help you to :

_____

_____

_____

_____

Above Ground Water Sources - Teacher's Notes

Rain is the initial source of fresh water
Sunshine evaporates fresh water from salty sea water. When the water vapour rises it cools, forms clouds and then rains fresh water.

Making Rain - Teacher Demonstration

Materials

- A zip lock sandwich bag.
- Hot (but not boiling) water.
- A basin or large beaker of very cold water. Adding ice cubes helps speed up condensation.

Method

1. Prepare the bath of cold water.
2. Pour in enough hot water to half fill the bag.
3. Zip lock the bag.
4. Holding the bag by the zip, lower it into the icy cold water.
5. Observe.

Observation

Water vapour from the hot water condenses on the cold sides of the bag and forms liquid droplets.

Rainwater must be collected together to form a large reservoir and transferred to where it is needed. Surface runoff collects in low-lying areas creating rivers and lakes which can be used as reservoirs. To stop water flowing away to sea, these areas can be dammed. Farmers make soil walls across winter streambeds and line them with clay to stop water seeping into the soil. These are called "turkey's nest dams" in the south of WA or "tanks" in the north.

Above Ground Water Sources - Teacher's Notes

Teacher's jokes What did the fish say when he swam into the wall at the end of the lake? DAM!
What did the frog say when summer had left him only 2cm of water in his pond? Knee deep!

Water Always Flows Downhill - Student Activity

In science we always test our ideas to make sure they work

Materials

- A sloping waterproof surface such as a cement ramp.
- Five straws, Pasteur pipettes or small containers for holding water. (Dip the straw into water, place a finger firmly over the top of the straw and the student can carry water in the straw).

Method

1. Students line up in groups of five along the middle of the ramp.
2. They hold the water container one hand's height above the sloping surface.
3. On a count of three they gently pour the water onto the surface.
4. The direction of water movement is observed and entered into the table provided.

Direction of water movement

	Up slope	Down slope	Across Slope
Student observation	0	22	0
Total			

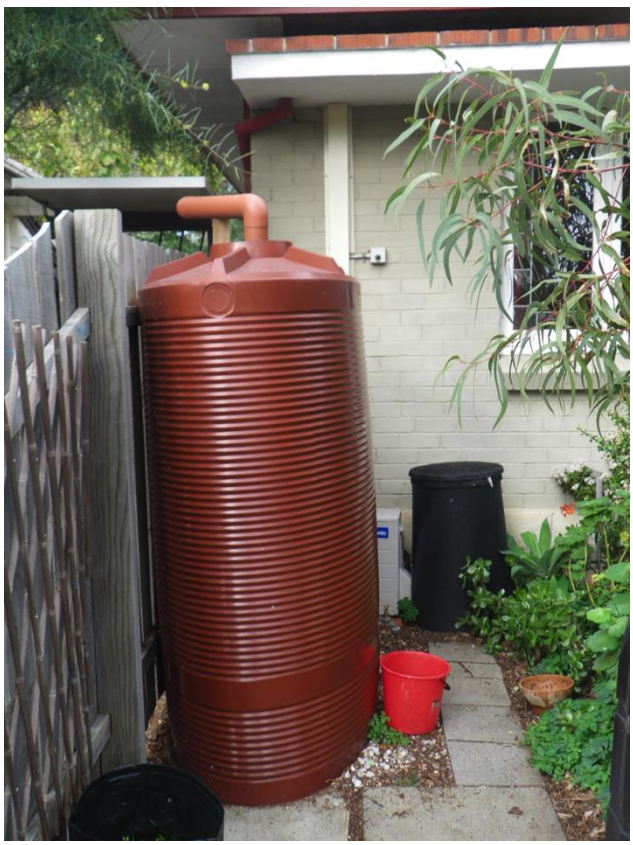
Which way does water flow? Down slope/down hill.

Above Ground Water Sources - Teacher's Notes

Why is there always a hollow or depression around a drain in the schoolyard? To drain away the rainwater.
Why isn't the bottom of your shower at home flat? To allow the water to drain away.
Why do some areas of the schoolyard always have puddles? They are low lying and don't have drains.

Rainwater Collectors – Man-made and Natural

What is the source of water in this tank? Rain from the roof.



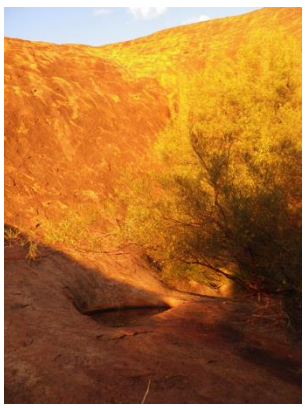
Rainwater can be collected directly from house roofs and downpipes and directed into rainwater tanks for storage. Water is filtered before entering the tank to remove any dead leaves or material from the roof and to prevent birds, frogs and lizards from entering. These tanks also often have screens to prevent insects such as mosquitos and flies from contaminating water. When properly maintained this water is good for most household and garden purposes.

More information on domestic rainwater tanks can be found at: http://www.eastfremantle.wa.gov.au/uploaded/pdf/rain.pdf

In country areas that depend on sourcing "hard" bore water for most of

their needs. rainwater is highly prized for drinking, cooking and rinsing washed hair, leaving it silky and not curiously crunchy.
In rural India, most households are primarily dependent on roof rainwater for all household needs. A large cistern is constructed under each house to hold all their private supply.
An excellent short (17m 14s) talk on TED explaining an Indian perspective on water collection can be found at:
https://www.ted.com/talks/anupam_mishra_the_ancient_ingenuity_of_water_harvesting?language=en
It has recently become possible to buy huge plastic membrane bags that can be inserted under our Australian houses to hold rainwater in a similar fashion. They are insulated from the sun's heat by the mass of the house and are sealed to reduce evaporation. (Mending leaks can be problematic however).

Rainwater falling over large rocky outcrops or areas of concrete can also be collected as runoff into town dams. The rock or concrete does not allow the water to penetrate into it, a clay or asphalt base stops it seeping underground. In this way water from a large area of rain falling on the ground is directed into a smaller holding dam.
Early settlers and Aboriginal people also used runoff from large rock outcrops. Rain would run from large areas of rock and be channeled towards ground level by natural cracks in the rock. At Walga Rock in the Murchison, water is seen trapped in a natural hole in the rock which Aboriginal people have widened and again further down slope in a water hole with a clay base.
For water to collect there needs to be a waterproof surface. In nature this is usually clay or rock.



Above Ground Water Sources - Teacher's Notes

Collecting Rainfall - Student Activity

Materials

- A piece of plastic.
- Two cups/jars of the same size.
- A watering can or empty cool drink bottle with its bottom perforated by thumbtack holes.
- Measuring cylinder or a teaspoon (each teaspoon contains 5mL)

Method

1. Sink both cups into the garden or sandpit until their tops are at ground level
2. Place the plastic over one cup and perforate the center (as in the picture) pushing it into the center to create a funnel.
3. "Rain" equally over both cups and collect water.
4. Measure how much water each cup has.

The cup collecting rain from a greater area will contain most water.

Name _____

Above Ground Water Sources - Student Worksheet

Rain is the initial source of fresh water

Making Rain – Teacher Demonstration

What did you observe in the cooling bag?

_____

_____

Rainwater must be collected together to form a large reservoir and transferred to where it is needed.

Water Always Flows Downhill – Student Activity

In science we always test our ideas to make sure they work

Materials

- A sloping waterproof surface.
- Five straws, Pasteur pipettes or small containers for holding water.

Method

1. Line up in groups of five along the middle of the ramp.
2. Hold the water container one hand's height above the sloping surface.

Name _____

Above Ground Water Sources - Student Worksheet

3. On a count of three gently pour the water onto the surface.
4. The direction of water movement in each case should be observed, counted and entered into the table provided.

	Up slope	Down slope	Across Slope
Student observation			
Total			

Which way does water flow? _____

Why is there always a hollow or depression around a drain in the schoolyard?

_____

Why isn't the bottom of your shower at home flat?

_____

Why do some areas of the schoolyard always have puddles?

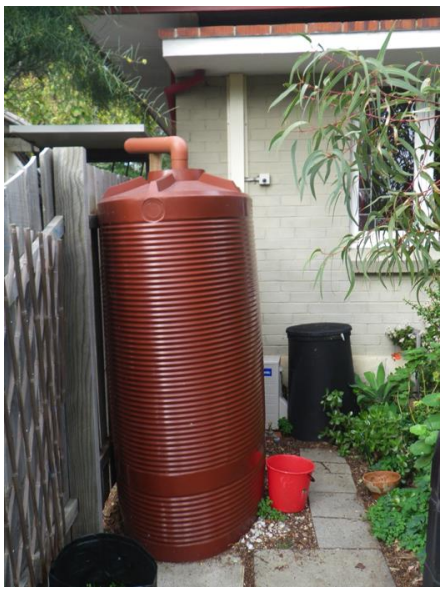
_____

Name _____

Above Ground Water Sources - Student Worksheet

Rainwater Collectors

What is the source of water in this tank? _____

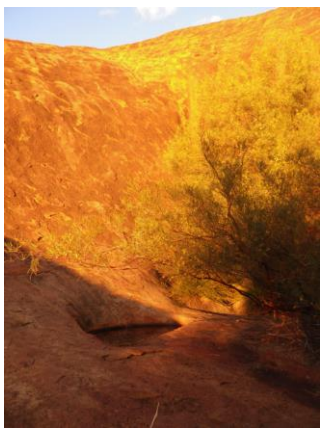


Water can be collected from house roofs and downpipes and directed into rainwater tanks for storage. It is filtered to remove any dead leaves or material from the roof and to prevent birds, frogs and lizards from entering. Does your house have a rainwater tank?

_____

Does your school collect rainwater?_____

Rainwater falling over large rocky outcrops or areas of concrete can also be collected as runoff into town dams. The rock or concrete does not allow the water to sink into the soil. These are relatively common in the Central Wheatbelt of WA.
Does your town have a water collecting rock?



_____

Underground Water - Teacher's Notes

Water Level - Teacher Demonstration

When rain falls on the ground it sinks through spaces between soil grains and percolates through pores in rocks until an impermeable layer of clay or rock stops its downward movement. Over many hundreds and thousands of years the groundwater level rises within the rock or soil and an underground water reservoir is formed. The top of the reservoir is called the "water table" and is almost horizontal. The first demonstration (below) can be skipped if you cannot find the equipment but it is a source of amazement and amusement to many students, especially if pairs of them are asked to demonstrate movement of the tube ends.
Aquarium tubing is inexpensive and other clear tubing is stocked in hardware shops.

Materials

- A length of clear plastic tubing. (aquarium tubing is inexpensive and ideal)
- Water (coloured if possible).
- A jug and funnel if you have one.

Method

1. Hold the tubing in a U shape.
2. Half fill with coloured water.
3. Ask the students what they think will happen to the water level if one tube end is raised or lowered.
4. Demonstrate what happens.

Draw what happens when the ends of the tube are moved? Water level remains the same or the top of the water remains level.

Underground Water - Teacher's Notes

Since ancient times, builders have used this technique to test that foundations are level. A small channel was cut into the outer edge of the base and this was filled with water. If the foundations were level the channel would fill and no water would spill. If the foundations were not level, water would spill out of the lowest point.

The carpenter's spirit level works on the same principle to test if beams are truly horizontal or vertical.

Moving Water - Student Activity

This activity tests for concept transference.

Materials

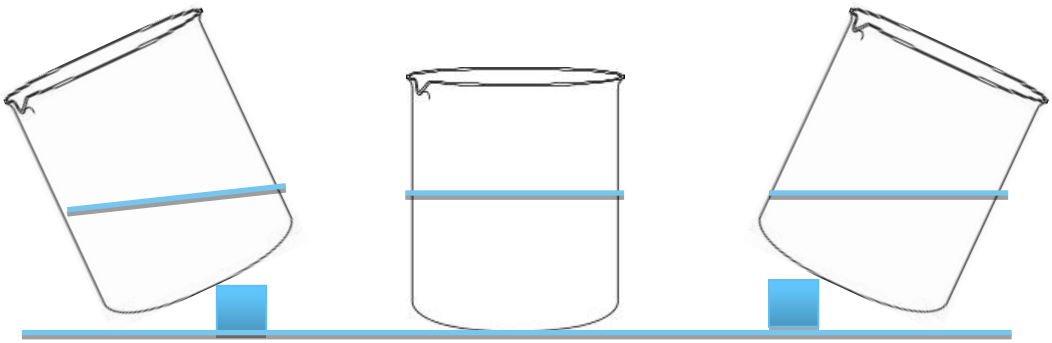
- A beaker, a jam jar or a glass.
- An eraser or book to chock up the beaker at an angle.
- Coloured water in a jug.
- A pencil (the same colour as the water if possible).

