



Teaching and Learning Strategies

Teaching Resources for Years 7- 12 children

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Literacy Teaching and Learning Strategies

Research has shown that students need to meet new concepts in at least four different ways before long term memory is assured. Research has also shown that to be competent and confident writers, using specific language such as the language of science, students first need to be confident and competent users of the language orally. For this reason, a number of different strategies have been written focusing on speaking as well as writing.

The strategies are divided into the different aspects of language acquisition - vocabulary, deconstructing text (reading for understanding) which includes questioning, constructing text (writing their own answers) and integrating strategies using many skills. These are mostly pair or group activities so that students use the scientific language in sentences to each other when discussing their responses.

Students understand concepts better when there is an emotional connection to their learning - having fun and empathising with people or animals involved. The Experiential activities section allows students to take different roles - other people, animals and plants, molecules, wind, sea etc. This helps them understand complex processes and the emotions and associated actions help them to remember.

Vocabulary Activities

1. Vocab Jumble
2. My Definition
3. Clustering
4. Making Words
5. Word Assembly
6. Definitions

Deconstructing Text

1. Sequencing
2. Snappy Headings

Constructing Text

1. Picture Dictation

Integrating Strategies

1. KWL Grids
2. Three Level Reading Guides

Co-operative Grid - Revisiting Climate Change

	Me	Others	Others
Some facts I already know about Climate Change			
What are the main human activities that contribute to Greenhouse Gases?			
What could be the major impacts of Climate Change for Samoa?			
Actions I think could be taken to reduce Greenhouse Gases.			

This fits better on a landscape page. The students have the opportunity to think of their own ideas and then hear from others and write down their ideas and knowledge. They can then craft much deeper answers to the questions, having learned from other students. They can work in pairs to create paragraphs about each question. They may come back to their grid later in a unit and add more knowledge that they have gained.

2. The Vocabulary Jumble

This activity can be used as a topic starter. It helps to identify what children think they know.

Type or write clearly 20-30 key words from the overall topic onto an OHT or write them on a blackboard that can be hidden.

Put the most important/frequent words in one frame headed 'Level One Words'. The rest, which would contain some of the specialized words, in a second frame headed 'Level Two words'.

Give students the **purpose** and **instructions** orally and in written form.

Purpose

This activity will help you to:

Check that you know the sound, spelling and meaning of some key words for this topic.

Use the key word list to predict what the text or topic will be about.

Student Instructions

1. (While the Vocab Jumble OHT is on).

Fold your arms and study the words on the OHT for TWO minutes. Try to remember all the words on List One so that you will be able to write them down later with correct spelling. Do the same for the Level Two words if you have time.

2. (After 2 minutes the Vocab Jumble OHT will be turned off).

Now write down as many words as you can, trying hard to spell them all correctly. Put a tick next to each of the words you are confident that you know the meaning and spelling of.

3. (With Vocab Jumble OHT back on).

Check all your words. Add any words that you missed and correct any spelling errors.

Level One Words

Rain	Hot	Cold	Wet
Dry	Flood	Breeze	Wind
Cyclone	Cumulus	Storm	
Isobar			

Level Two Words

Tornado	Barometer	Condensation
Cirrus	Nimbus	Thermometer
Drought	Evaporation	

3. My Definitions: One step further

A way of helping students grasp an understanding of words and meanings is to complete a definition table. Students first complete the 'my definition' part of the table below. They use words from the vocabulary jumble. They should be encouraged to have a guess if they aren't really sure - there are no 'wrong answers' at this point as the purpose is to show their deepened understanding over the topic.

WORD	MY DEFINITION	REVISED DEFINITION

4. Clustering

This is an easy one to prepare and takes 10 to 20 minutes in a lesson, depending on the number of words used and the students' familiarity with the task. Make a list of about 20 words integral to the topic. They may be the words from the Vocab Jumble. Arrange them on the page and photocopy them so you have a set per 3-5 students. Using recycled paper from the photocopier to make the cluster words means they can be thrown away after use if getting all the pieces back is a problem. Making laminated sets in different colours ensures they are always available for teachers in the department to use.

This strategy can be a diagnostic activity at the start of a unit - you can suggest that they might need to make a cluster of words that no-one knows the meaning of. This will help your planning. It can also be a useful revision exercise at the end of a unit.

Rules:

- Give each group of 3-5 students a set of words. Their task is to put the words into groups in a way that they can explain why they have put them together. Stress that there is no **one correct way**!
- There are blank cards to use as headings when the groups are sorted.
- If groups of students are making large clusters, then introduce the next rule - no cluster may have more than 6 words in it.
- When all groups have finished they can then "Walk and Gawk" - walk around each group in the classroom and look at what they have done (no talking!), or "Walk, Gawk and Talk" where one person from each group stays behind to explain their reasoning.
- Debrief with students - what terms were difficult to place? Why? What different ways of clustering the words could they think of that they did not use? What other words would they add to the selection?

The following page lists some of the words that can be useful for the first two strategies discussed.

Neap Tide

Stratus

Hail

Snow

Wind

Breeze

Rain

Fog

Thermometer

Tornado

Spring Tides

Cyclone

Barometer

Gravity

Cold Front

Warm Front

Low Pressure

Summer

Condensation

Winter

Anti-cyclone

Isobar

Drought

Cirrus

Mist

Tsunami

Wind Vane

Precipitation

Storm

Anemometer

Flood

Dry

Cold

Wet

Hot

High Pressure

Cumulus

Evaporation

El Nino

La Nina

Stratus

Nimbus

5. Making Words

When students learn new words in science they often do not understand that the words can be used in different ways in different tenses. This is a good way to link language learning with science learning. The table can be used to help them make words and put them into sentences. It could be done as an oral or written activity.

Making Words

Each word below is a verb. By changing the ending, you can change the words into other parts of speech such as nouns and adjectives. Some endings do not match or new words have been formed. These have been done for you. Some words will need to lose a letter e.g., evaporate becomes evaporating. Others need to change a letter - "e" can change to "a".

Word	-ing	-es	-ed	-tion
Evaporate				
Condense				
Freeze			Froze	
Precipitate				
Blow			Blew	
Rise			Rose	

Write a sentence with one word from each row. Make sure you use each ending at least once, e.g. The puddle disappeared because the water had evaporated.

The wind blows in from the sea during the day.

6. Word Assembly

Another useful strategy is to break words into syllables so that the students have to join them up to make the words. Put all the syllables on pieces of paper for each group to assemble.

e.g.

precipi	tation
evapor	ation
conden	sation
tempera	ture
thermo	meter
anemom	eter
baro	meter

7. Definitions

This is a version of 'chinese whispers' on paper. This activity will work with students in large or small groups.

Using a template like the one shown, the first student looks at the word.

They write their definition on the space provided and turn over the end of the piece of paper so the word is hidden but their definition is shown.

This is passed onto the next person who has to guess the word from the student definition. They write their word in the space provided and turn over the piece of paper to hide the definition used.

This is passed onto the next student, who writes a definition for the word given, hides the word and passes it on.

Once everyone in the group has had a turn, the paper is opened up and the group compare their word and definitions from the start.

Definition Activity:

- Students are in groups of 4.
- The teacher gives student 1 the word.
- Student 1 writes a definition and hides the word. The sheet is passed on to the next student who does not know what the word is.
- Student 2 writes out what they think the word is based on Student 1's definition. They then hide the definition and pass the sheet onto Student 3.
- Student 3 now writes a definition based on Student 2's word. Student's 3's definition is hidden and passed onto Student 4.
- Student 4 writes what they think the word is based on Student 3's definition.
- When Student 4 has finished the paper is opened up and their answer compared to the original word.
- The group discuss the outcome.

Template: Definition Activity

Teacher	Student 1	Student 2	Student 3	Student 4
Word	Definition	Word	Definition	Word

Teacher	Student 1	Student 2	Student 3	Student 4
Word	Definition	Word	Definition	Word

Sample Activity

Teacher	Student 1	Student 2	Student 3	Student 4
Word	Definition	Word	Definition	Word
Tides				

Teacher	Student 1	Student 2	Student 3	Student 4
Word	Definition	Word	Definition	Word
Climate				

Teacher	Student 1	Student 2	Student 3	Student 4
Word	Definition	Word	Definition	Word
Density				

Teacher	Student 1	Student 2	Student 3	Student 4
Word	Definition	Word	Definition	Word
Precipitation				

8. Text Deconstruction

1. Sequencing

Taking separate sentences and putting them into the correct order requires students to read for meaning. Any piece of text can be used in this way. It is also a useful strategy when giving instructions to carry out a practical. Until the group has put the steps in the correct order and had this checked, they cannot start the practical. The steps could be written on the board in the incorrect order or copied onto recycled paper.

Sequencing Instructions

- Turn over all your sentences so the whole group can see them.
- Put the sentences in order you think they were written -
 - Statement
 - Explanation
 - Example

or

- Generalization
- Elaboration
- Example
- Check that the paragraph then makes sense.
- Carry out any instructions in the sentences.

Sequencing: Cyclones

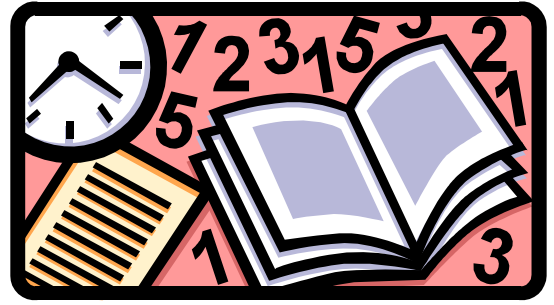
- There are times when the air rising over the warm regions of ocean can form areas of extreme low pressure.
- This happens when the sea temperatures are above 29°C.
- The convection currents start spiraling around this low pressure centre, causing rotation.
- The winds spiral clockwise in towards the centre of the low pressure area picking up more moisture from the sea.
- At the centre, the air rises upwards, with the water vapour condensing to give high cloud formations and heavy rainfall.
- As long as the low pressure centre remains over the warm ocean, there will always be energy to continue feeding the system.
- The amount of water in the system builds up and wind and rain intensify and the system becomes a tropical cyclone.
- When the tropical cyclone has moved over land or cooler water, there is no energy to feed the system and the cyclone will die away.
- In the meantime the amount of energy and rain can do a great deal of damage.

Heating Land and Sea Breezes:

- During the day, the sun heats up the land and the sea.
- The land heats up faster.
- The air above the land heats up.
- The hot air rises.
- Cooler air from over the sea moves onto land to fill in the space.
- This is why onshore breezes occur during the day.
- The land cools down faster at night.
- The warm air over the sea rises.
- Cooler air from the land moves out to sea to fill the space.
- This is why offshore breezes occur at night.