Method

1. Pour water into the beaker until it is about one third full.
2. Draw what this looks like on your diagram.

3. Tilt the beaker by placing the eraser under one side
4. Draw what this looks like on your diagram.
5. Tilt the beaker in the other direction and place the eraser under it
6. Draw what this looks like on your diagram.

Observations



Draw what you think will happen when the beaker is tilted See drawing
Does water always find its own level? Yes

Groundwater Supplies – Teacher Demonstration

Aboriginal people and early settlers dug wells to find the water table and fresh water supplies they needed. They also used soaks and springs where the land surface naturally dipped to cut the water table and water bubbled out. Aboriginal meeting places were often near such soaks and later European settlements relied on them. There was conflict over "ownership". A worksheet on Aboriginal perspectives on water is included in this topic. Living in the driest habitable continent, we cannot depend solely on rainwater so have come to rely on groundwater supplies from boreholes sunk below our farms, towns and cities.

Underground Water - Teacher's Notes

There is a major student misconception that underground water is found in great lakes in caverns below the surface. The water really only fills pore spaces within sands, sandstone and limestone. There is no huge hole or empty space. Water from rain falls on the ground and seeps downward until something stops it. Impermeable layers of clay or igneous rock underlying them can trap water above. The trapped water is called groundwater and the reservoir an aquifer (water maker). Aquifers can take millions of years to build up.

When the water table lies below the surface, as in the model, some plants can send roots down to get water, but animals must depend on water drawn from wells or raised by windmills and other pumps.

If too much water is pumped from the aquifer and is not replaced by rainfall the water table will drop, trees die and bores have to be deepened. In Perth we are drawing on water supplies that have formed over thousands of years. Because the dams, which were built to collect rainfall runoff, are no longer sufficient for the needs of our much greater population we now rely on groundwater and desalinated seawater.

Most major cities in Western Australia depend on bore water from their underlying aquifers.

Materials

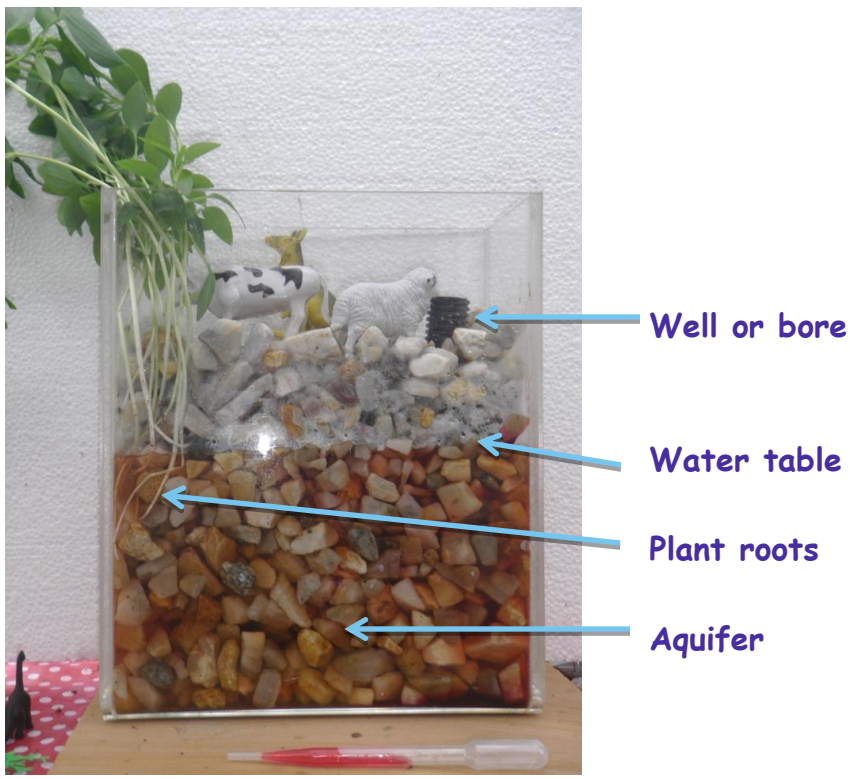
- A large transparent container. Old fish tanks or worm farms are excellent. School canteens often have large glass jars, which contained mayonnaise, which work well.
- Washed gravel or aquarium pebbles. The model in the photograph had pathway gravel but loose road gravel works well. Place in a sieve and rinse well. No need to dry as it will mostly be wet.
- A piece of tubing to represent the well or bore. I used garden hose but if that isn't available, cut about 7cm from the top of an empty cool drink bottle and use that.
- Some plants with roots.

Underground Water - Teacher's Notes

- Water (coloured if possible).
- Option. Plastic animals.

Method

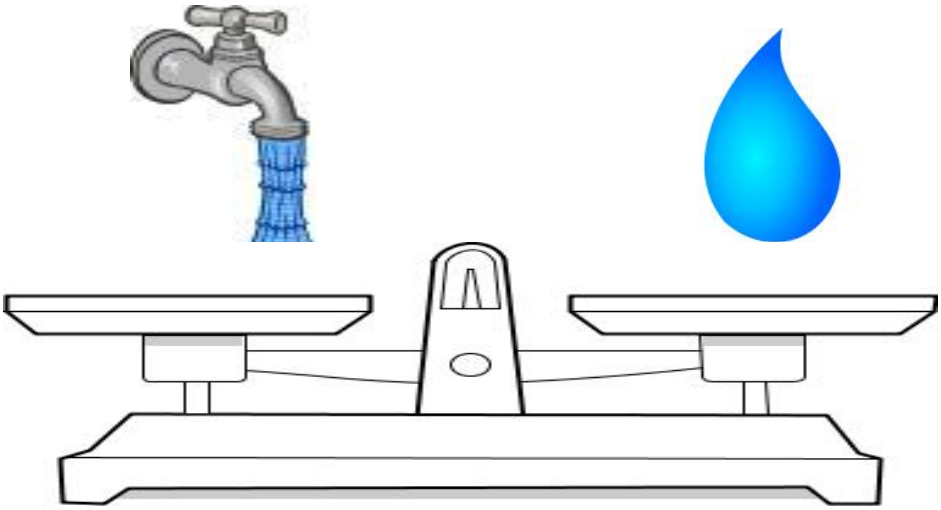
1. Half fill the container with gravel.
2. Hold the tubing that represents the bore so that the top will be slightly above ground level.
3. Hold plants with roots below ground level and infill the rest of the gravel so that the plant roots are covered and the top of the well protrudes above the surface.
4. You may create a dip on the surface to make a lake or soak where your animals may drink.
5. Add animals
6. Add water until the water table appears in the lake depression at the surface.



Underground Water - Teacher's Notes

You can demonstrate a drop in the water table either by simulating summer leaving the model in the sunshine causing water to evaporate, or by drawing water from the well using a pipette or drinking straw and watching the water disappear for the animal's drinking hole/soak/lake. In either case animals and plants are deprived of water.

Recharge (How Much is Enough?)



Some aquifers are enormous and it takes a lot of pumping before there is a noticeable change in the level of the water table. Many remote areas depend on much smaller local perched water tables that are closer to the surface and often lie above small clay pans within soils. These can be slow to recharge and, being smaller, are more sensitive to pumping.

Materials

- A bucket, a glass and a teaspoon
- Masking tape or permanent marker
- Water

Underground Water - Teacher's Notes

Method

Almost fill the bucket and the glass with water
Mark water levels on both
Remove two teaspoons (10mL) of water from each
Observe any change of water level

Observation

Water loss/a drop in water level is hardly noticeable in the bucket but is much more apparent in the glass.

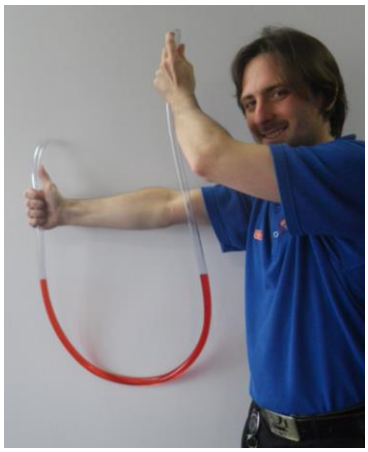
A water bore has always supplied this household with water. The garden does not need to be watered and the animals can drink at a nearby soak or billabong because the water table is close to the surface.
What will happen if;
More water is needed for a new swimming pool? This will lower the water table. If sufficient water is removed, the plants will die because their roots are not long enough and the soaks will dry killing the animals
Rainfall is halved? Again the level of the water table will drop because it is not being recharged
The family moves away and stops drawing water from the bore? The level of the water table will eventually recover and rise. With luck plants and animals will return.

Name _____

Underground Water - Student Worksheet

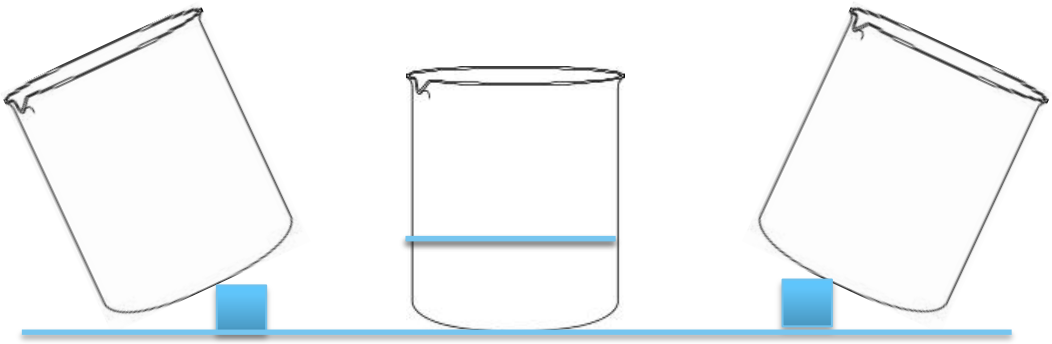
Water Level – Teacher Demonstration

Draw what happens when the ends of the tube are moved up and down?



Moving Water

Draw what you think will happen when the beaker is tilted



Now test with water. Did this happen? _____

Does water always find its own level? _____

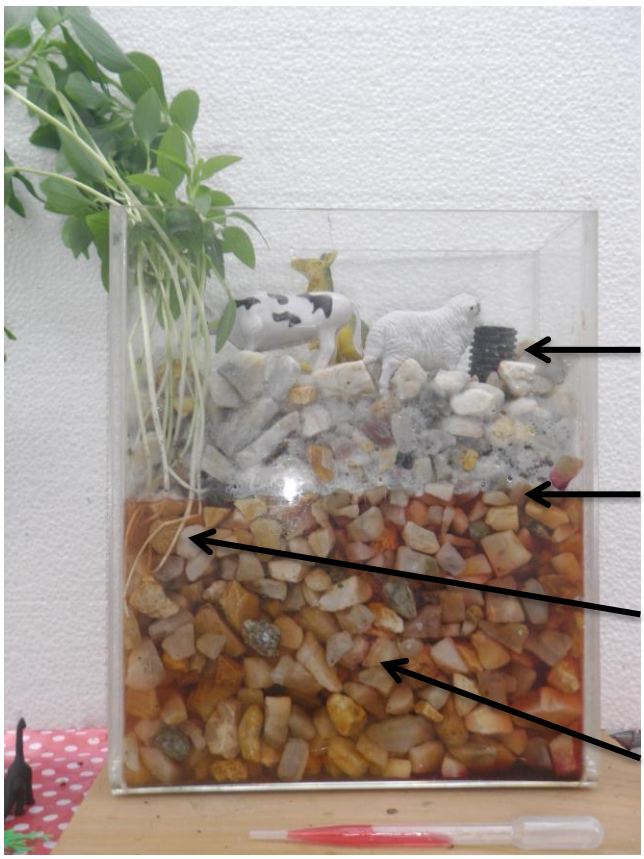
Name _____

Underground Water - Student Worksheet

Groundwater Supplies – Teacher Demonstration

Underground water is not found in great lakes in caverns below the surface. The water really only fills pore spaces within the rock. Trapped water is called groundwater and the reservoir an aquifer (water maker). Aquifers can take millions of years to build up.

Label the **well**, **water table**, **plant roots** and **aquifer** below.



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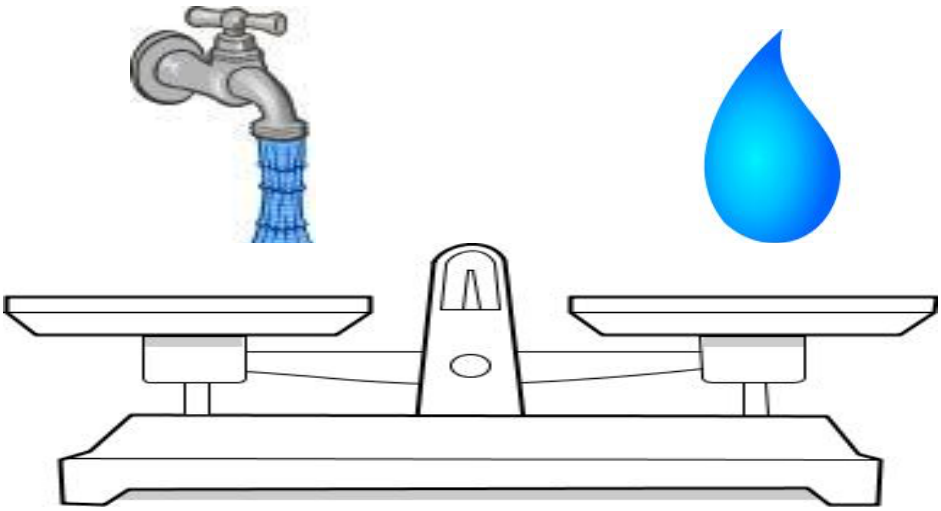
Name _____

Underground Water - Student Worksheet

Recharge (How Much is Enough?)



A water bore has always supplied this household with water. The garden does not need to be watered and the animals can drink at a nearby soak or billabong because the water table is close to the surface.

What will happen if;
More water is needed for a new swimming pool?

_____

Rainfall is halved? _____

The family moves out and stops drawing water from the well?

_____

Transfer of Water to Point of Use - Teacher's Notes

Water has to be transferred from the source reservoir to the point of use. The easiest way of doing this is when the source lies uphill from the point of use. This is known as gravity feed. Most towns have their reservoirs uphill. All pipes are laid on a very gentle slope leading downhill to the user.

If the dam is uphill or upslope from the place where the water will be used water can flow downhill. If however the water has to flow uphill or travel a long way across country it needs to be pumped to encourage it to flow. Often we need more water pressure to raise water from our underground mains to the taps and showerheads in our houses and schools.

Gravity Feed - Discussion

Gravity feed water tank that increases water pressure for the Perth suburb of Coolbellup.

Transfer of Water to Point of Use - Teacher's Notes

If the point of use is downhill from the source, water will naturally flow downhill. This is known as ***gravity feed***. (See earlier activities). The Ancient Greeks and Romans transferred water from rivers and springs to towns by canals, aqueducts and clay pipes. The Romans sometimes used lead pipes which contaminated water. If water is needed for showers or machinery, water pressure may need to be increased by pumping water into a header tank at the point of use. Many towns, small settlements and schools have header tanks uphill or on the roof to maintain "mains pressure". Suburban water supplies have small pumping stations to maintain water pressure.

When C. Y. O'Connor built the Perth to Kalgoorlie water pipeline, 1896-1903, water had to be pumped uphill and over 557 kilometers. It needed eight huge wood fired steam driven pump stations along its length to keep the water running. Twenty small modern pumps have replaced the original ones.

Small pumping station in South Fremantle (built 1934 – now unused)

When water falls from a great height it picks up energy (potential energy). Water pumped from underground can be stored in header tanks to pressurise water in underground mains to rise upwards for domestic use.

Transfer of Water to Point of Use - Teacher's Notes

Gravity Feed - Teacher Demonstration

This activity should be carried out outside.

Materials

- A funnel.
- A length of tubing/garden hose about 2m long.
- A small bucket of water.

Method

1. Fix the funnel into the end of the tubing.
2. Arrange for the funnel end always to be highest.
3. Ask a student to pour water into the funnel whilst you stop the flow with the pad at the base of your thumb.
4. Ensure all students stand back and that the bottom end is pointing away from your feet.
5. Holding the funnel end as high as you can, release the water flow and observe. If you can organise one student to stand on a veranda or steps and then have another student who is much lower hold the lower end and direct the water away from themselves and others.
6. Repeat at half the original height and then with funnel and exit at the same level.

The water will flow strongly and even rise above the lower hose end when the funnel is much higher than the outlet.

When funnel and outlet are at the same level little pressure can be observed once water level has been equalised.

Transfer of Water to Point of Use - Teacher's Notes

Height Increases Water Pressure/Rate of Flow – Teacher Demonstration

Materials

- An empty plastic cool drink bottle
- A thumb tack or sharp nail
- Water

Method

1. Push the nail or tack into the wall of the bottle to make two holes. One should be near the middle of the bottle and the other near the bottom

When the bottle is filled with water the pressure from above causes the lower hole to release water at greater pressure than the one above.

Ancient builders in China and Greece made sure that water collected from the roof was not directly allowed to fall to the cellars where the high pressure would cause erosion, like it does at the bottom of some downpipes. It was brought down in stages along curved channels to reduce damage.

Modern cities and towns have water mains that run below the roads and into houses. In this case the water must be pressurized to move upwards into the house. Pumping stations along the water mains maintain water pressure.

Transfer of Water to Point of Use - Teacher's Notes

Height Affects Water Flow - Student Activity

This activity is best performed over the sink or outside. If it is performed in the sandpit students may notice that the holes drilled into sand become deeper as the height above ground increases. If it is also performed on cement or tarmac, students may notice how much more water from the top container splashes. Remember to repeat to confirm observations.

Materials

- 3 students to hold the cups or bags and 3 students to test the strength of water flow.
- 3 Paper cups or three zip-lock sandwich bags the same size
- A large nail or scissors

Method

1. Make a hole near the base of each cup or bag and ask students to seal it with their finger or with a piece of plasticine
2. Fill each cup or bag with the same amount of water
3. Ask the first student to hold their water container at head height, the second to hold theirs at waist height and the third at knee height.
4. Making sure that the cups are held with the hole pointing away from the student, remove/push out the stoppers from the cups or cut the corner pointing away from the student from each plastic bag.
5. Using their hands, ask students to rate which flow was strongest, medium or weakest.
6. Observe the difference that height of source makes on water flow and what happens when it hits the ground. Draw the observations into the table below.

Transfer of Water to Point of Use - Teacher's Notes

	Strength of flow	Depth of hole in sand
 Head height	(strong)	(deep)
 Waist height	(medium)	(medium)
 Knee height	(weak)	(shallow)

When the cup is high the water pressure is MORE / LESS

Emergency services suggest that in the warning of any on-coming natural disaster, it is a good idea to have containers (including the bath!) filled with water in case electricity is cut and water cannot be pumped to your house. Earthquakes and fires also damage pipes.

To detect a water leak – turn off all taps and listen to the water meter. If it continues to tick there is a leak in the pipes underground. Would you expect a damp soggy spot to form on the ground? No. Water does not usually move uphill unless it is forced to.

Name _____

Transfer of Water to Point of Use - Student Worksheet

Gravity Feed

Gravity feed water tank that increases water pressure for the Perth suburb of Coolbellup.

If the point of use is downhill from the source, water will naturally flow downhill. This is known as ***gravity feed***.

Height Increases Water Pressure/Rate of Flow

Draw a picture of the water flowing out of the bottle below.

Name _____

Transfer of Water to Point of Use - Student Worksheet

Height Affects Water Flow

Materials

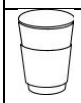
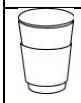
- 3 students to hold the cups or bags and 3 students to test the strength of water flow.
- 3 paper cups or three zip-lock sandwich bags the same size
- A large nail or scissors

Method

1. Make a hole near the base of each cup or bag and seal it with their finger or with a piece of plasticine
2. Fill each cup or bag with the same amount of water
3. One student holds their water container at head height, the second to holds theirs at waist height and the third at knee height above the sandpit.
4. Hold the cups with the hole pointing away from you, remove/push out the stoppers from the cups or remove your finger.
5. Decide which flow was strongest, medium or weakest.
6. Observe what happened to the sandpit under each.

Name _____

Transfer of Water to Point of Use - Student Worksheet

	Strength of flow	Depth of hole in sand
 Head height		
 Waist height		
 Knee height		

When the cup is high the water pressure is MORE / LESS

Emergency services suggest that in the warning of any on-coming natural disaster, it is a good idea to have containers (including the bath!) filled with water in case electricity is cut and water cannot be pumped to your house.

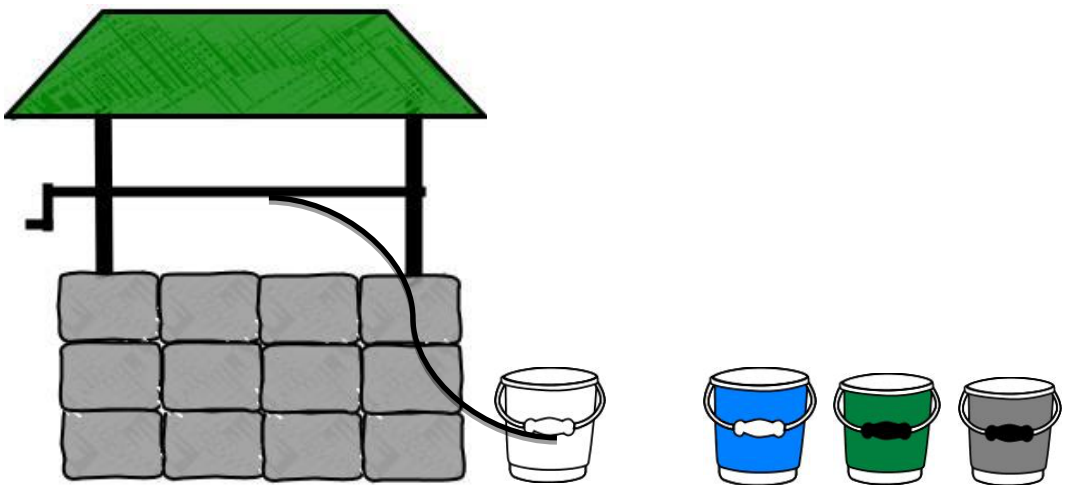
To detect a water leak – turn off all taps and listen to the water meter. If it continues to tick there is a leak in the pipes underground. Would you expect a damp soggy spot to form on the ground?

_____

Small Scale Water Treatment - Teacher's Notes

Springs, Wells, Dams and Bores - Discussion

Hippocrates the Ancient Greek identified the significance of good water quality for good health. He is famous for stating "It is preferable to use water from a good source than treat water from an inferior source". Early settlers collected water by making dams that collected runoff and by "sinking" wells into trapped groundwater and bucketing the water back to the surface. To stop water being lost, dams were lined with impermeable clay. To stop wells collapsing, settlers lined them with rock and wood but left spaces where groundwater could seep into the well. Wells for human use were often situated slightly uphill from settlements, farms and animals to reduce contamination from sewage.