2. Snappy Headings

1. In pairs, read the following article carefully.
2. Make up a "Snappy Heading for each paragraph - this may be witty or factual but must relate to the content of the paragraph.
3. Write 1 sentence that summarises each paragraph.
4. or: Write 3 questions based on the article for another pair to answer.



The next two pages give a sample of the original reading and the same reading with the headings removed.



Weather Extremes: Cyclones

Water on the move

The sun is the energy source that drives our weather. As the sun warms the atmosphere, air sitting above the ocean's surface heats up and rises. The rising air picks up water vapour that has evaporated from the ocean's surface. As the warm air rises it cools and water vapour condenses to form clouds. Cool air moves in to replace the warm air continuing the process.

Over the Pacific

Over the Pacific Ocean's equatorial regions, heat energy from the sun creates large areas of warm, rising moist air. The southeast trade winds move over this warm ocean and pick up this water vapour. If you could see this region from space you would see large areas of cloud covering the Pacific.

This then creates large areas of low air pressure in this area.

As the surface temperature rises, more moist air rises. In turn, more water vapour starts to condense to form droplets of liquid water in the clouds. The heat energy released when water vapour condenses, creates more convection type air currents in these clouds, pushing the air further upward. This causes huge cumulonimbus clouds to build up over the ocean.

Cyclones

This system can go into over-drive. When the surface of the ocean reaches 29°C, large quantities of air start rising quite rapidly over the warm regions of ocean. This creates huge areas of moisture and areas of extreme low pressure. No-one can explain fully why this happens.

The convection currents cause this low pressure centre to rotate. This creates winds which spiral clockwise in towards the centre of the low pressure area picking up more moisture from the sea. At the centre, the air rises upwards. The amount of water in the system builds up to give high cloud formations, strong winds and



heavy rainfall. The system becomes a tropical cyclone.

As long as these remain over the warm ocean, there will always be energy to continue feeding the system.

Where does Argo fit into this?

Argo floats take on an important role in helping to assess the likelihood of cyclones forming.

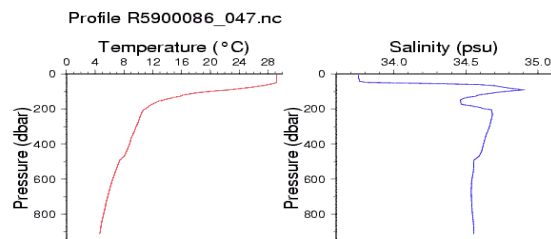


An Argo Float



When an Argo float is dropped into the ocean, it sinks to depths of up to 2 kilometres. It then drifts with the currents for a period of 10 days, before coming back to the surface. On its way back up it measures the temperature and salinity (salt content) of the water.

High rates of evaporation will mean water with a high salt content. Combine this with



high ocean temperature and the float is

Temperature and Salinity Profile from Tropical Waters

measuring cyclone conditions.

The information helps scientists link the weather we experience on the earth's surface with what is happening in the oceans.

What will be the effect of Global Warming?

One of the effects of global warming will be to see the temperature of both oceans and atmosphere increase. This will mean more cloud cover trapping heat below, heating the air and ocean. Larger areas of the Pacific Ocean will become warmer and this will increase the chances of the sea surface temperature being at the figure of 29°C.

The consequence of this is greater extremes of weather with an increased likelihood of cyclones.

Weather Extremes:

.....?

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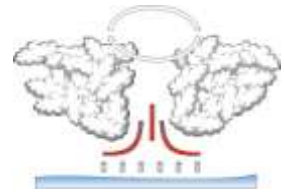


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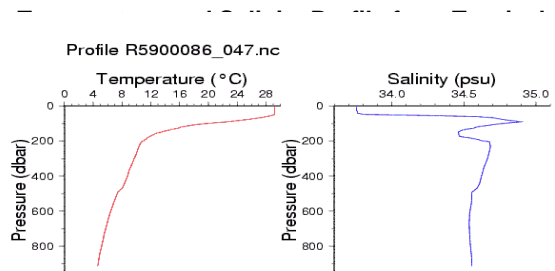
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**An Argo Float**

1. Picture Dictation

Why use this strategy

- It uses all the language modes.
- Children have to listen carefully to the statements.
- It takes what is said and transforms that information into visuals.
- It orally puts the visuals back into words.
- Children have to write captions to match the visuals.
- Reading the captions.
- Sequencing.
- Children have to focus on key ideas.

How to use this strategy

- Select a clearly sequenced text (for example, a list of instructions or the steps in a process or story).
- Divide it up into eight or ten basic stages, sentences etc.
- Ask the students to each draw up a page with numbered boxes (eight or ten) - one box for each statement. Space for a caption underneath.
- Number the boxes.

1	2	3	4

5	6	7	8

- Read out each of the sections in turn, and ask the students to each draw their own simple visual for that section/statement. (Remind the students that a perfect picture is not required and they don't have much time to draw.) They can record a single word in a frame if they wish to help memory - if they can't draw what they need to.
- In pairs, the students take it in turns to translate each visual back to words.
- Individually, the students write a caption for each visual and then read their caption to their partner.

10. The Water Cycle - Picture Dictation Activity

STEP 1:

Heat from the sun dries up the liquid water that is on the earth's surface, a lot of water from the oceans, because they are so large.

The liquid water is turned into an invisible gas, which we call water vapour.

STEP 2:

The water vapour rises into the air. As it gets higher the water vapour cools, and changes back into tiny drops of liquid water, which start to crowd together. This is when they form a cloud.

STEP 3:

The clouds are blown over the ocean by wind. When they reach land they are forced higher into the sky. The higher the clouds go the colder it gets.

STEP 4:

As the clouds gets colder the tiny droplets of water join together and become so heavy that they cannot stay up there. They fall down to the ground as rain.

STEP 5:

When the water reaches the ground, it soaks into the soil. A lot of the water ends up in streams, which flow into rivers which then flow into the oceans.

STEP 6:

The sun warms up the water in the oceans again. It changes into water vapour and floats up to make a cloud.

Greenhouse Gases – Picture Dictation

Humans burn fossil fuels in cars, factories and power stations, which produce large quantities of carbon dioxide.

People are also removing forests (deforestation) and using land for farming which produces methane, another greenhouse gas.

These are greenhouse gases which trap the sun's radiation (heat rays) in our atmosphere, warming the planet and producing climate change.

Predictions indicate temperature rises of between 1°C to 7°C on the surface of the earth by the year 2050.

The oceans will absorb this heat and become warmer.

This will cause changes in weather patterns and will bring stronger cyclones to parts of the Pacific.

The ice covering Greenland and Antarctica will melt.

Climate change is going to bring about a rise in sea levels.

Integrating Strategies

1. Knowledge/ Learn Grids

This is a simple strategy for students to organize their knowledge and what they have learnt from a reading passage. It allows opportunity for reflective learning.

Have students draw up a grid like the one below. It should have 12 spaces.

They then complete the grid after reading the passage.

The heading questions can be adapted. For instance the last column could be altered to: "3 Things I want to find out".

4X3 Information Processing Grid

3 Most Important Ideas	3 Things I knew already	3 Questions about this text	3 Key words/new words

The K-W-L-H chart is another useful pre-reading activity. Students could complete the first two columns before reading, then fill in the rest after reading the article.

Student Instructions:

K-W-L-H Grid

Complete the first two columns of this grid now. You will have the chance to complete the following two columns later in the workshop.

Topic:

What I <u>K</u> now about this topic	<u>W</u> hat I want or need to know about this topic	What I <u>L</u> earned about this topic	<u>H</u> ow I learned it

2. The Three Level Learning Guide

This helps students locate information in text, interpret what the text means and apply the information by taking it further into possible implications.

The three levels are:

➤ **Level 1: Literal.**

Reading on the lines to find out what is actually written.

➤ **Level 2: Interpretive.**

Reading between the lines to infer what the text means.

➤ **Level 3: Applied.**

Reading beyond the lines to relate information to other ideas, knowledge or situations.

The students have to focus on the actual information, and think about it. From this they can draw conclusions. The next step is to use this as discussion. They have to give their views and ideas from what they have got from the reading.

When making a three level reading guide it is important that:

- The topic is appropriate, relevant and important.
- The objectives of the exercise are known.
- Write the level 3 statements first. **(3 statements will do)**
- Write the level 1 statements next selecting the facts that match the objectives you have picked out. **(6 to 8 statements)**
- Write the level 2 statements last. These will help the students interpret the information. **(4 to 5 statements)**

It is helpful to make sure that some of the statements can be interpreted more than one way. This helps discussion.

When using the three level reading guide:

- Introduce the topic in the usual way.
- Ask students to read the article independently.
- Have the students work through the reading guide on their own.
- Have them share, discuss, and debate their responses in pairs or small groups.
- Help the students clarify ideas and misunderstandings.
- And most importantly, have students explain their answers and justify their ideas.

Three Level Reading Guide – Climate Change

Decide whether each statement is True (T) or False (F). Be prepared to explain why you have chosen your answer.

Level One – Literal (reading 'on' the lines – factual statements from the text).

- _____ 1. Five different systems interact to influence climate on earth.
- _____ 2. The earth is warmed by solar radiation.
- _____ 3. The earth absorbs all the solar energy that falls on it.
- _____ 4. The oceans store heat energy and CO₂.
- _____ 5. Icecaps absorb solar energy.
- _____ 6. Plants absorb CO₂.

Level Two – Interpretation (reading 'between' the lines – ideas that are suggested by the text).

- _____ 1. Changes to the cryosphere will affect the atmosphere.
- _____ 2. Changes to the Biosphere won't affect climate.
- _____ 3. Clouds influence the amount of heat energy stored in the oceans.
- _____ 4. If the icecaps disappear, less solar energy will be absorbed by the atmosphere.
- _____ 5. A lot is known about climate systems.

Level Three – Application (reading 'beyond' the lines – linking ideas that are suggested and your own understanding of the topic).

- _____ 1. Reforestation programmes will be beneficial to the climate.
- _____ 2. There will always be the same amount of heat energy on the earth – it is just stored in different places.
- _____ 3. Action by an individual in one country can have effects on the climate experienced by many people in another country.

Introducing Climate

Climate is the interaction of the following systems on the planet:

- the atmosphere;
- the oceans;
- the cryospheres (made up of glaciers, sea ice, and the continental ice caps);
- the geosphere (earth's solid surface);
- the biosphere (the living organisms on land and in water).