To obtain clear water for washing and drinking, water often had to be left to settle to the bottom of the bucket as dropping it into a well or dam will disturb the fine sediment and result in collecting muddy water. After settling, upper clearer water was then ***decanted,*** or poured, from the top of the bucket. The clearest water was used for drinking, cloudy water was used for washing people and clothes (sometimes first one then the other) and the "lees" or leavings were used for animals and the garden. As a child

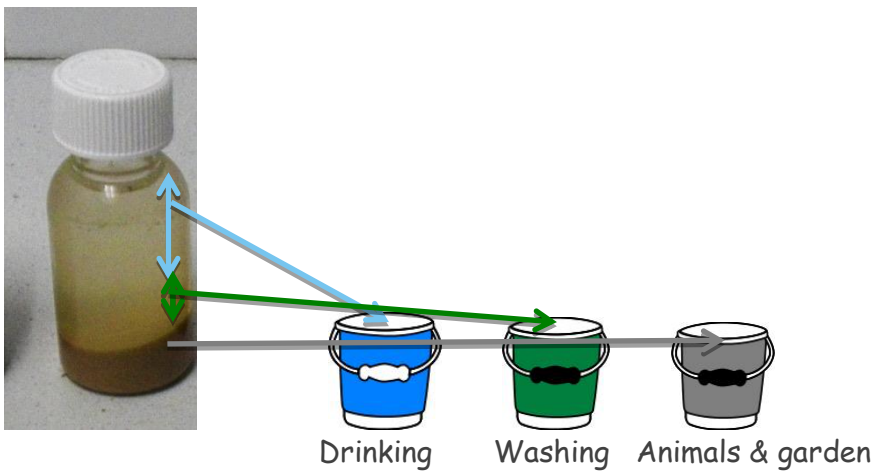
Small Scale Water Treatment - Teacher's Notes

I remember pouring the clearest water into a blue enamel bucket which went into the kitchen, the slightly cloudy water into a green bucket which went into the washroom/laundry and the lees (leftovers) were poured into a grey galvanised bucket for chickens, pigs, dogs and the garden. Even today not everyone is connected to mains water supplies.

Settling and Decanting Water - Teacher Demonstration or Student Activity

If this is to be a teacher demonstration, mix the sand and water in A transparent container in front of the class before and leave it to settle while you discuss the need for clear water. When decanting, it is important to slowly angle the bottle, pour and stop as soon as the dirty layer reaches the rim of the container. If you only have red pindan soil it can take two or three days before the colloidal red mud settles out.

For this water sample, which part of the water should be decanted (poured) into each bucket? Answer given below.



Small Scale Water Treatment - Teacher's Notes

Materials per group

- A screw top bottle or jar. Empty cool drink bottles are fine.
- A beaker or container for the clear decanted water. A white cup provides good contrast.
- A teaspoon.
- Water
- Old newspaper to protect desks.

Method

1. Cover desks with newspaper.
2. Place 2 teaspoons full of soil into each bottle.
3. Add water until half full.
4. Screw on lid firmly.
5. Shake until completely mixed (about 1 minute).
6. Leave for about 5 minutes to settle.
7. Decant clear water at top into another container.
8. Compare the samples of decanted water.
9. The winner is the student who has the largest and clearest water sample.

And the winner was? _____

Please note that this water is clear.
It may not be clean enough to drink.

For human consumption this water needs to be boiled, disinfected or treated with UV light to kill off microbes and their toxins.

Small Scale Water Treatment - Teacher's Notes

Aboriginal people used to cover their "gnamma" holes with rocks or brush to stop animals disturbing their water making it murky or fouling it. They did not drink murky water because they said the snake which made the waterhole was still swimming in it. They would let it settle and then stoop down beside it and scoop up water from the top. IT may be clear but it will not be sterile and can carry germs.

Testing Water from Different Sources - Extension

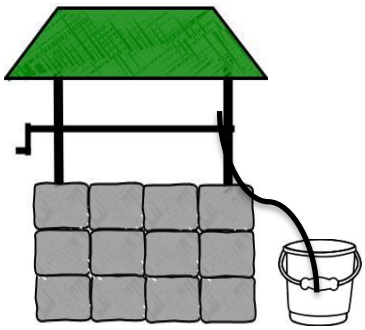
Ask students to collect samples of water from local natural water sources e.g. ponds, rivers and dams. Compare the settlement rates and water quality from these sources.

Water samples from four wells

Water samples after being allowed to settle for 5 minutes

Name _____

Small Scale Water Treatment - Student Worksheet



To get clear water for washing and drinking, early settlers had to leave it to ***settle*** and then they ***decanted*** it.

Clear water was used for _____

Cloudy water was used for _____

Muddy water was used for _____

Was it safe to drink the clear water? _____

Why? _____

Name _____

Small Scale Water Treatment - Student Worksheet

Decanting competition

Draw your container of settled water below.
Join the different layers of water to the correct buckets


Drinking


Washing


Animals & garden

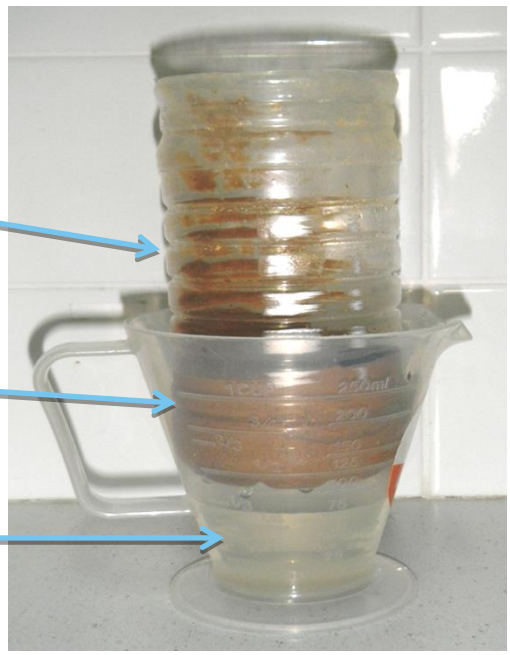
And the winner was? _____

Please note that this water is clear.
It may not be clean enough to drink.

Large Scale Water Treatment - Teacher's Notes

Where large volumes of water are needed for domestic and industrial use, it is first filtered to remove solids then treated to remove germs. If the water is stored in a reservoir, a measure of settling out of solids occurs.

Sand Filtering - Teacher Demonstration



Method

- Cut the bottom from an empty cool drink bottle
- Using a drawing pin make at least 6 holes in the bottom
- Fill one third of the bottle with washed sand
- Place this over a container
- Pour dirty water in the top container and collect the filtered water in the container below.

Water coming from large dams such as the Mundaring Dam which used to be Perth's major water supply is initially passed through a sand filter and then through other filters, before being treated further to make it safe to drink.

Large Scale Water Treatment - Teacher's Notes

Mundaring Weir near Perth

The first case of using sand as a water filter was in 1804 in Paisley in Scotland

Filtering Water - Student Activity

Materials per student or group. For schools without this equipment a substitute activity follows.

- 1 filter funnel
- 1 piece of filter paper
- 1 beaker
- 1 container of mixed water and soil

Method

1. Place the funnel above the beaker
2. Fold the filter paper to fit into the filter funnel
3. Slowly pour in the muddy water taking care not to overfill
4. Collect the clean water

Large Scale Water Treatment - Teacher's Notes

Substitute equipment

A plastic cool drink bottle can be cut in two to create:

a filter funnel
and
a beaker

Paper kitchen towel, "Chux" wipes or cotton fabric can be used as filter paper.

Students may be tempted to help push the water through the filter paper with their fingers or a pencil. This will cause holes in the filter paper and dirty water will flow through. Patiently adding the dirty water will prevent overflow.
Sand filters need to be regularly cleaned by "backflushing".

Disinfecting water

More complex membrane filters can be used to remove disease producing organisms such as giardia and cryptosporidium, however water is commonly disinfected by adding chlorine. Contaminated water is the greatest reason for childhood deaths in third world countries. Every 23 seconds a child dies from water born disease.

Fluorine can be added to help reduce tooth decay.

Precious Water - Teacher's Notes

Essential Water - Discussion

Some water uses are more important than others.

In modern Australia:

- The average person requires 370L of water per day. In WA most of this goes on gardens.
- The average household requires 900L per day
- Industry and commerce uses a further 150L per day

Guess how much water:

1. Should a year 2 student drink? 1L. Add 1L more if you are exercising
2. Does it take to make a hamburger? 2,500L. Most of this is drunk by the cow as it grows
3. It takes to flush a modern toilet? 5L

Method

- Read the data above and ask students what activities they use water for.
- Board student ideas.
- Ask students to classify their answers in their worksheet under the headings of:
    - I must have
    - I would prefer to have
    - I do not need
- Board student's answers
- Students break into groups which select two "must haves" from the board and each group discusses why having fresh water for their "must have" is absolutely necessary. Alternatively allocate "must haves" to each group.
- Students write their explanations into their worksheet and share them with the class.

Precious Water - Teacher's Notes

Worth its Weight in Gold – Student Activity

We are used to always having water "on tap" nowadays.

During the 1900s Gold Rush out in the bush, fresh water was so difficult to get that weight for weight it was more expensive than gold!

Very expensive water was carried to the miners on the back of camels and bullocks. People's unwashed bodies stank from sweat and dirt. Disease was common. Many small children died from water borne diseases and were buried with their iron cots marking the edges of their graves. Life is hard without water.

Materials

For this activity it is a good idea to have a collection of water filled one and two litre containers. You will need enough to hold 20L of water or more. Screw top cool drink or milk containers are ideal because if students drop them there is less chance of mess. At the end of the activity students can feel the weight of water they should ideally need for 4 days.

It is 1900 and your students are newly arrived settlers in WA. They are poor and need money so they decide to travel inland to the Goldfields to make their fortune. There will be stages of their trip when they need to carry water with them as there is no water to be found. Since they are walking, ideally they will each need to carry at least five litres of water a day.

The next well is four days walking away. How many litres of water must you carry? Use the block below to estimate the amount of water needed. In

Precious Water - Teacher's Notes

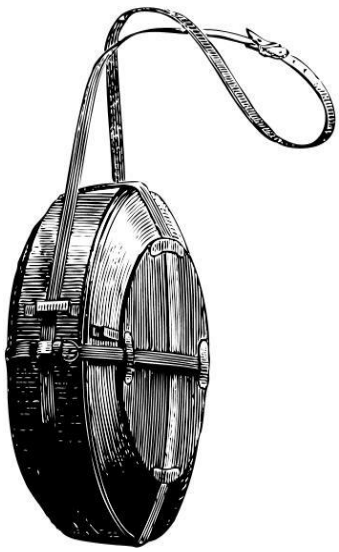
year 2 students need to drink at least one litre of water a day. They need to add another litre if it is hot and yet another if they are exercising. Toss a coin to decide if each day will be hot or not. (Heads is hot)

Estimating drinking water

DAY	Drink	Exercise	Hot weather
1	X	X	?
2	X	X	?
3	X	X	?
4	X	X	?

How much water do you ideally need to carry? Between 8 and 10L depending on the weather.

1L of water weighs 1kg. What weight of water would you need to carry? 8-10kg. The average year 2 student weighs about 20kg.
What fraction of your body weight would you be carrying on the first day? They would need to carry almost half their own body weight!



Of course the load would reduce each day.
The average canteen (pictured) holds slightly less than 1L. How many canteens would you need to carry? Between 8 and 11.

In practice dehydration was not uncommon. Some students may have experienced dehydration headaches, dizziness and a general feeling of sickness after a day in the heat without rehydration.
ASIDE: Most Australians carried a waterbag not a canteen. It was made of hessian or sacking. Water seeping through its sides evaporated keeping the

Precious Water - Teacher's Notes

water relatively cool.

Until recently many Western Australian schools kept a waterbag hanging on the end of the veranda as a water cooler for students.

What could have been done to reduce water loss through sweating? People tried to reduce their water need by not travelling during the heat of the day. Rich people travelled by donkey, horse, camel and eventually by train.

Many hopeful miners could not carry their picks, shovels, camping gear and water as well. There are reports of tracks leading out of Perth and Northam with abandoned tent poles, tents and other gear along their sides. Travellers had to decide what was necessary and what was not.

How far do you think you could carry 10L of water? Any reasoned estimate.

You might like to help students by telling them 10kg is the weight of 5 large bags of sugar or 5 bags of potatoes. To more scientifically estimate, students can lift 10L of your prepared bottles of water to experience the weight. If they are a humorous class, congratulations!. Take them outside and see how hard it is for two students to carry them a third across the oval.
Although there are lakes on the route to Kalgoorlie, they are salt lakes and the water is not potable/drinkable. The water found underground in the mines is so saline that it is saltier than the sea and can contain arsenic which is often present with vein gold. Now the Goldfields area is supplied

with freshwater from a pipeline running from Mundaring Dam near Perth 560 km to Kalgoorlie. It was designed by C Y O'Connor and finished in 1903.

A Young Bush Hero - Story

You may wish to read this to your students. It tells of a very resourceful and brave young West Australian boy. His care for his brothers and sisters in desperate circumstances captured admiration across the British Empire and monies were raised to award him a medal for bravery. He lived near Lennonville in the Mt Magnet Goldfields.

More than a hundred years ago, ten-year-old Vincent Atkinson had to set off through bush tracks in blistering summer heat with his three younger brothers and a sister, the puppy and the baby sharing the go-cart with the waterbag. His father was away prospecting when his mother dropped dead while hanging up the washing. Vincent's first thought was to walk 12 miles (almost 18 km) to where his father was camped but he would have had to leave the little ones behind and he would not have reached his father by nightfall. He decided to walk to where he knew his uncle was working in a mine near Mt Magnet. There would be people there to help.

Before leaving their isolated camp he first fed and watered the hens and then switched off the windmill, so that precious water would not be wasted. He sat his brothers, Robert aged 8 and Arthur aged 3 and his sister Isabel aged 5 down to eat a meal of bread and butter before explaining what they had to do. He filled a waterbag for the children and took an enamel mug to feed water to the baby.

Walking barefoot in temperatures over 42°C was terrible. The baby needed water frequently and the exhausted puppy soon joined it in the go-cart.

Precious Water - Teacher's Notes

Then his three-year-old brother had to be carried because his feet were so badly blistered. Although suffering from heat and exhaustion himself, he successfully shepherded his family to the mine.

When his story was told in the newspapers in London people raised money to give him a medal for his foresight and bravery.

I should like to thank Mary Callaghan and Geraldton Museum for their help in checking the facts of this event.

Name _____

Precious Water - Student Worksheet

Essential Water

Some water uses are more important than others.

Guess how much water:

A year 2 student needs to drink daily? _____

It takes to make a hamburger? _____

It takes to flush a modern toilet? _____

List the uses of water under the following headings

I must have water for these essential things	I would like to have water for these	I do not need water for these

Group decision

We must have water for _____ and _____

because _____

Name _____

Precious Water - Student Worksheet

Water Worth its Weight in Gold

We are used to always having water "on tap" nowadays.
During the 1870s Gold Rush out in the bush, fresh water was so difficult to get that weight for weight it was more expensive than gold! People's bodies stank from sweat and dirt. Many small children died from water borne diseases and were buried with their iron cots marking the edges of their graves.
Life is hard without water.

You are a "new chum" on your way to dig for gold. You have to walk for four days across country with no water holes. You ideally need to carry 1 liter of water to drink, wash your face and share with others, another liter if you are exercising (walking) and another if it is hot.

Calculate how much water you need to carry

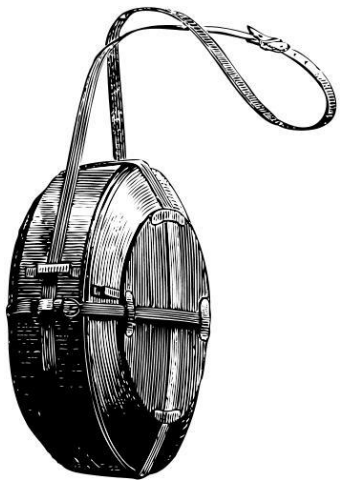
DAY	Drink	Walk	Hot weather

Name _____

Precious Water - Student Worksheet

How much water would you ideally need to carry?

_____liters



1 liter of water weighs 1 kilogram.

How many kilograms of water would you have to carry?

_____kilograms

The average year 2 student weighs about 20kg. What fraction of their body weight would you be carrying on the first day?

_____

How far do you think you could walk carrying that load?

_____

The water canteen above carries slightly less than 1L water. How many canteens would you need?

_____

What could you do to reduce water loss?

_____

Saving School Water - Teacher's Notes

School Water Use Audit - Thirteen Suggestions

Your school's ability to save water and to use it efficiently will depend on its age, climate, community involvement and funding. The Water Corporation program for "waterwise" schools can be accessed at: http://www.watercorporation.com.au/home/teachers/waterwise-schools-program

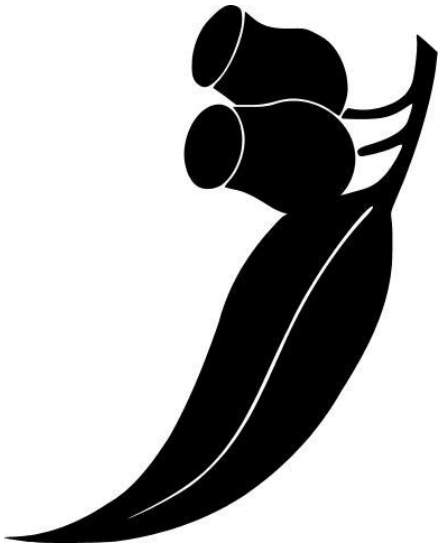
Some suggestions follow to help students identify actions at school which can conserve water resources.

1. Set a tap to "drip" into a measuring cylinder or jug. Estimate how much water would be lost if students didn't turn taps off properly. (1L is about 4,000 drips)
2. If washers in taps are not renewed regularly they will drip. Who would you tell in your school if you found a dripping tap?
3. Younger students may not be strong enough to turn off a tap properly. Older students should help them.

4. Toilets should be dual flush to minimize water use. In some Japanese schools' "intelligent" toilets are installed. There the water used to wash your hands is held in a basin at the top of the toilet then channeled down to flush the toilet too! The Water Corporation has a lovely video of a singing toilet for National Toilet Day.

Saving School Water - Teacher's Notes

5. Where possible taps in toilets should be spring loaded to switch themselves off automatically.
6. Lawns and gardens should only be watered on the correct days and at the correct times, early in the morning and in the evening. Water sprayed in the middle of the day is mostly evaporated. Sprinkler systems should be adjusted to work automatically.
7. Where possible waterwise planting with native plants or plants with low water needs is advised.
8. Applying mulch and compost retains water in soils.
9. Does your school have a worm farm? How would that help retain water?
10. Drip irrigation uses less water than sprinklers and more water reaches plant roots.
11. Trees and bushes provide shade and humidify the air around them. Treat them with respect.
12. Is water collected from the roof channeled into the garden beds and water tanks?
13. Use sealed paths around grassed areas rather than walking across them. This creates bare dry areas.



Q Who is responsible for stopping water waste at your school?

A EVERYBODY!

Name _____

Water Saving at Home - PPP

Two experiments that can easily be done at home

In Science we have been looking at water and how it is used.

1. Water loss from a dripping tap

You will need:

- A tap set to drip
- A container to collect the drips
- A measuring jug to find out how much water is collected
- Something to colour the water collected (option)
- A clock, watch or timer

Set up the equipment and find out how much water is lost from a dripping tap in 1 hour. If you do not have a measuring jug, 1 teaspoon usually holds 5mL of water. How much water was lost?

2. Glass or tap to clean your teeth?

Do you use more water if you rinse your mouth under the tap or if you use a glass of water?

You will need:

- Toothbrush and toothpaste
- Half a glass of water
- A tap and basin with a plug
- A piece of masking tape or electrical tape

Make sure the basin is plugged. Clean your teeth with the tap running, rinsing your mouth in the flowing water. Mark the level of water in the sink with masking tape and then drain the water. Repeat using only water from the glass. Replace the plug and pour half a glass of water into the sink. Which technique uses the most water?

(Note: The brush appears broken because water bends light rays differently to air).

Aboriginal Perspective on Water - Teacher's Notes

Although Antarctica is the driest continent on Earth, Australia is the driest inhabited continent. About 40-50,000 years ago, towards the end of the last Ice Age, world sea level was lower because rain water which would have normally run down to the sea was still trapped in great glaciers and ice caps. This allowed people to walk over land now covered by sea.

The first waves of ancestral Aboriginal people arrived from the north about 40,000 – 50,000 years ago. They were able to walk, sail and island hop on rafts southwards to the north coast of Australia. Radiocarbon dating and cultural relicts suggest there were at least two waves of Aboriginal settlement. Genetic evidence suggests that the dingo arrived with a late settlement wave about 18,000 years ago. The longest consistent culture on Earth is of the Australian aborigine. (In comparison, Ancient Egyptian civilization only started 3,100 years ago).
Once they had arrived on the north coast they travelled southward across the continent mostly following the coast where there was best access to fresh water and food. People also followed the great rivers inland.
Men mostly hunted large game and women hunted small game and gathered fruits and seeds. When their descendants reached the south coast they were even able to walk across to Tasmania. Then the climate warmed, the ice melted, the sea level rose and Bass Strait became sea again isolating Tasmania.
Because food sources were poor they followed seasonal fruits and game, movement living a hunter-gatherer lifestyle. Their "walkabout" lifestyle was essential so that they did not exhaust any resource, be it food or water. They also travelled in small groups because resources were limited. Children were raised to believe that they had to look after "country" . They belonged to the land and were responsible for its maintenance. They were custodians of Air, Water, Living Things and Land.

Aboriginal Perspective on Water - Teacher's Notes

Aboriginal People and Water

Fresh water could be found in rivers, billabongs (ponds remaining in drying rivers), soaks (where rain runs off from a rock to be ponded on clay pans in the soil) and in small hand extended reservoirs in rock called "gnamma" holes after the gnamma or snake which was believed to have gnawed them out. Noongar people called the water snake "Waugal". They advised that you should only drink water if it is clear and not when it is murky because the "snake" was still swimming around in it. This gnamma hole near Sandstone has lost its capping rock and has filled in with soil. It still fills with water after rain.

By mostly travelling and hunting in the morning and evening they reduced water lost by sweating. In extreme heat they would dig a hole in damp sand and bury themselves up to the neck to keep cooler. In the central deserts, small groves of desert oaks found within the sand dunes sometimes display little holes drilled into their bark. People would insert grass "straws" into these holes and suck out tree sap for water. The holes would be sealed with mud after use.

The "song lines" by which Aboriginal people remember how to safely navigate their way around their territories often described pathways from water source to water source. The high frequency of water signs in paintings and carvings indicate the importance of water in Aboriginal culture.

Aboriginal Perspective on Water - Teacher's Notes

A Sign for Water - Discussion

People used stories as maps of where and when to find water. They left petroglyphs (rock markings) to indicate that water was nearby and children had to memorise songs which "mapped" routes to water sources in their land.

One of the most common signs for water in petroglyphs (rock pictures) and in paintings is concentric circles as shown in this photograph.

It comes from rocks near a waterhole close to Newman but similar signs can be found on rocks and in paintings across Australia

Why do you think Aboriginal people used concentric circles to represent water? If you drop a stone into water, concentric waves are created.

Why didn't they just write a sign saying "WATER "on the stone?

1. Aboriginal people did not have a written language, indeed there were many different language groups sharing hunting ranges but being there at different times. The signs had to be understood by many groups. You may wish to refer to: http://www.abc.net.au/indigenous/map/
2. Although some groups used ochre and made paintings, these had to be under overhanging rock or in caves as they wash off in rain and their colour is lost. The rock carving told anyone speaking any dialect that water was near.

3. The petroglyphs were made by scratching through the redder weathered rock on the surface to make lighter lines from the rock below. Carving into rock is very difficult and time consuming. Their creation and maintenance over thousands of years is an indication of their importance.

Petroglyph Design – Student Activity

Unlike writing with pencil and paper, petroglyphs cannot be rubbed out and changed if mistakes are made. Students are asked to design their own icon for water and model it in flour.