How each of these will interact with each other is very hard to predict, as the balance between them has taken centuries to reach. Changing that balance can cause problems. It could take a day or even centuries for a new balance to be reached again.

The sun's rays (**solar radiation**) drive the climate system. The energy from the sun passes through earth's atmosphere and warms the earth's surface. It is re-emitted as heat energy. This heat energy is absorbed by the gases in the atmosphere, warming the part of the atmosphere we live in.

Changes in Earth's Climate

How the earth is warmed by solar radiation depends on the nature of Earth's surface – whether the radiation falls on land, ocean, icecaps or vegetation. The different surfaces release different amounts of energy back into the atmosphere. This in turn affects the weather and ultimately the climate.

Oceans cover almost 70% of the earth. These are the great regulators of earth's climate. Oceans absorb heat and carbon dioxide from the atmosphere. When ocean water sinks into the deep oceans it takes the heat energy and carbon dioxide with it. These remain trapped for long periods of time. This makes the oceans the great storehouse of the planet.

If you were in space looking back at Earth, the **icecaps** would stand out. This is because they reflect back a lot of incoming solar radiation. If the ice caps were to shrink or disappear, there would be changes in the amounts of solar energy absorbed by the atmosphere.

The part that we all live in is called the **biosphere**. All earth's living organisms that live on both land and sea have an effect on the climate. All living things produce carbon dioxide. Living organisms containing chlorophyll (mostly plants), remove that carbon dioxide from the atmosphere. The interaction between biosphere and atmosphere is complex, but it does have an effect on climate.

The **atmosphere** has its role. The exact role of clouds is still unknown. Scientists are trying to find out:

- How much radiation passes through clouds?
- How much heat energy is trapped by clouds?
- How much heat energy is stored in different cloud systems?
- How is heat exchanged between the atmosphere and the other parts of earth's surface?

How are we going to answer these questions?

According to the Intergovernmental Panel on Climate Change (IPCC) more research is needed to better understand these systems.

We need to:

- Improve the global observation technology.
- Investigate the climate of the past.
- Develop models that explain and predict our climate systems.
- Increase support for national and international research.
- Facilitate the international exchange of information.

On the next three pages there is a Reading Guide Template and two sample readers related to Climate Change

Three Level Reading Guide - Template.

Decide whether each statement is True (T) or False (F). Be prepared to explain why you have chosen your answer.

Level One - Literal (reading 'on' the lines - factual statements from the text).

_____ 1.

_____ 2.

_____ 3.

_____ 4.

_____ 5.

_____ 6.

Level Two - Interpretation (reading 'between' the lines - ideas that are suggested by the text).

_____ 1.

_____ 2.

_____ 3.

_____ 4.

_____ 5.

Level Three - Application (reading 'beyond' the lines - linking ideas that are suggested and your own understanding of the topic).

_____ 1.

_____ 2.

A Consequence Wheel

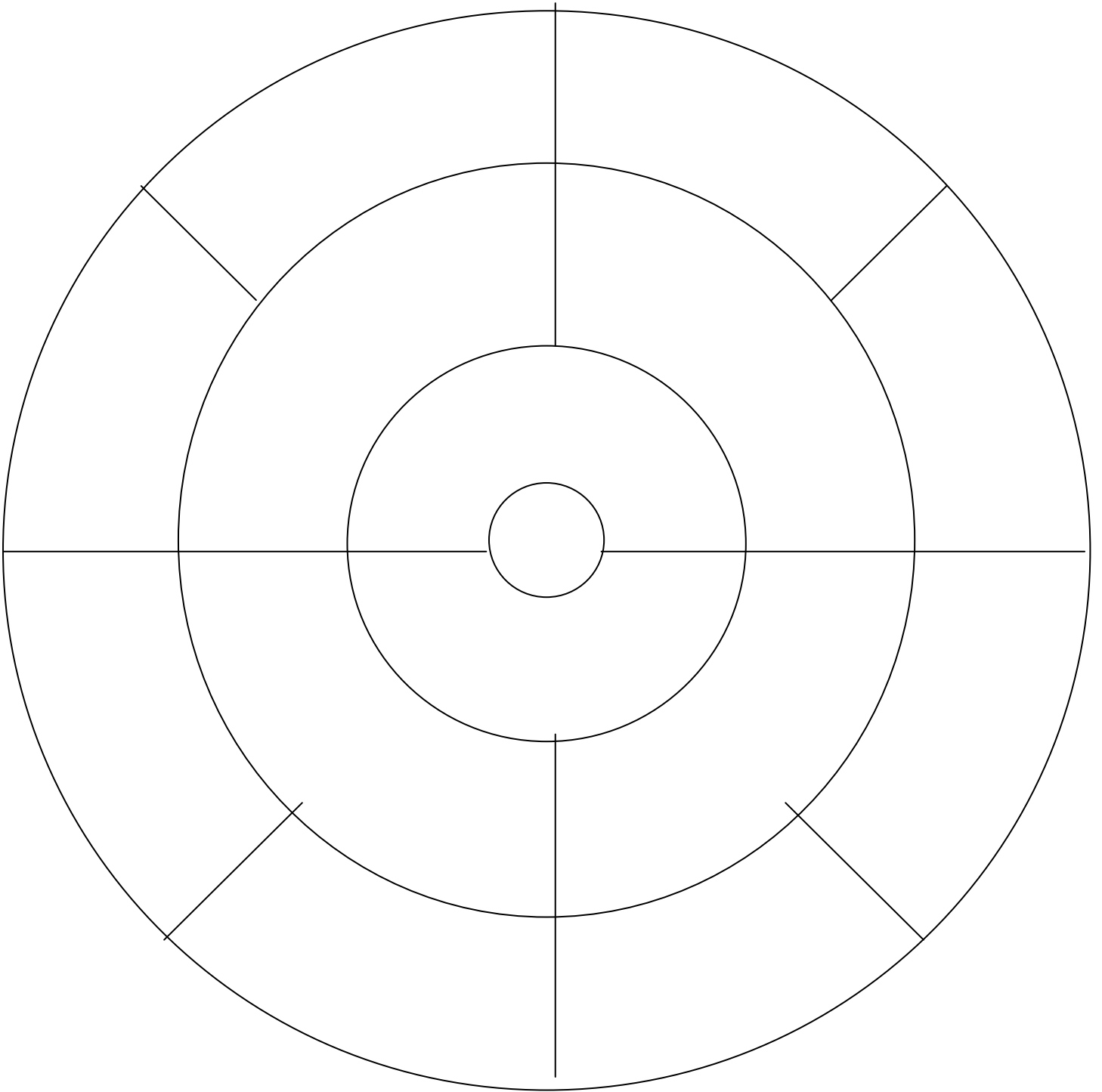
Students use a consequence wheel by writing an action in the centre, and then writing consequences of this action in the surrounding two spaces. Consequences arising from these go in the next four spaces and so on until the wheel is complete. More layers may be added. Students can draw their wheels on scrap paper to start with. They could then make good copies as posters.

If the centre was filled in with “ A 3 month drought has emptied tanks and there is little clean water left.” there will be many consequences.

- all drinking water needs to be boiled → more expensive electricity is being used → people have less money for food
- there is no water for gardens → less fresh fruit and vegetables →
people may go hungry

It can be useful to limit the top of the wheel to positive consequences and the bottom to negative consequences – this helps students focus their thoughts.

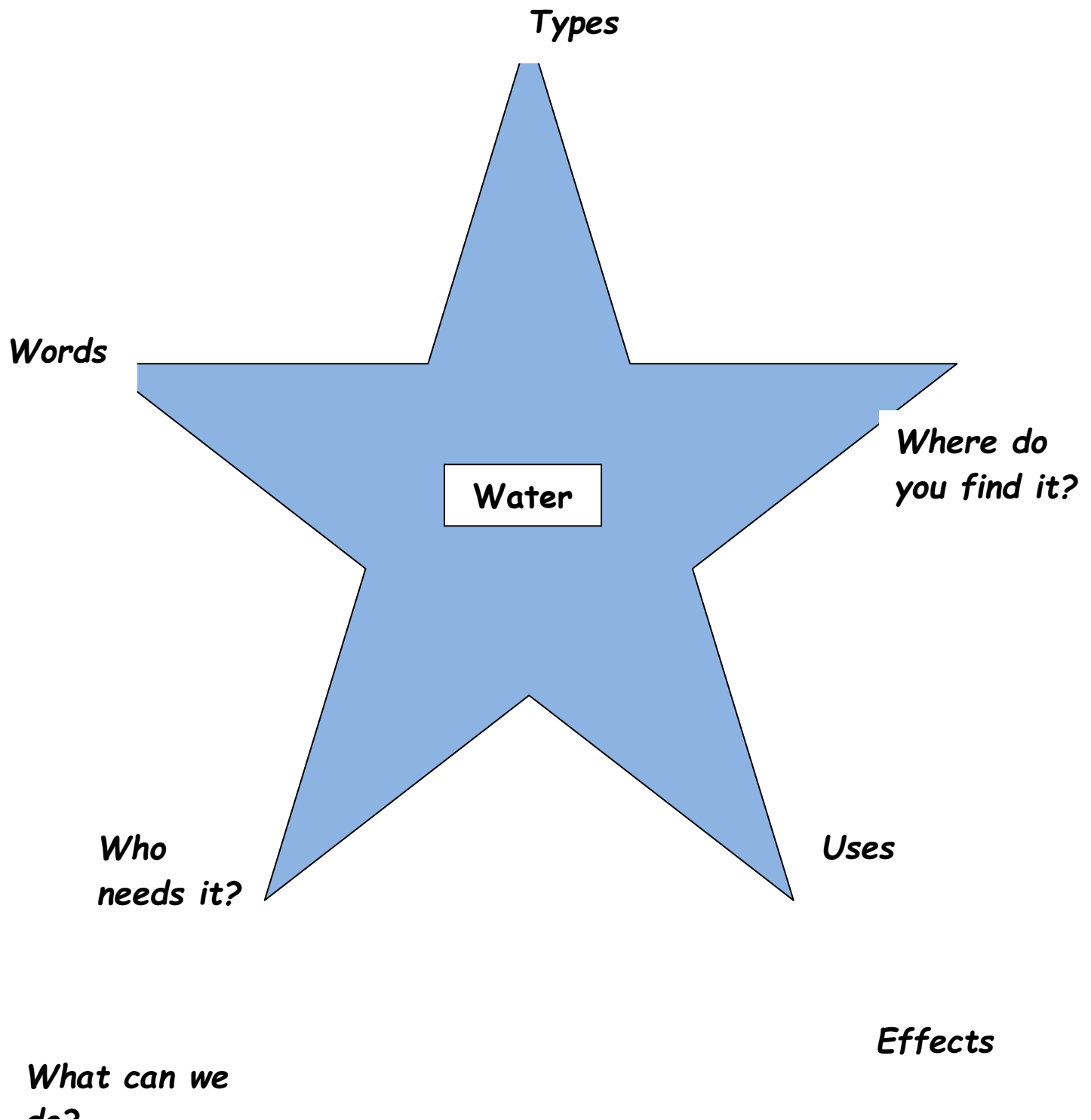
When they are used to the concept, make each consequence lead to a positive and a negative consequence



Water Concept Star

Water and the water cycle is the basis of weather and climate. Good readers activate their prior knowledge prior to reading to prepare them for new learning.

1. Write all the words and ideas you can think of by each subheading at the point of the star
2. Share your words and ideas with a partner.



The Global Warming Loop Game

This is a version of "I Am...Who Has"

- Cut out each strip of card with an answer and an "I am" statement
- Shuffle them well.
- Each student is given a strip of card with an answer and a statement
- First student reads out the statement on the right and another student with the correct answer needs to call it out then read their statement and so on.
- Continue until all the cards have been read. Re-shuffle the cards and hand them to different students. See if you can go through faster. Or you could have a competition between teams.
- These cards could also be used as mix and match, Bingo or dominoes

Reflection

What did you learn?

What did you remember?

How did this game help you learn?

Global warming	I am produced over millions of years from the remains of dead plants and animals and am known as.....
Fossil fuels	I am the most common greenhouse gas produced by burning fossil fuels
Carbon dioxide	I am another greenhouse gas produced by burning fuels
Water vapour	I am a word to describe an energy resource, such as fossil fuels, which will one day run out
Non-renewable	I am a fossil fuel other than natural gas
Oil	I am a gas that is needed for fossil fuels to burn
Oxygen	I am the term given to the effect of a layer of gases holding heat in our atmosphere
The greenhouse effect	I am another greenhouse gas produced from cows' bottoms and burps

Methane	I am the original source of nearly all our energy
The sun	I am an important sink for carbon dioxide on land
Forests	I am a massive sink for carbon which live in the oceans
Plant Plankton	I am a revolution that happened in the 19th Century, resulting in a rise in carbon dioxide levels
The industrial revolution	I am another word for a change in global weather brought about by global warming

Ice caps	I could result in problems to low-lying areas as a result of heavy rains
Flooding	I am a country likely to be affected by flooding
Bangladesh	I am the word to describe sources of energy that will never run out
Renewable	I am 2 examples of renewable energy
Solar power, hydro power	I am a more energy-efficient way of transporting large numbers of people instead of using cars
Public transport	I am something that can easily be fitted at home to reduce the amount of energy used
Energy-efficient light bulbs	I am a type of environmentally-friendly transport that can also improve your health
Cycling	I am the effect on the earth's temperature caused by the greenhouse effect which is known as.....

Fishbones

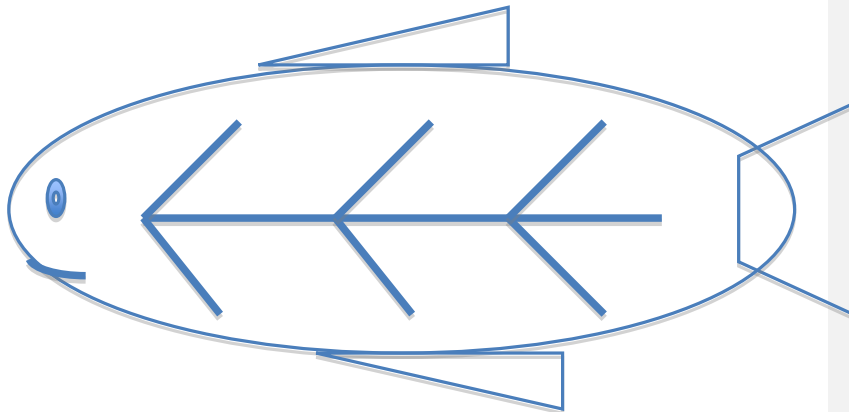
This is a useful strategy to elicit students' questions in a safe environment. This activity provides an interesting frame for students to create questions about a new topic which they can then answer at the end of the unit. Students may have an introductory activity to introduce the ideas in the topic .

- in small groups draw a fish with the skeleton inside.
- students then create a question about the topic that they would like to find out for each bone of the fish and write it on the bone.
- Teachers may need to check the questions and also give prompts for students to use the 5'W's and a "H" (what , when, where, why , who and How?)

Over the course of the unit the students will gather information and at the end of the unit can identify what they have learnt by answering the questions on the fish.

It is even more effective to have the answers on a matching fish so that the two can be stapled together and stuffed, decorated and hung in the classroom. This will show the students what they have learnt.

Use plain paper and draw the outline of a fish on a double layer of paper. Fins and a tail make it look realistic. Then add a spine with 3 ribs up and 3 ribs down.



Introduction to Man-made Climate Change

Understanding the composition of gases that make up our atmosphere is important to understanding the reasons for climate change.

Our atmosphere is made up of predominately nitrogen and oxygen, with smaller quantities of water vapour, carbon dioxide and other gases. The cause of the current climate change comes through human activity, which has seen the release of greenhouse gases into the mix of gases in our atmosphere. Some of these gases, in particular carbon dioxide and methane are crucial in determining earth's climate.

The concentrations of greenhouse gases are rising due to humans:

- Burning fossil fuels and removing forests (deforestation) which produce large quantities of carbon dioxide.
- Intensive agriculture and breaking down of biomass by bacteria producing methane.
- Other activities which produce gases such as nitrogen oxides, Chloro-fluorohydrocarbons (CFC) and ozone.

In the last 200 years the quantities of these gases in our atmosphere have increased way beyond anything in earth's past history.

Effects on the Pacific

What maybe happening on one side of the planet is going to affect the whole planet. The Pacific region will suffer the results of these greenhouse gases being put into the atmosphere.

Climate is a complex system of interactions between the atmosphere, the land, the oceans and biomass.

What is happening the Scientists cannot be sure of, but one thing is for certain global temperatures will rise. That means the temperature of the atmosphere we live in will increase and so will the oceans. Predictions indicate temperature rises of between 1°C to 7°C on the surface of the earth by the year 2030. This is faster than anything over the last 10, 000 years.

It is easy to overstate the extent of climate change and say it is only a possibility, but that also undermines the risks to our existence, agriculture, land use and coastal communities. However climate change is fact. In the last 100 years average temperatures have risen from 0.3°C to 0.6°C across earth.

The Pacific region is going to get warmer, and still greenhouse gases are being emitted into our atmosphere.

The future

The long-term build up of these gases is going to have long term consequences. This has a long term effect on our communities and way of life.

Climate change is going to bring about:

- A rise in sea levels.
- Changes in weather patterns.

The biggest risk we face is the failure to recognize what is happening and adapt. Global warming is happening.

Scientists are working to find ways to predict the changes taking place. The scientists may debate the extent of global warming. The facts are certain, more of the sun's radiation is being trapped in our atmosphere, warming the planet and producing climate change.

Greenhouse Gases

Introduction

Our atmosphere is made up of predominately nitrogen and oxygen, with smaller quantities of water vapour, carbon dioxide neon, argon, methane and a few others. Some of these gases are "greenhouse gases".

It is important to know which are the greenhouse gases. The build up of these gases is responsible for global warming and the problems associated with climate change – otherwise known as the greenhouse effect.

What do Greenhouse gases do?

The greenhouse gases absorb the heat radiation from the sun as it travels through the atmosphere. This causes the temperature in the atmosphere to increase. If the temperature in the atmosphere increases then so does the temperature of the land and the oceans as the heat energy is transferred. In turn the amount of water evaporating from the oceans will increase, creating an increase in cloud cover.

What causes an increase in Greenhouse Gases?

Greenhouse gases are increased in two ways:

- Increase in the sources of greenhouse gases through man-made activities – burning fossil fuels, intensive agriculture and breaking down of biomass by bacteria producing methane and activities which produce gases such as nitrogen oxides.
- Decrease in the absorbers (sinks) of greenhouse gases such as through deforestation and ocean pollution.

Important Greenhouse Gases

Water Vapour

The amount of water vapour in the atmosphere depends on the balance between evaporation and condensation. The main issue is the formation of clouds. The increase in cloud cover helps to enhance global warming, as heat that radiates from the land and oceans can no longer escape.

Carbon Dioxide

This is the result of burning fuels such as wood, petrol, oil and coal. Carbon Dioxide stays in the atmosphere for decades, so the effects on global temperatures will remain with us for a long time. The only way to remove carbon dioxide is through

photosynthesis from plants and plankton. However natural processes associated with living and decay also release carbon dioxide.

Methane

The quantity of methane is increasing through:

- The intensification of agriculture and deforestation.
- Coal mining and the extraction of natural gas and oil.
- The melting of the vast ice tundras of the arctic regions.
- The biodegrading of organic material.

Methane may not last long in the atmosphere but the damage it can do is far more serious.

Chlorofluorohydrocarbons (CFC's)

These are man-made gases and were used in aerosol cans, refrigerators and foam products. These may not directly cause global warming - this has yet to be proved. CFC's deplete an ozone gas layer in the stratosphere. This causes the growth of the "ozone hole."

Ozone protects earth from the effects of ultra-violet radiation, which would kill everything on the earth's surface if it was not blocked by the ozone layer. The Montreal Protocol has stopped the use of CFC's which should enable the ozone layer to repair itself.

Other gases

Other gases such as hydrocarbons, carbon monoxide and nitrous oxides are released into the atmosphere through human activities. The effect of these on our atmosphere and global warming is still largely unknown.

What does this mean?

This means that the temperature of the atmosphere we live in and the temperature of the oceans will increase. Predictions indicate temperature rises of between 1°C to 7°C on the surface of the earth by the year 2030. This is faster than at any time over the last 10,000 years.

Climate change is going to bring about:

- A rise in sea levels.
- Changes in weather patterns.

Global warming is happening and the Pacific Region will suffer the results. The biggest risk we face is the failure to recognise what is happening and adapt.

Experiential Learning Activities

Managing the Mynas

Experiential learning activity for students in Years 7 - 13

Introduction

This activity is designed to introduce or recap the impact of introduced species, but can be used to clarify ecological concepts:

- the difference between biotic (living) and abiotic (non-living) factors;
- the influence of biotic and abiotic factors on a community;
- the interconnectedness of living things within a community, particularly with respect to:
 - feeding relationships;
 - energy flows;
 - nutrient cycles.