Materials

- Petri dishes, saucers or other flat dishes
- Flour or sand
- Spoon
- Pencil
- Newspaper
- Coloured pencils or pens

Method

1. Cover the desk with a piece of newspaper.
2. Place a thin layer of sand or flour on the bottom of the dish and smooth it flat with the back of the spoon.
3. Cut your design into the flour or sand with a pencil or spoon handle.
4. Adjust to improve.
5. Copy the design onto this worksheet.

Aboriginal Perspective on Water - Teacher's Notes

Draw your sign for water below and explain why you chose it.

WATER
Why I chose it _____ _____

Way to Water - Extension

Students may wish to create a dot painting indicating the route from their desk to the nearest drinking fountain. Icons for footsteps and landmarks would have to be selected.

Materials

- Paper
- PVA paint in jam jar lids
- Blunt brushes or the ends of pencils. Plastic drinking straws make excellent dots if recharged frequently.

Name _____

Aboriginal Perspective on Water - Student Worksheet

About 40-50,000 years ago, Aboriginal people moved south into Australia. Water was very important to their survival. Their "walkabout" lifestyle was essential so that they did not exhaust any resource, be it food or water. Children were raised to believe that they had to look after "country". They were custodians of Air, Water, Living Things and Land.

Fresh water could be found in rivers, billabongs, soaks and in small hand extended reservoirs in rock called "gnamma" holes. This one near Sandstone has lost its capping rock and has filled in with soil. It still fills with water after rain.

A Sign for Water

People used stories as maps of where and when to find water. They also left petroglyphs (rock markings) and paintings to indicate nearby water.

Why do you think Aboriginal people used concentric circles to represent water?

_____

Name _____

Aboriginal Perspective on Water - Student Worksheet

Why didn't they just write a sign saying "WATER "on the stone?

_____

_____

Petroglyph Design

Materials

- Saucers or other flat dishes
- Flour or sand
- Spoon
- Pencil
- Newspaper

Method

1. Cover the desk with a piece of newspaper.
2. Place a thin layer of sand or flour on the bottom of the dish and smooth it flat with the back of the spoon.
3. Cut your design into the flour or sand with a pencil or spoon handle.
4. Adjust to improve.
5. Copy the design below and explain why you chose it.

Name _____

Aboriginal Perspective on Water - Student Worksheet

My design

I chose this design because _____

_____

_____

Introduction to Soils - Teacher's Notes

Soils are the product of rock weathering, erosion and deposition, modified by living things and their products.

Some Western Australian soils

From left to right

Top	Rockingham	Mingenew	Geraldton
Bottom	Esperance	Spearwood	Perth

The colour of soil depends on the nature of the original rock fragments and later modification by living things.

Some interesting soil facts

- One tablespoon of soil has more living organisms in it than there are people on Earth.
- It takes more than 200 years to create 1cm of fertile topsoil.
- Nearly all modern antibiotics used to fight infections are obtained from soil organisms.

Introduction to Soils - Teacher's Notes

- Parts of coastal Western Australia arguably have the second worst soils in the World.

Soils are useful resources for:

- Growing food, wood, shelter and recreation areas.
- Making rammed earth buildings.
- Sheltering decomposers and other animals.
- Holding and filtering water.
- Burning for fuel (peat).

Soil Recipe - Teacher Demonstration

Materials

- Gravel/ pebbles/road metal
- Sand

Introduction to Soils - Teacher's Notes

- Dried leaves/grass (crushed if large)
- Compost
- Water
- Mixing bowl

Method

1. Ask the students where they think each component comes from.
2. Gravel – broken/weathered rock
3. Sand even more broken/weathered rock
4. Leaves from trees and bushes
5. Compost from compost heap/bin or worm farm. If you don't have compost use potting mix.
6. Mix about half a handful of each into a larger container, add about 2 tablespoons of water and ask the students what they think you are trying to make. They may say "soils".
7. Ask the student what ingredient/thing is still missing. They may say the brown part or living things such as worms and slaters (woodlice). This mix also doesn't have fungi and bacteria that are needed to decompose dead plants and animals to make humus.
8. Discuss with the students how much of each component should be added to make a good soil for the garden. (Recipe for a good soil).
9. Ask the students why all soils are not the same. The different sources of rock and percentage of components result in different soil types.

If you have some good soil from your garden or the school garden, students can compare the soil you have mixed with the real thing.

This activity is based on an activity from Earth Learning Ideas web site www.earthlearningideas.com

Introduction to Soils - Teacher's Notes

Senses and Soils – Student Activity

As science students, we use our senses to learn about the World.
Which senses can we use to study soils.

				
See/sight	Listen/hear	Feel	Taste	Smell
YES	YES (but no sound)	YES	NO	Soil can smell if it is wet and rich in humus

Materials per group

- Old newspaper to protect desks
- Some soil from the school garden
- Rubbish bin
- Access to somewhere to wash and dry hands

Method

1. Place a small heap of soil in front of each group.
2. Invite students to use their senses to describe the soil. (Alternately classes can be taken outside and examine soil in situ.)
3. Ask each group to report on what their soil was like using their best science words.
4. Board a consensus description for the students to copy

Introduction to Soils - Teacher's Notes

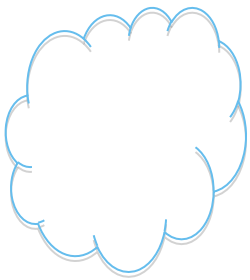
Soil description words

- Colours
- Coarse, medium, fine grained
- Living things visible or not
- Wet damp or dry
- Clay, sand and grit

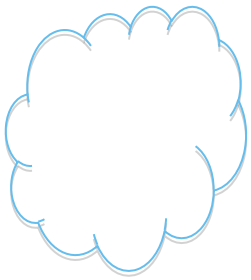
Soils contain living things. What lives in soils in Australia?
Worms, insects, roots from plants. Wombats, lizards and snakes live part of the time in burrows in soil as do some birds.

Soil is a resource. What is a resource? Something that is useful.

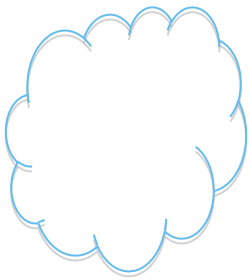
What Do We Use Soils For? - Student Brainstorm Activity



At Home



On the farm



In school

Materials per group

- Paper for rough copy of ideas of what we use soils for
- Worksheet
- Pencils

Introduction to Soils - Teacher's Notes

Method

1. Brainstorm what soils are useful for.
2. Explain that these ideas need to be clumped into groups or classified as above
3. Ask the group to write down their ideas and classify them. This may take two steps, one to write down and another to put them into groups.

Suggestions

1. At home - Garden for food and flowers. Grow shade trees and bushes. Inside grow decorative pot plants.
2. On the farm - Grow crops for sale. Grow plants to feed animals. Plants for hedges. Plants for shelter for animals.
3. In school -? Garden to please the eye. Garden for learning how to grow food. Shade. Sports fields

Name _____

Introduction to Soils - Student Worksheet

Senses and Soils

As science students, we use our senses to learn about the World.
Which senses can we use to study soils?

Soils contain living things. What lives in soils in Australia?

_____

_____

Soil is a resource. What is a resource? _____

_____

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Santos & ESWA supporting earth science education

Name _____

Introduction to Soils - Student Worksheet

What do we use soils for?

At home

On the farm

In school

Humus in Soil - Teacher's Notes

Humus is living material that has been broken down and composted by worms, insects, fungi and bacterial to create a magnificent soil conditioner. Humus does not usually add fertiliser to the soil but it provides the chemical conditions which allows important elements such as nitrogen, magnesium and potassium to be bound to soil's mineral grains and remain available to plants. In our poor "gutless" soils fertiliser can wash straight through the soil and enter the aquifers and rivers causing algal blooms. The added ability of humus to retain water means that dissolved fertiliser becomes more available to plants.

Materials per student or group

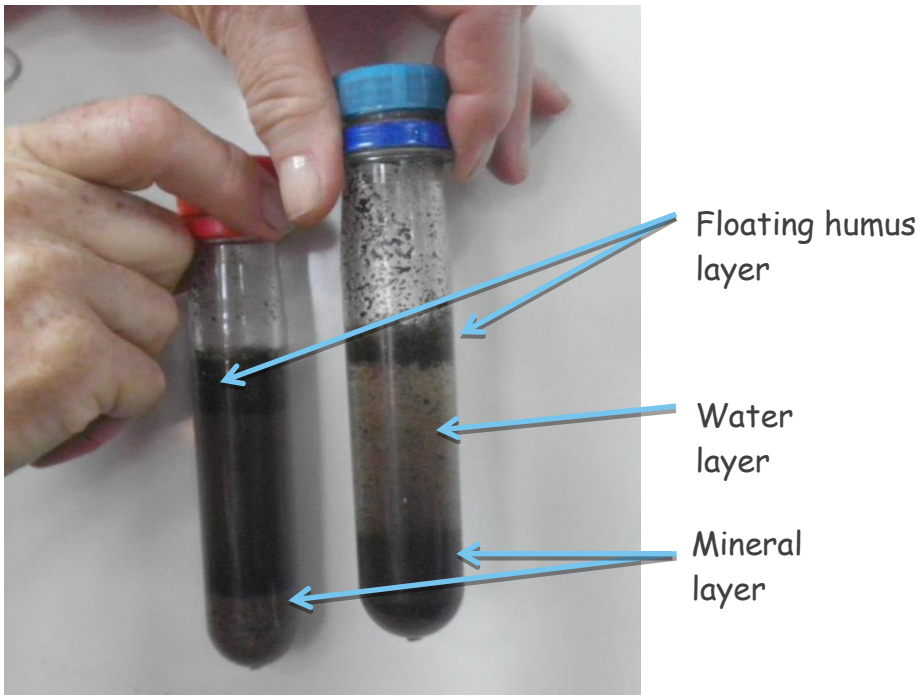
- About 2 tablespoons of garden soil. Make sure to collect samples from below the mulch layer.
- A container that seals. An empty cool drink bottle or jam jar are fine. If students use test tubes they must be careful to seal the top with their fingers or thumbs.
- Water in a jug
- A piece of scrap paper and a pencil

Method

1. Place a specimen of soil in the container.
2. Lay the paper alongside the soil and make a mark to measure the soil level in the container.
3. Half fill with water.
4. Seal and give it a good shake for 1 minute
5. Hold upright without moving for at least two minutes to allow the soil settle. Clay rich soils may take longer to settle.
6. Lay the paper along the container and measure the thickness of the humus layer

Humus in Soil - Teacher's Notes

Dark humus (dead and living component) will float to the surface of the water and lighter coloured but heavier fragments of broken rock will sink to the bottom.



Two specimens of soil (one from the garden and one from the nature strip along the roadside)

7. Estimate the fraction of the original soil that was humus by finding out how many times the humus measurement will fit into the total soil measurement. (In most established school garden soils the fraction of humus in soil is about $\frac{1}{4}$).

The richer the soil, the higher proportion of soil will be humus. If the school has its own worm farm students will be able to see how worms and other creatures breakdown plant and animal matter into humus. If students can use magnifying glasses they may be able to see the fungal filaments and tiny arthropods that also work there to enrich soil. They can also see small

pieces of rock.
Broken down rock minerals in soil feed not only the plants and animals on land but also those in the sea. Rocks are broken down into small pieces of gravel, sand and clay initially by weathering and by mosses and lichen. They are further digested and chemically altered by microscopic bacteria and fungi. Worms and insects mix and aerate the humus allowing water and air to enter.

More information about humus
Humus can hold up to 90% of its weight in water. Most plants need at least 10% humus in the soil to grow. Humus has a negative charge which means that ammonium (a source of nitrogen), calcium, magnesium and phosphorous are attracted to it. This stops rainwater washing these precious nutrients away. Adding too much organic matter can make the soil too acid. It will not break down quickly forming a peat layer that is only suited to a few plants.

Mulch and compost

Mulch is organic or inorganic material that is added to cover the surface of the soil. This keeps it cool, retains some water and reduces weed growth. Mulch can be dead leaves, newspaper, and black plastic or even stones. When the Israelis were revegetating the Sinai desert they placed at least three large stones around each tree planting to aid plant survival. Mulch can take 10 to twenty years to breakdown. Leaves from some Australian trees, such as eucalypts actually need to remove nitrogen from the soil to break down.