Resources

- gym/tennis court/playing field.
- 4+ area-markers (cones).
- 10+ ice-cream container lids.
- 2+ nerf/sponge balls.
- 4 Processing Cards.

What to do

- Define the playing area - 1/2 netball court for 20 pupils initially.
- Non-players (illness, disability) can be easily accommodated as judges and marshals.
- Everyone is an insect but these insects can walk (*and ONLY walk!*).
- If an insect leaves the playing area then they become mynahs.
- Pick one of these insects or ask for a volunteer - this is the mynah.
- Pick another insect to be the hunter.

Mynah

- Chases insects and "tags" them - Mynah can also only walk
- A tagged insect then becomes a Mynah.
- Mynah's must hold hands/link arms and **together** pursue the other insects.

Hunter

- Using the nerf/sponge ball "shoots" at the mynah.
- If hit the mynah breaks from the chain and becomes an insect again. (*The remaining mynah must all join again*).
- Hunter then retrieves the ball and does one complete lap of the playing area before being able to shoot again.

Game continues for 10-15 minutes or until all the insects have become mynah.

PROCESSING - (PART ONE):

- What happened to the mynah numbers during the game?
- What happened to the insect numbers? ("Hands up all the mynahs, hands up all the insects").
- Why did this occur? (mynahs keep increasing/insects decreasing).
- How did the hunter feel?
- Why did the hunter have to do a lap before shooting? (Track down prey again).
- What could we change in this model to investigate its effect? (Mynah no.'s, Hunter no., Insect no.'s, area size, different hunter techniques, etc.).

PROCESSING - (PART TWO):

Depending upon the feedback from pupils vary different factors within the community either individually or in combinations.

- Run a trial using larger area:
 - ❖ What happened to the mynah numbers?
 - ❖ How hard was it for cow birds to get food?
 - ❖ Why harder? (Resource distribution)
 - ❖ How was it different for the hunter? Why was this?
- Introduce more hunters:
 - ❖ What happened to the mynah numbers?
 - ❖ How hard was it for the hunters this time?
 - ❖ What did the hunters have to do to kill mynah effectively? (Co-operative strategies for hunters).

What other techniques do we use to control populations?

Poison, traps...

- Introduce poison:
Introduce an ice-cream container lid as poison - hunter to drop it on playing area. If a mynah steps over it then the mynah is dead and becomes an insect.

The Hunter may collect and redistribute at will - but ONLY by DROPPING.

- Introduce two mynah populations:
What happened to the mynah numbers?
How hard was it for the hunters?
Did they (mynah or hunters) have to alter their strategies etc?

PROCESSING - SUMMATIVE

For environmental education on an introduced pest, processing questions may follow these lines:

- What strategies did the mynah develop for success? (Both co-operative and individual strategies are important).
Identifying and avoiding threats (poison, hunter), catching insects.
- What strategies did the hunter develop for success?
Retrieval of ball, herding of cows, birds to kill, etc.
- Why are the mynah so successful in this activity and in real life?
Because they are well adapted for eating all insects but have no natural predators to keep the population in check.
- Why are the mynah harmful to native Samoan species?
Because they are competition for many native species of animal that eat the same food as they do.
- Are there any other introduced species in Samoa that present a similar problem?
Yes many e.g.
- Are there any ways that you and I are contributing to this problem?
- Is there anything that we can do to reduce this problem?
Yes - we ...

PROCESSING - SUMMATIVE

For biology (ecology) processing questions may follow these lines:

- What strategies did the mynah develop for success? (Both co-operative and individual strategies are important).

*Identifying and avoiding threats (poison, hunter) through communication.
Catching insects through teamwork and co-operation.*

- What strategies did the hunter develop for success?

Retrieval of ball, herding of mynah to capture.

- What strategies did the insects develop for success?

Avoiding mynah and each other.

- What does the hunter represent?

Predation, disease, competitive exclusion - any occurrence that can cause the death of an individual.

- What are the insects representing?

Resources (Air, water, food, space, nests, etc.)

- What does the marked playing area represent?

Habitat as defined by tolerance limits of the organism. (Hence death when leaving playing area).

- What is ecology?

The study of living things and their environment.

- What sort of things might affect an organism?

Start with a clean whiteboard and try the initial brainstorm activity again but this time facilitate "correct" answers. As factors are called out try to retain the biotic/abiotic split as below and write these factors on the appropriate side of the whiteboard:

Conclusion/Summary

Ecology is the study of living things and the environment, and particularly the interrelationship between the two.

Ecology is most frequently investigated through populations. Populations are dynamic.

Ecology

Abiotic (Non living factors)	Biotic (Living factors)
Environment	Nesting
Light	Animals and Plants
Water	Predation
Air	Competition
Temperature	Disease
Sites/Territories	Food
Shelter	

The Water Cycle - an Experiential Learning Activity

Children understand concepts better when they are actively involved in building their own knowledge of the concept. Hands-on investigations are good learning experiences for this reason. Another alternative successful learning strategy is to have students act out processes - those that are too big or too small to be investigated easily. When students have done investigations into condensation and evaporation, they can put the water cycle together by acting it.

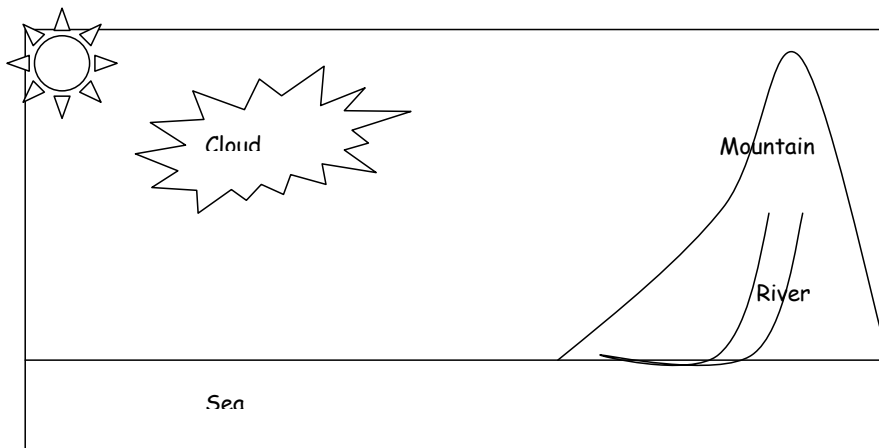
Instructions

For 20 students, you will need a space about half the size of a classroom. This can be inside the classroom or outside on concrete.

Draw a line on the floor or concrete about 2 metres from the wall or edge. The sea is behind the line.

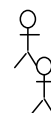
Draw a cloud shape above the sea - large enough for 4-5 children to stand in.

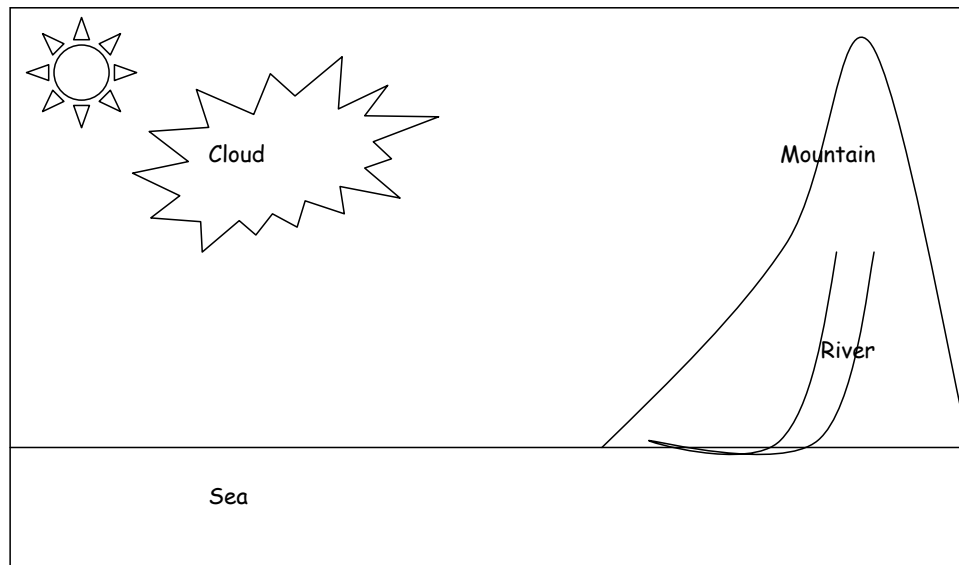
On the other side of the space, draw a mountain and a river leading to the sea. Draw a sun in a corner.



The following numbers are for a class of 20. Adjust the numbers in proportion if there are more or less children in the class.

1. 3 children stand in the cloud
2. 4 children stand on the mountain
3. 4 children stand in the river
4. 8 children stand in a line in the ocean
5. 1 child is the sun.

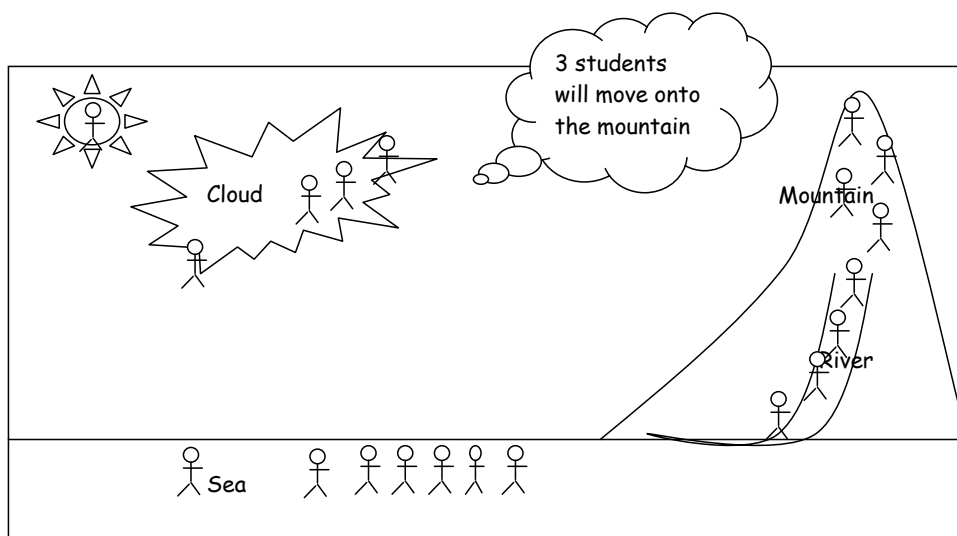


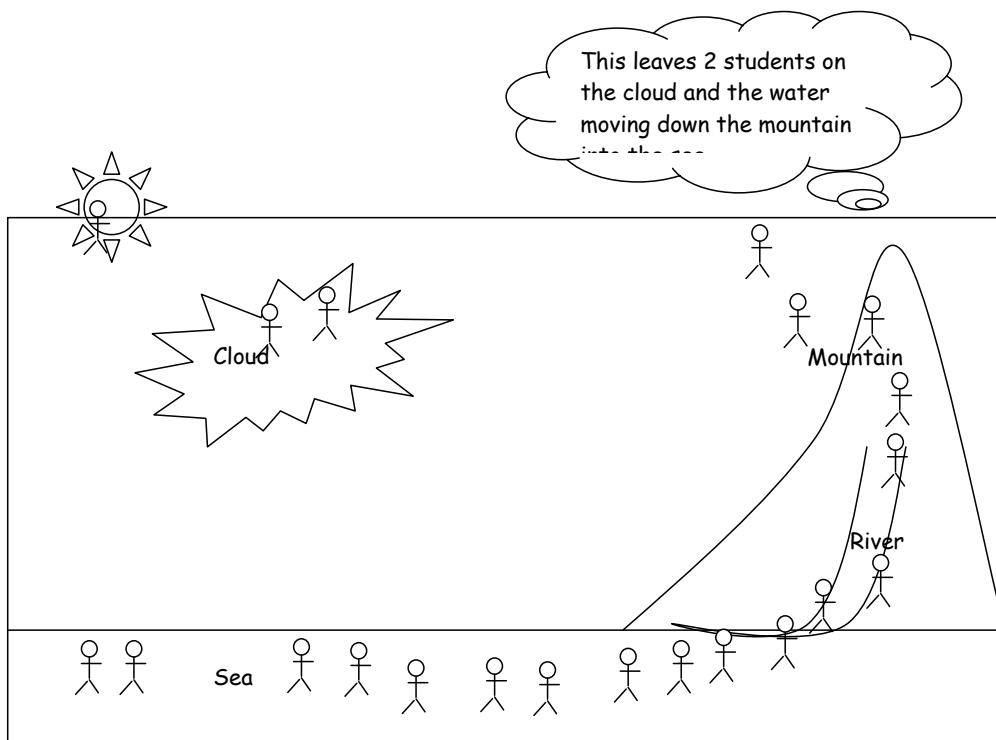


The 'sun' beats their arms up and down. This is the sun providing heat energy to warm up the ocean.

At each 'beat' of the sun :

- the students in the sea take 1 step to their left. After 2 steps the student on the left hand end moves up towards the cloud. The following student has to reach the same place and continue this movement
- The students in the cloud wait till there are 5 in total. The original 3 students move to the mountain. The other 2 remain until the cloud has built up to 5 again and repeat the process.
- The students on the mountain take 1 step towards the river
- The students in the river take 1 step towards the sea





Keep this going till all the students have been around the cycle several times.

Now add the sounds - for each step students need to say what they are doing - evaporating, condensing, precipitating, melting, etc.

Next step - introduce the actions of the molecules - fast with lots of energy when evaporating, shivering for condensing, raindrops - floating down, swimming down the river and slowing down in the sea.

The final cycles will be very noisy and have lots of student action which they will enjoy.

Questions

1. Where did the energy for the water movement come from?
2. Where did the water molecules spend most of their time?

Something extra to try:

Try the same activity with the sun being brighter - bigger movements - relate this to the seasons with the sun directly overhead.

- The students in the sea take 2 steps per beat
- The cloud fills to 4 then loses 2
- The students on the mountain take 2 steps per beat
- The river movement stays the same

Similarly the action can be slowed for the cooler seasons.

Shrinking Islands

This activity is designed to start students thinking about some possible effects of Climate Change. It needs to be handled carefully, particularly with younger children, as it is possible to scare them into thinking their whole island may disappear. For that reason, emphasise that the island they draw is an imaginary one.

This could be used in a unit on preparing for natural disasters. It is an activity that draws on skills and knowledge across several curriculum subjects.


Materials

1. 1 piece of plain white or brown paper about 1 metre square per group of 5-8 students
2. Felt tips pens or crayons - 3-4 colours per group

Instructions

1. Discuss with students what they would find on a Pacific Island - draw out the natural features such as mountains, rivers, trees, and the needs of the people - church, school, houses shops. How do people get to the island? What crops do they grow? Would they have plantations? How do they get from place to place? Use your knowledge of your students to decide how much of this discussion will happen first as a class and how much each group needs to think about on their own.
2. Each group has to draw an imaginary island on their piece of paper. It has to be a map or "birds eye" view. They should use as much of the paper as possible. Mark in N, S, E and W. Groups should name their island.
3. Each island should have 2-3 villages with whatever else they think is necessary. They can use symbols and a key if they wish or draw pictures. Encourage them to make their islands as safe and self sustainable as possible.
4. Bring the groups into an open space, each holding up their island. Ask each group to report on why their island is special. What is the most important feature on their island?
5. Make a direction for North - it does not have to be accurate, just so all islands have north in the same place. Lay the islands on the ground and explain that the island they have drawn is their home and it supports them, therefore they all have to stand on the island. They cannot have their feet in the sea. They can hold onto each other if necessary to balance on the island on one foot. If the groups are large they may find this difficult but will be able to make it.
6. Ask them to stand off the island again and then talk about the big cyclone that has hit their islands from the North West. The waves were very rough and eroded a lot of land. The North West corner has disappeared so they need to fold over the NW corner of their paper.



7. Now they need to look at their islands - what have they lost? Ask each group - if they have lost roads - who is cut off? Have they lost taro patches, wharves, schools, water supplies?
8. Now ask them to stand on their island again. There will be students who won't fit - where will they go? You may need to have a refugee corner - ask the refugees how do they feel? Who are they - the young? The old? How do the ones left feel about losing family members?
9. The next scenario is rising sea levels and in a La Niña year that could be more from the east so they fold down a strip on the east of the paper. It could be a small tuck all the way around. It would be necessary to explain that the strip is just a model for the effect of a La Niña and not what will happen in the actual event.
10. What have they lost this time? How many people can fit on the island now? The refugee group is probably getting quite large. Have they met up with each other? Are they in a different part of their country or in another country?
11. You can continue with different scenarios for 1 or 2 more times, depending on the size of the groups and their islands.
 - The water supply under the island has been contaminated with sea water and half the people must leave as there is no longer sufficient water for them to live
 - The cyclone that damaged the NW resulted in damage to the coral reef. There is another storm and more land is lost in the NW
12. You can discuss the outcome in various ways with students. How did they feel losing land? Losing their friends and family? What could they do to protect themselves? It would be valuable to bring all the refugees back to their island - would they build in different places if given another chance? Did they have higher land they could have used? Are any of these suggestions applicable locally?

ONE FISH TWO FISH RED FISH FEW FISH*

*with acknowledgements to Dr Seuss.

Objective

This experiential activity is designed to show students the impact humans can have on the marine ecosystem.

Teachers;

- Facilitate the first run through of the game
- Explain the rules clearly
- Support students to reflect on the experience
- Give students the opportunity to add to the game with new ideas and then trial them
- Could use the experience to explain the:
 - difference between biotic (living) and abiotic (non-living) factors
 - influence of biotic and abiotic factors on a community
 - connections between living things within a community, particularly with respect to: -feeding relationships, -energy flows, -nutrient cycles.

Students will;

- Listen to first instructions
- Participate in the experience
- Reflect on what happens and describe what that means
- Suggest new ideas to play the game to create more sustainable fisheries
- Play new versions of the game and compare the changes
- Reflect on the experience

AIM of the GAME - To reach a level of sustainable fisheries.

-

RESOURCES • tennis court/playing field • 4+ area-markers (cones) or a long rope • 10+ ice-cream container lids or pieces of card • 2+ sponge balls • picture of a ~~trawler~~trawler-longliner fishing boat and a turtle, hula hoops or loops of rope (for simulated marine reserves), arm bands, pegs.

WHAT TO DO:

- Define the playing area - 1/2 netball court for 20 pupils initially. Non-players (illness, disability) can be easily accommodated as judges and marshals.
- Everyone is a fish but these fish can walk (and ONLY walk!). If a fish leaves the playing area then they become ~~trawlers~~trawler-longliners,
- Pick two volunteers as ~~trawlers~~trawler-longliners- they wait outside the playing area ("in port"). The ~~TRAWLER-LONGLINER~~ chases fish and "tags" fish. The tagged fish then becomes a ~~trawler~~trawler-longliner and must hold hands/link arms and together pursue the other fish;

1. START THE GAME and play until there are no fish left. Usually the game will only last 2-3 minutes.

Stop the game and gather in the students (with a suitably horrified tone) "Look what you have done?!! You have just made all fish life extinct!!! How are you going to feed your families or provide for your ~~town~~village/city? This is not sustainable!

How can we change the rules of this game so that we are more sustainable?" Students come up with suggestions such as:

- a) Marine reserves or conservation areas- " Discuss with students how you could represent marine reserves with the items you can find. Eg hoops. Pieces of string, sticks. "What rules can we create?" (e.g., fish are only allowed in marine reserve for 20 seconds).
- b) Appropriate mesh size for nets or fish hook design -so small fish or breeding fish are not caught they cannot be tagged, (identify some students as small fish with arm bands or pegs?)
- c) Quota system - "What rules can we create?" eg. Once a ~~trawler~~ longliner has tagged 3 fish it must retire to a port i.e., outside game area.
- d) Observers on ~~trawlers~~ longliners - 1 Or 2 students act as Ministry of Fishery observers. Rule; Using the sponge ball or soft toy they shoot at the ~~trawlers~~ longliners, if hit, the ~~trawler~~ longliner breaks from the chain and becomes a fish again. (The remaining ~~trawlers~~ longliners must all join again). MoF observer then retrieves the ball and does one complete lap of the playing area before being able to shoot again. Game continues for 4-5 minutes or until all the fish have become ~~trawlers~~ longliners.
- e) Turtle impact - Discuss how nets also trap turtles and long-lining ~~and how~~ hooks catch birds so fishing at night ~~or~~ not throwing fish offal overboard ~~or~~ redesigning hooks or adding sinkers keeps mortality down).

Introduce one new rule per round or it becomes too confusing.

At the end of each round, ask for a show of hands as to how many fish and #pawlers-longliners there are.