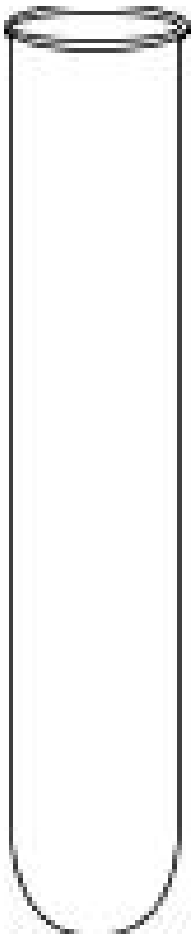
Compost is organic matter that is in the process of decomposition.

A good gardener has a layer of mulch above a layer of compost and then a humus rich soil.

Name _____

Humus in Soils - Student Worksheet

Humus is made from living things.
Humus keeps soil healthy.
Draw your soil and label the **humus layer**, **water** and **mineral layer**.



What fraction of your soil is humus? _____

Soil and Worms - Teacher's Notes

Willie the worm needs a new home

To replay the understanding that soil has living and non- living components and why it is an essential resource, the following activity "Willie the worm needs a new home", can be used.

The activity might be preceded by a visit to the school's worm farm or mulch heap to view working worms (and other decomposers) that live there and break down organic matter to enrich soil. If you are not familiar with worm farms, the layer under shredded newspaper often contains lots of worms.

The worksheet and pictures may be uploaded to a Smart Board or projector and the class can discuss possible answers before filling in their own worksheets.

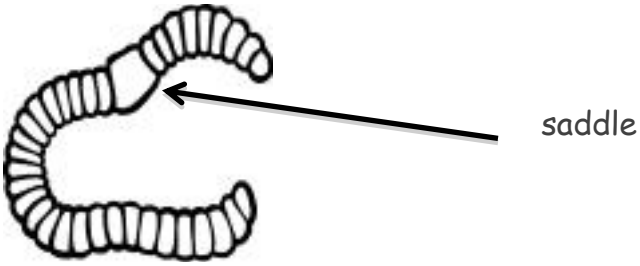
This also provides an opportunity for students to create a puppet show or drama relating this story and its characters.
Students can take the parts of:

- Narrator
- Willie the worm
- The farmer
- The cow
- The wheat
- Willie's friends, the worms, the bacteria and the fungi

Worm information

Would you please ask students to only handle worms minimally as they are sensitive to heat from human's hands.

Soil and Worms - Teacher's Notes



The garden earthworm is a segmented worm. It has little hooks or chaetae on the underside of its segments that it uses to pull its way along. It moves forward in waves of contraction and extension along its body.

One end of the worm has sensitive tissue that reacts to light and heat. This is the shorter portion in front of the thick saddle. Worms move away from light. A bird has to be up early to catch a worm on the surface of the grass. At daybreak light drives them underground. If it rains heavily and their tunnels are filled with water you may also find them at the surface.

Worms are hermaphroditic being both male and female. They can fertilise each other and both lay eggs. (Perhaps our worm should be called Willie/Wilhemina?)

In soft earth it pushes its head forward through the soil, however if the soil is hard, it can also eat its way through. It leaves tunnels that allow air into the soil and water to penetrate easily. Plants depend on air and water reaching their roots. They depend on nutrients dissolved in water. Worm castings are a very valuable type of fertiliser.

Worm Farm Option

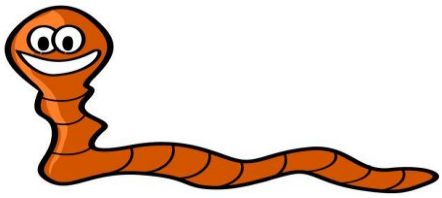
Using an old aquarium or other large transparent container, fill with thick layers of soil, shredded newspaper (visit the school office?) and vegetable waste (canteen?). It should be kept warm and damp, not wet.

If the farm is placed inside a cardboard box or covered by a cloth, student will be able to remove these and see how the worms mix up the layers and make tunnels.

Worms digesting kitchen scraps, turning them into humus for the kitchen garden.

Only use vegetable waste in your worm farm as this reduces the chances of smell and flies.

Soil and Worms - Teacher's Notes



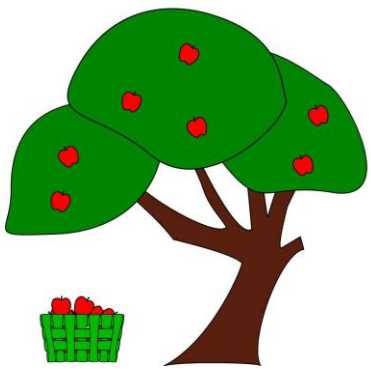
Willie the worm needs a new home

"There are too many worms in this place" said Willie.
"I need to make a new home. I need some soil of my own".

"Rocks can you help me?" asked Willie.

"We can give you **gravel and sand**" said the rocks.

"Thank you" said Willie and he took away the **gravel** and the **sand**.



"Apple tree, can you help me?" asked Willie.

"I can give you **dead leaves and rotten fruit**" said the apple tree.

"Thank you" said Willie and he took away the **dead leaves** and **fruit**.

Soil and Worms - Teacher's Notes

"Sky, can you help me make a new home?" asked Willie.

"I can give you gentle drops of rain" said the sky.

"Thank you" said Willie and he took away the gentle drops of rain.

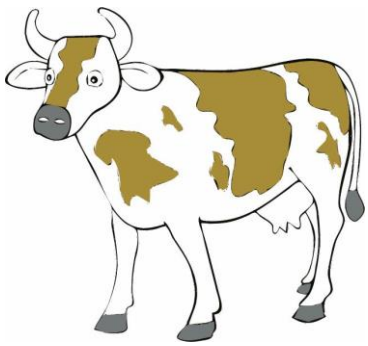
Willie mixed together the gravel and sand, the dead leaves and fruit and then added the rain.

Willie had made soil. It was lovely.

The farmer said "Come with your lovely soil and live on our farm".

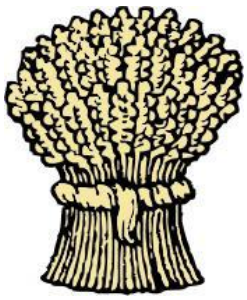
"Yes, please come" mooed the cow. "Why?" asked Willie.

"Good soil grows good grass. Cows eat grass. Working worms improve soil" mooed the cow. "I eat grass and make milk for my calves and the farmer" mooed the cow.



Soil and Worms - Teacher's Notes

"Yes, please come" whispered his wheat. "Why?" asked Willie.

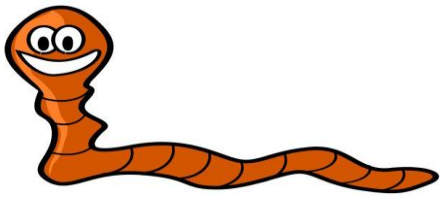


"Good soil has food for growing wheat. Working worms improve soil" whispered the wheat.

Soon other worms came to join him. (Willie also brought his friends the fungi and his buddies the bacteria. The farm was a wonderful place for worms). They ate tunnels through the soil and helped the plants and animals.
Draw Willie and the other worms in their soil.

Name _____

Soil and Worms - Student Worksheet



Willie the worm needs a new home

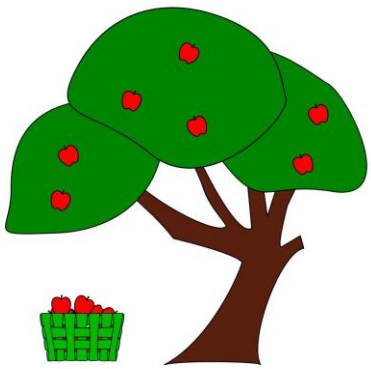
"There are too many worms in this place" said Willie.
"I need to make a new home. I need some soil of my own".

"Rocks can you help me?" asked Willie.

"We can give you _____

and _____ said the rocks.

"Thank you" said Willie and he took away the_____ and _____.



"Apple tree, can you help me?" asked Willie.

"I can give you _____and

_____" said the apple tree.

Name _____

Soil and Worms - Student Worksheet

"Thank you" said Willie and he took away the _____ and _____.

"Sky, can you help me make a new home?" asked Willie.

"I can give you _____

_____"

said the sky.

"Thank you" said Willie and he took away the _____

_____

Willie mixed altogether the_____

_____

_____

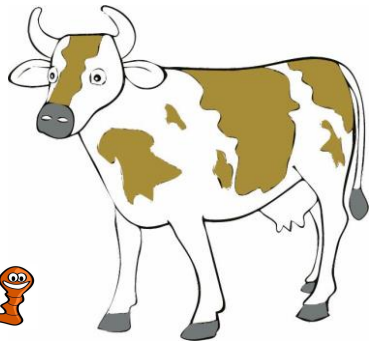
.

Willie had made soil.
It was lovely!

Name _____

Soil and Worms - Student Worksheet

The farmer said "Come with your lovely soil and live on our farm".



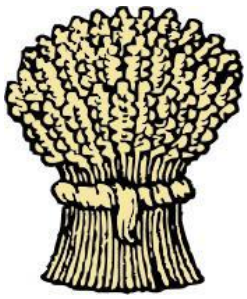
"Yes, please come" mooed the cow.
"Why?" asked Willie.

_____

_____

_____

"Yes, please come" whispered his wheat. "Why?" asked Willie.



_____

_____

Soon other worms came to join him. (Willie also brought his friends the fungi and his buddies the bacteria). The farm was a wonderful place for worms. They ate tunnels through the soil and helped the plants and animals.

Name _____

Soil and Worms - Student Worksheet

Draw Willie and the other worms in their soil.

Save our Soil Poster - Teacher's Notes

Students are invited to draw a poster using one of the ideas below.

1. Don't walk on soil as you squash it and this makes it difficult for rain and roots to penetrate. Keep to the pathways when you walk or ride bicycles and skateboards.
2. Don't throw away rubbish as this can pollute the soil.
3. Don't throw away water with paint or chemicals into the garden. It will poison the plants and kill the worms.
4. Have a compost center or worm farm to improve the quality of the soil.
5. Place mulch onto the soil to keep it cool and moist over summer.

Marking key

Simple snappy title in large letters	1 mark
Drawing fills the space and is easy to understand	2 marks
Uses few colours	1 mark
Checked by fellow student	1 mark
Name on back	1 mark
	6 marks

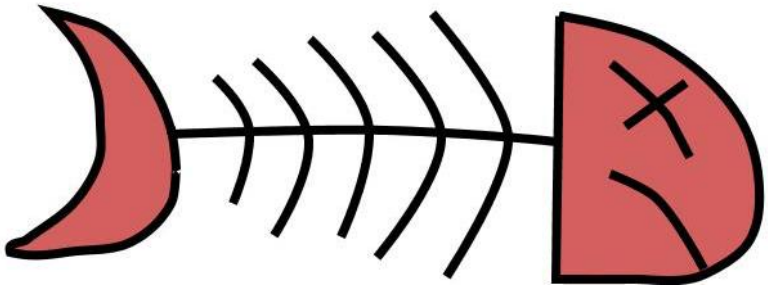
Name _____

Save our Soil Poster - Student Worksheet

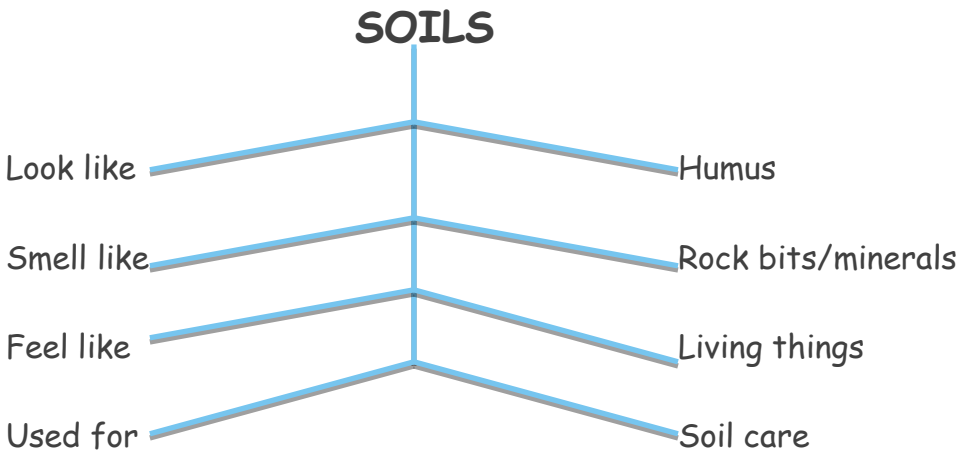
Text goes here

Fishbone - Teacher's Notes

Revision sheet for "Soils"



A fishbone graphic organizer allows students to revise what they have learned and classify, or put the information they have gained, into context (processing and analysing information). At the fish head students write the topic "SOILS". Then, either alone or in groups, they can write what they remember as important information along the bones of the fish skeleton. They may use past worksheets to remind themselves of important words.