Also, time each round to show how long it takes to catch all the fish with different sustainable strategies

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Reflection - (PART ONE):

- What happened to the #pawler-longliner numbers during the game? What happened to the fish numbers? ("Hands up all the #pawlerslongliners, hands up all the fish").
- Why did this occur? (#pawlers-longliners keep increasing/fish decreasing).
- How did the MoF observer feel? Why did the MoF observer have to do a lap before shooting? (Track down prey again).
- What else could we change? (#pawler-longliner number's, MoF observer numbers. Fish numbers, area size, different MoF observer techniques, etc.).

PROCESSING AND VARIATIONS - (PART TWO):

Depending upon the feedback from participants, vary different factors within the fishing community either individually or in combinations.

Run a trial using larger area:

- What happened to the #pawler-longliner numbers?
- How hard was it for #pawlers-longliners to get food? Why harder? (Resource distribution).
- How was it different for the MoF observer? Why was this?

Introduce more MoF observers:

- What happened to the #pawler-longliner numbers?
- How hard was it for the MoF observers this time?
- What did the MoF observers have to do to 'control' #pawlers-longliners effectively? (Co-operative strategies for MoF observers).
- What other techniques do we use to control exploitation?

PROCESSING (SUMMATIVE)

How did the fish avoid being caught?

What strategies did the #pawlers-longliners develop for success? (Both co-operative and individual strategies are important.) Identifying and avoiding threats (MoF observer). Catching fish. The MoF observer?

- Why are the #pawlers-longliners so successful in this activity and in real life? (Because they are well adapted for finding fish and require Govt/public intervention to keep fishing in check.)
- What does the marked playing area represent? The marine habitat (Hence death when leaving playing area).
- Are there any other resources in your country that present a similar problem? E.g. (Coral reefs, turtles, land, water)
- Are there any ways that you and I are contributing to this problem? (E.g. buying unsustainably fished species, polluting the water, polluting the land)

- Is there anything that we can do to reduce this problem? (E.g. Yes -, assist in replanting areas in mangroves and natives trees, minimise our resource use in general to lessen habitat destruction, buy local.)
- What is ecology? (The study of living things and their environment)

TURTLE TRIUMPHS

INTRODUCTION

Many Turtle species are endangered because of being captured and because their breeding grounds have been taken over by humans. They get caught in fishing nets and injured by boats. This activity relates to Loggerheads and Hawksbill turtles but not the vegetarian Green turtles. Discuss with children that the "fish" could be jellyfish, sponges or very small reef fish.

RESOURCES

- 4+ area-markers (cones).
- gym/tennis court/playing field.
- 2 blindfolds.
- 4 Processing Cards.

WHAT TO DO

Establish parameters and rules with students:

- Where do turtles live?
 - What do they eat?
 - How do they find their food?
 - What kills turtles?
 - What do they need to watch out for?
 - How can we represent this in an activity?
1. Designate two players as Turtle and Fish, Blindfold both players.
 2. Turtle and Fish stand within a circle of the rest of the class, who have their hands joined to create the largest circle possible. Turtle must tag Fish to end the game.
 3. Whenever the turtle goes "swish, swish, swish" the Fish must respond with a "dong dong dong". Having thus partially located the Fish the Turtle moves in, and the Fish attempts to evade - blindfolded remember!
 4. When the turtle is within two steps of the Shoreline the students closest to the turtle should go ""bang, bang, bang" in response to the turtle. If the Turtle contacts the Shoreline it is killed for its meat and shell.

PROCESSING - (PART ONE)

- How did the Turtle find its food (the Fish) in the murky water?
- Was this easy?
- How is this activity different to reality?

- ❖ *There are other noises in the sea.*
- ❖ *Fishermen using nets are present.*
- ❖ *Other predators are in the sea eating fish.*
- ❖ *Turtles' own predators are in the sea.*

PROCESSING - (PART TWO)

Use the feedback from students to run the game with other aspects of the Turtle's environment that could include:

- A Shark that hunts Turtle by listening only (also blindfolded).
- Turtle goes "swish, swish, swish".
- Fish goes "dong, dong, dong" in response.
- Shoreline goes "bang, bang, bang" in response when Turtle is nearly ashore.
- Shoreline quietly goes "whoosh" representing waves, or "crackle-pop" for shellfish.
- Powerboat goes "roar" on its periodic trip through the circle.
- Fishermen use nets that are almost undetectable by sight.

Of primary importance to us are nets so...

1. Get three or four volunteers to act as a Net by joining hands and forming a line within the circle (the Net makes no noise).
 2. When a Turtle moves into a Net it is killed.
 3. When a Fish moves into a Net it remains there alive, and still returns the Turtle's "swish, swish, swish" with "dong, dong, dong".
- What happened to the Turtle? To the Fish?
 - What caused this to happen?
 - Is this more 'realistic' than the first trial?
 - Why does the turtle end up in the Net?
 - What could we do about that?
 - ❖ *Ban the use of nets.*
 - ❖ *Use fishing lines instead.*
 - ❖ *Let the Turtles die out - we are more important.*
 - ❖ *Put something on the Net to warn the Turtle.*

PROCESSING - (PART THREE)

Use the feedback from students to run the game again but introduce the notion of strategies for minimization of net harm to Turtles: introduce pingers on net.

- Net goes "ping" continually.

- Turtle goes "swish, swish, swish".
 - Fish goes "dong, dong, dong" in response.
 - Shoreline goes "bang, bang, bang" in response when turtle is nearly beaching.
 - Shoreline quietly goes "whoosh" continually, representing waves, or "crackle-pop" for shellfish.
 - Powerboat goes "roar" on its periodic trip through the circle.
- What happened to the Turtle in this simulation?
 - *Game One - Turtle was able to find its food though occasional beaching may occur.*
 - *Game Two - Most of the time the turtle was killed by the net because it couldn't.*
 - *Locate it in the water.*
 - *Game Three - No matter what disturbances were introduced to the simulation the turtle was capable of avoiding the Net.*

PROCESSING - SUMMATIVE

- How did it feel to be the Turtle? Fish?
Fun, interesting, challenging,
- How did it feel when the turtle was caught? The Fish? Others?
Turtle - disappointing.
Fish - rewarding, satisfying.
Others - interesting.
- Was it easy to catch the Fish or avoid the Turtle this way?
No - we are not well adapted for this type of hunting or avoidance.
- How did you feel when the Turtle was killed?
Terrible, sorry, sad,
- How did you feel when we were able to avoid killing the Turtle?
Happy, satisfied.
- Why is it necessary to have nets in the water?
We need it to feed our families and ourselves or to make a living from fishing that allows us to pay bills, buy petrol...
- Are there other living things affected like this?
Yes many species are threatened by our need for resources.

DOLPHIN DELIGHT

Experiential learning activity for students years 7 - 13.

INTRODUCTION

The population of many species of dolphins are endangered. This is mostly due to man destroying parts of their environment or using dangerous practices such as net fishing.

RESOURCES

- 4+ area-markers (cones)
- gym/tennis court/playing field
- 2 blindfolds
- 4 Processing Cards

WHAT TO DO

Establish parameters and rules with students:

- Where do dolphins live?
 - What do they eat?
 - How do they find their food?
 - What kills dolphins?
 - What do they need to watch out for?
 - How can we represent this in an activity?
1. Designate two players as Dolphin and Fish, Blindfold both players.
 2. Dolphin and Fish stand within a circle of the rest of the class, who have their hands joined to create the largest circle possible.
 3. Dolphin must tag Fish to end the game.
 4. Whenever the Dolphin goes "click click click" the Fish must respond with a "dong dong dong".
 5. Having thus partially located the Fish the Dolphin moves in, and the Fish attempts to evade - blindfolded remember!
 6. When the dolphin is within two steps of the Shoreline the students closest to the Dolphin should go "click click click" in response to the Dolphin. If the Dolphin contacts the Shoreline it is beached and dies.

PROCESSING - (PART ONE)

- How did the Dolphin find its food (the Fish)?
- Was this easy?
- Why don't Dolphins look for their food?
- What problems might this cause?
- How is this activity different to reality?
- ❖ *There are other noises in the sea.*
- ❖ *Fishermen using nets are present.*
- ❖ *Other predators are in the sea eating fish.*
- ❖ *Dolphins own predators are in the sea.*

PROCESSING - (PART TWO)

Use the feedback from students to run the game with other aspects of the Dolphin's environment that could include:

- A Shark that hunts Dolphin by listening only (also blindfolded).
- Dolphin goes "click, click, click".
- Fish goes "dong, dong, dong" in response.
- Shoreline goes "click, click, click" in response when Dolphin is nearly beaching.
- Shoreline quietly goes "whoosh" representing waves, or "crackle-pop" for shellfish.
- Powerboat goes "roar" on its periodic trip through the circle.
- Fishermen use nets that are undetectable by SONAR.

Of primary importance to us are nets so...

1. Get three or four volunteers to act as a Net by joining hands and forming a line within the circle (the Net makes no noise).
 2. When a Dolphin moves into a Net it is killed.
 3. When a Fish moves into a Net it remains there alive, and still returns the Dolphins "click, click, click" with "dong, dong, dong".
- What happened to the Dolphin? To the Fish?
 - What caused this to happen?
 - Is this more 'realistic' than the first trial?
 - Why does the Dolphin end up in the Net?
 - What could we do about that?
 - ❖ *Ban the use of nets.*
 - ❖ *Use fishing lines instead.*
 - ❖ *Let the Dolphins die out - we are more important.*
 - ❖ *Put something on the Net to warn the Dolphin.*

PROCESSING - (PART THREE)

Use the feedback from students to run the game again but introduce the notion of strategies for minimization of net harm to Dolphins: introduce pingers on net.

- Net goes "ping" continually.
- Dolphin goes "click, click, click".
- Fish goes "dong, dong, dong" in response.
- Shoreline goes "click, click, click" in response when Dolphin is nearly beaching.
- Shoreline quietly goes "whoosh" continually, representing waves, or "crackle-pop" for shellfish.
- Powerboat goes "roar" on its periodic trip through the circle.
- What happened to the Dolphin in this simulation?

Game One - Dolphin was able to find its food though occasional beaching may occur.

Game Two - Most of the time the dolphin was killed by the net because it couldn't locate it in the water.

Game Three - No matter what disturbances were introduced to the simulation the Dolphin was capable of avoiding the Net.

PROCESSING - SUMMATIVE

- How did it feel to be the Dolphin? Fish?
Fun, interesting, challenging.
- How did it feel when the Dolphin was caught? The Fish? Others?
Dolphin - disappointing.
Fish- rewarding, satisfying.
Others - interesting.
- Was it easy to catch the Fish or avoid the Dolphin this way?
No - we are not well adapted for this type of hunting or avoidance.
- How did you feel when the Dolphin was killed?
Terrible, sorry, sad.
- How did you feel when we were able to avoid killing the Dolphin?
Happy, satisfied.
- Why is it necessary to have nets in the water?
We need it to feed our families and ourselves or to make a living from fishing that allows us to pay bills, buy petrol...
- Are there other living things affected like this?
Yes many species are threatened by our need for resources.