The most interesting thing I learnt was _____

_____

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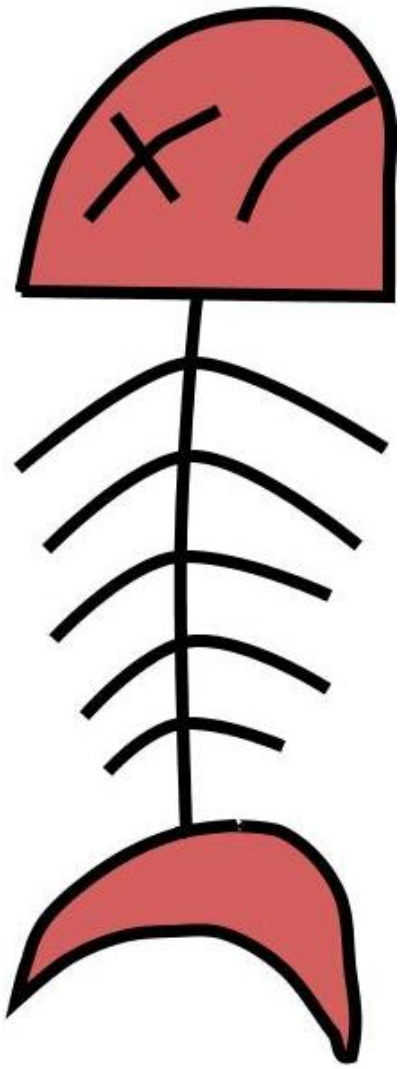
Name _____

Fishbone - Student Worksheet

SOILS



The most interesting thing I learnt about soils was _____

_____

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Good Soil and Bad Soil - PPP

We have been studying "**soils**" in our Science class. If you give your student:

- An empty jam jar or small cool drink bottle.
- Enough soil from your garden to 1/3 fill the container.
- Enough water to 2/3 fill the container.

They will tell you how much humus is in your garden soil by sealing and shaking the container.

Humus is a wonderful soil conditioner. It is made from living and dead matter. It not only retains moisture in the soil, it helps the soil retain fertiliser and grow healthy plants.

An experiment to demonstrate this at home

Materials

- Two containers such as plant pots or yoghurt pots. (Make sure there are holes in the bottom to allow water to drain away.
- Permanent ink labeling pen
- Two different soils (perhaps one from the garden and another from the roadside).
- Fast growing seeds such as alfalfa, mung beans or peas

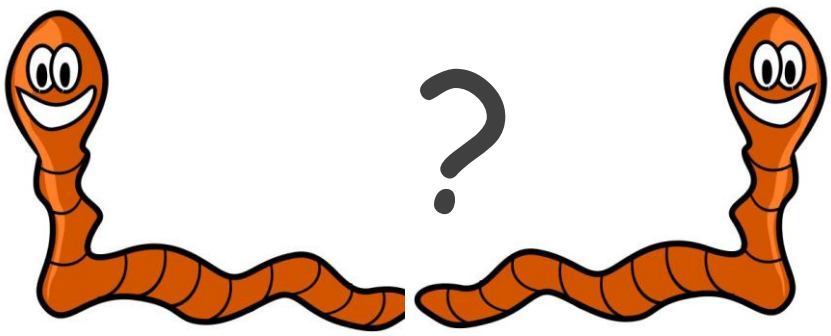
Name _____

Good Soil and Bad Soil - PPP

Method

1. Label the containers 1 and 2.
2. Place equal quantities of soil in each container.
3. Add seed and cover lightly with more soil
4. Water lightly
5. Place in a sunny area and water when dry. (Soil needs watering when it doesn't stick to a dry finger).

Please note – The first days a seed grows it is dependent on the food supply it already has within the seed and will not be immediately affected by a poor soil. After a couple of weeks however, when its own supply has been exhausted, the effect of soil differences on plant growth will be more obvious.



Ask your science students what part worms play in having a healthy soil.

Happy Soil Science!

Clean Air - Teacher's Notes

Clean air as a resource

Have you ever noticed how the air smells different in the city from the bush? In the bush there is less pollution from burning fossil fuels for industry, household energy and transport. Dirty air makes people sick and can even kill them. During the winter of the "Great London Smog" of 1953, between 5,000 and 7,000 people died and 90,000 children had to go to hospital with severe respiratory illnesses. The main culprit was burning low-grade brown coal for industrial use and domestic heating. When laws were passed to restrict coal fire pollution the health of the nation improved rapidly. During the last two Olympic Games competitions, local industries were closed down so that athletes could compete fairly and that sick visitors did not embarrass host cities.

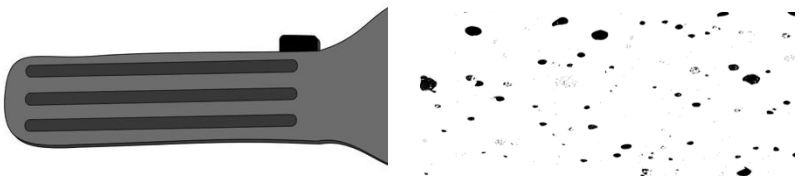
It may be important to explain that many of the pollutants in our air that are released when fossil fuels are burned, such as sulphur dioxide, nitrogen oxides and carbon monoxide, are invisible.

Our neighbors to the north suffer annual breathing problems from illegal fires lit to clear land for growing palm oil trees. Air quality becomes particularly bad when the peaty soil catches fire. Pollution from fires in Indonesia affected Malaysia, Singapore, Guam, Palau and the North Marinas closing schools, cancelling international flights and sending the old people and children to hospital. Normally the onset of the cyclone season puts out these fires but in 2015 this was unusually late. During 26 days the 2015 Indonesian fires produced more greenhouse gasses than the USA, whose output is second only to China. Air is shared internationally.

Clean Air - Teacher's Notes

Dust in Air - Teacher Demonstration

Pre-test this activity in your classroom as not all rooms can become sufficiently dark. Masking tape can be used to create a narrow light beam from a light or torch. If you are able to darken your classroom by switching off lights and drawing curtains or blinds, a narrow bright torch beam or shaft of strong light from the data projector will demonstrate the fine dust particles whirling in the air if viewed from the side. If it is bright and sunny outside, a narrow gap in the curtains will also display dust particles.



Dust is always part of the air we breathe. It is the dust in our atmosphere that causes the wonderful colours in the sky at sunrise and sunset.
Up to 30% of the dust we breathe in town is thrown up by road vehicles.
Most of the dust we breathe at home is dead skin cells!

Pollution and Lung Problems

Students who suffer from bronchitis or asthma may be aware of the effect gasses and dust can have on their breathing. The lining of their airways can become inflamed and narrow. Breathing out can be very difficult.
One of your students who suffer from airway problems may be able to remind other class members of what First Aid could be done if they have an attack. What they should and shouldn't do and who to contact. A visit from the Community Nurse might also be possible.

Clean Air - Teacher's Notes

Dust in the Air - Student Activity

We shall be examining "particulate matter" or DUST. (This activity should not be done immediately after rain, as most of the dust will be washed off).

Have you ever breathed in a lot of dust? What happened?
You may have to remind students of hiding under the bed, hiding in a wardrobe playing "hide and seek" or standing round a camp fire and getting a face full of smoke. Coughing, wheezing, eyes water, sneezing.
Early settlers often were troubled by dust storms caused by clearing vegetation from the land.

Air quality in our school

When scientists test air for dust they use a machine like a vacuum cleaner. Air is sucked in through fine filters and the quantity and volume of dust estimated. We shall be using an air filter from Nature.
Plants take in air through holes (stomata) in their leaves and use parts of it (carbon dioxide) to make food for themself and for us. If we wipe the surface of leaves around the school we can sample the amount of dust in the air. Dust on the top of the leaf is more liable to be washed away by rain. Samples taken where teachers park their cars are usually pretty dusty. Some indoor plants, which do not get washed by rain or blown by wind, can be pretty dusty too! Thank goodness that few students smoke because in years gone bye "Smoker's Corner" was outstanding for its pollution. If you fear your class may severely defoliate the school grounds, wiping windowsills or the outside of windows can be substituted.

Clean Air - Teacher's Notes

Materials

- Scissors
- Worksheet and pen
- Map of the school. Students may already have been shown how to use a map in Geography. Alternatively display the map on a Smart Board.
- 6 Pre-cut pieces of tissue (toilet paper sheets cut in quarters are fine).
- Access to stapler or glue stick

Method

1. Issue student groups with worksheet and map of the school help them select 6 locations. Place the numbered locations on the map.
2. Board the number and name of each location.
3. Issue each student with six pieces of double tissue.
4. Accompany students to each location and ask them to firmly wipe the underside of leaves at each location six times. Explain that leaves are to remain undamaged on the trees or bushes.
5. Return to the classroom and fix the paper in the correct square with the stapler or glue.
6. Discuss your findings and range your locations from least dusty to most dusty.

Clean Air - Teacher's Notes

Results

Which area had the worst dust pollution? The area with the worst dust was the teacher's car park.

Most Dusty					Least dusty

Most of the dust within our houses and schools is made from dead skin cells. When you see the filter from your vacuum cleaner after one week you will realise how much this can be. Within the dust lie little arthropods that eat it. These dust mites are the most common cause of childhood allergies. After two years, 10% of your pillow is composed of dead mites and their droppings!

If the air at school suddenly became less fresh, what could you do to make it be less dusty?

- Keep as many vehicles (including bicycles) as far away as possible.
- Walk to school.
- Dampen down the dust with sprinklers.

- Wear a facemask.
- Plant more low lying groundcover to stop the wind blowing the dust around

Smoking signs

Smoking cigarettes produces both noxious gasses and fine hot particles.

What have these signs to do with clean air?

Smoking makes clean air dirty.

Why aren't people allowed to smoke in school?

Smoking makes people sick.

Is it only the smokers who get sick?
No. People around them breathe in smoke too.

Name _____

Clean Air - Student Worksheet

Have you ever noticed how the air smells different in the city from the bush? In the bush there is less pollution from burning fossil fuels such as coal, oil and gas.

Have you ever breathed in a lot of dust? What happened?

_____

If we wipe the surface of leaves around the school we can sample the amount of dust in the air.

Stick your dust samples in the space below.

Name _____

Clean Air - Student Worksheet

Observations Which area had the worst dust pollution?

Most Dusty →					Least dusty

If the air at school suddenly became less fresh, what could you do to make it be less dusty?

_____

_____

Signs

What have these signs to do with clean air?

_____

Why aren't people allowed to smoke in school?

_____

Is it only the smokers who get sick?

_____

Minerals - Teacher's Notes

Although commonly the word "mineral" is used to denote a metal, minerals are any inorganic (non-living) thing which has an almost constant chemical composition and whose crystals have the same geometric shapes.

In Earth Science minerals include iron ore, diamonds, clay and even quartz sand.

Oresome Resources have a fine lesson recognising everyday uses for minerals at:
http://www.oresomeresources.com/resources_view/resource/lesson_everyday_objects_made_from_minerals_year_2

If you visit the Earth Science Western Australia website www.earthsciencewa.com.au you will find how to access free teachers loan boxes with a selection of minerals and activities with teacher's guides. You can modify to suit your class

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