CONNECT FOUR GAME - GAME RULES

The game can be played by individuals or pairs within a group (up to 4 individuals or pairs).

Players take it in turns to select a card from the pile or envelope on the table.

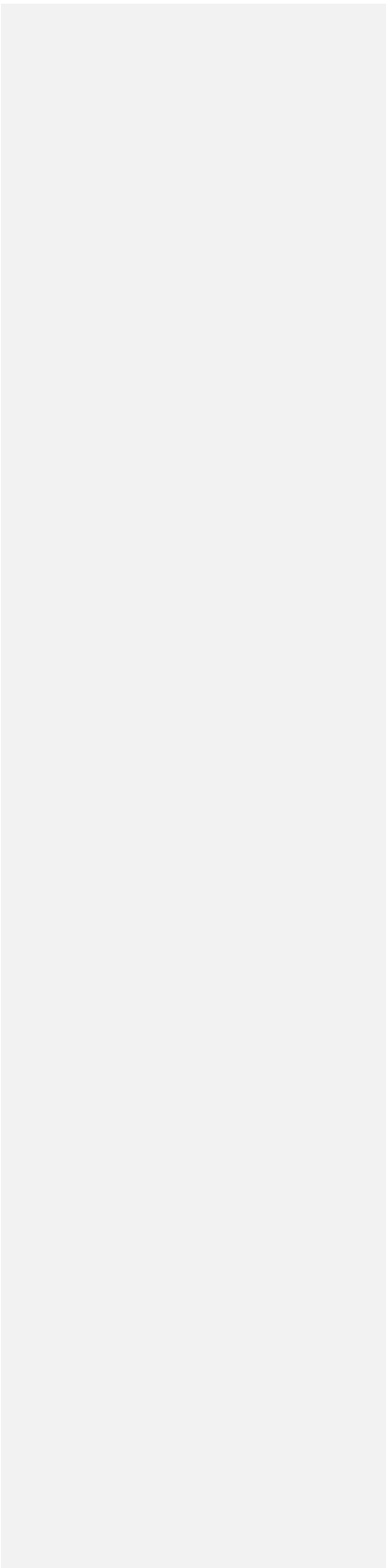
A card must be placed on a square, on the game base board, to which it relates. There must be agreement, through discussion, amongst all players in the group that the scientific reason for placing the card is correct before it can be placed on the game board.

The aim of the game is to connect a line of four continuous cards, vertically, horizontally or diagonally. Whoever does this first wins the game.

Several games may be played as a 'rubber' - e.g., best of three, or five games.

NOW PLAY!

States of Matter Connect Four			
Solid	Liquid	Gas	Solid
Liquid	Gas	Solid	Liquid
Gas	Solid	Liquid	Gas
Solid	Liquid	Gas	Solid



Water

They are
invisible.

You can take
hold of it.

They are
runny.

Air is made up
of a mixture
of these.

It will not
change unless
you break a bit
off.

They flow
downwards.

It has the
same shape
and same
volume as its
container.

Brick

The volume
doesn't
change.

It is hard to
control.

Sugar

Jelly

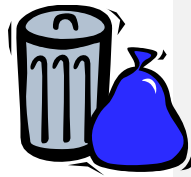
Oxygen

Cement

Lemonade

Activity - Waste Time Line

Objective: To give students a visual representation of the time it takes for various materials to break down by relating the time to concrete examples.



Materials:

- 10 m piece of coloured string.
- Metre ruler or tape measure.
- Clothes pegs.
- Variety of waste materials.



Instructions:

Round one: Creating a time line (working in groups of 3-4 people).

- a) Place a 10m time line across the room or along one wall, or alternatively use chalk and draw a line along the concrete.
- b) Using materials you have, on the time line mark out every 100 years (1m=100 years).
- c) Label the beginning of the line TODAY!
- d) Using the cards, answer the questions and place the cards in the correct position on the time line.

Questions:

1. How long are most people expected to live? (80 years).
2. How does this age compare with the total length of the time line?
3. What skills did you use to create the time line?

Round two: How Long to Rot

- a) Give each group a range of waste items.
- b) They are to discuss and decide how long they think it will take the article to breakdown (under ideal conditions).
- c) Place (or hang) their articles on the time line showing their estimate.

Question:

1. What criteria did you use to estimate the time?

Round three: According to the Statistics

- a) Now give each group the card showing the real time for the articles to break down.

- b) Get the students to move their article along the time line to place it at the estimated time to break down according to the statistics given.

Questions:

1. What surprised you?
2. What did you learn?
3. How could you use this knowledge?

Round four: What can be recycled?

Ask participants to return to their waste time-line and remove all the articles they can reuse and/or recycle.

Questions:

1. What materials were left on your line?
2. What could you do with these materials?

Reflection / Evaluation of the Activity:

1. What was the purpose of doing the activity?
2. What skills were practiced and developed in the activity?
3. How does the development and practice of these skills in this activity compare with other ways of approaching these skills?
4. How could you modify this activity to use for your work with -
 - (a) With children.
 - (b) With teachers or educators.
 - (c) With other adults (community groups).



Article	Time to break down	Article	Time to break down
Apple core	2 months (in water)	Orange or banana peel	Up to 2 years
Aluminium cans	200 - 500 years	Plastic bags	Between 20-1000 years
Cardboard box	2 months (in water)	Plastic bottles	forever
Cigarette butts	1-5 years	Plastic coated paper	5 years
Disposable nappy	450 years (in water)	Plastic film containers	20-30 years
Fishing line	600 years (in water)	Plastic six pack holders	100 years
Glass bottles	forever	Styrofoam	forever
Leather	Up to 50 years	Tin cans	50 years
Nylon fabric	30-40 years	Wool socks	1-5 years

Activity - Waste Time Line : Questions

Round One: Creating a Time Line

1. How long are most people expected to live?
2. How does this age compare with the total length of the time-line?
3. What skills did you use to create the time-line?

Round Two: How long to rot?

1. What criteria did you use to estimate the time?

Round Three: According to the Statistics

1. What surprised you?
2. What did you learn?
3. How could you use this knowledge?

Round Four: Reuse and Recycle

1. What materials were left on your line?
2. What could you do with these materials?

Reflection / Evaluation of the Activity

1. What was the purpose of doing the activity?
2. What skills were practiced and developed in the activity?
3. How does the development and practice of these skills in this activity compare with other ways of approaching these skills?
4. How could you modify this activity to use for your work with -
 - (d) With children
 - (e) With teachers or educators
 - (f) With other adults (community groups)

Build A Tree

This activity works best with at least 15 students years 7 to 13.

What do trees need? What do trees do?

Brainstorm with students - need sunlight, water, soil, oxygen (air).

They need roots, leaves, branches, flowers.

They grow tall, make their own food, provide food and shelter for humans and other animals, transpire.

Explain that the students are going to "build" a tree by becoming parts of the tree then acting out their roles. This is best done somewhere where students won't mind lying on the ground but does not need much room.

1. *What do you see when you look at a tree?* Ask for a volunteer to be the trunk - they may need to stand on a chair. They need to stretch their branches (arms) high, *roots for new growth?* Phloem or tubes. Four or five and move their leaves (fingers) in the sun.
2. *What keeps the tree up?* Students will say roots so ask for 3 volunteers to lie on their stomachs facing out from the trunk.
3. *What do the roots do?* When they refer to getting water from the soil, ask the roots to wriggle their root hairs (fingers) and make slurping noises to show they are taking in water.
4. *How does the water get up the stem?* If they know xylem or mention tubes or pipes ask for 3 volunteers to be xylem. They stand around the trunk, facing outwards and holding hands. They need to crouch down then make a sipping noise as they rise - lifting their hands up to carry water to the leaves, then back down again for the next load.
5. *What are the leaves doing with the water?* Making food. *How does the food travel around the plant and down to the* volunteers will be needed to face in towards the xylem, holding hands. They will make a 'whish' noise as they carry food downwards, then rise again to repeat.
6. *What protects these tubes?* Bark - 5-6 volunteers to stand facing outwards, holding hands. When danger approaches they will 'bark' and try to repel them.
7. *What do trees need protection from?* The answer may well be humans but look for birds and insects. Two or three students can be invaders.

The tree now needs to come to 'life'. Everyone needs to make their noises and move accordingly. The tree should be very active and noisy.

Processing

- Why does the tree need so many parts?
 - Lots of different things need to happen. Water and food are going in different directions - need different paths.
- What happens if one part doesn't work properly?
 - The rest won't work properly either.
- Which part is the most important?
 - None - they are all important - students will usually claim the part they acted. This is good as they have a deeper understanding when they have an emotional attachment.
- What stops the bark being effective?
 - Being cut or damaged.

The Bean Game

An experiential activity.

This game gets students to look at the earth's resources over time. Students can then look at a different future.

What do you need? A bowl of mixed dried beans(eg chick peas, black beans , lentil, haricot, rice , grain etc) or sand or jelly beans per group of six people. A variety of tools can be used also like an iceblock stick , chopsticks or teaspoon.

Introduction; Teacher to say the following

In front of you have a bowl of dried beans

Number each member of the group 1 to 6.

When I say **Go**

Person 1- picks up as many beans as possible using only a **pinkie finger and thumb**.

They have **10 seconds** to do this and place the beans in a pile in front of them.

Teacher - Start timing and then give the **GO**

Then at the teachers start:

Person 2- does exactly the **same**

Then at the teachers start:

Person 3- has **10 sec** but can use **2 fingers and thumb** to pick up as many as possible. (could use an iceblock stick)

Then at the teachers start:

Person 4- does exactly the **same**

Then at the teachers start:

Person 5- uses **3 fingers and a thumb** but has only **5 seconds** (could use a teaspoon)

Then at the teachers start:

Person 6- uses their **whole hand** but only have **1 sec**.

Then count the beans and find average or just look and discuss the piles. What has happened? What do you think we were modelling? Ask the students to think what the beans could represent.

Notes to guide reflection

- The first 2 students represent the **stone age**- have many tools during that age so cannot collect many beans
- The next 2 students represent the iron age- more advanced and had more tools in that age. They can collect more beans.
- Then we come to the industrial age when the metal was turned into machinery. With extra tools they were able to pick up more in a much shorter time.
- The last person, who used their whole hand represents today, right now. This is the modern age of technology. Great changes take place quickly in this age- a few years ago the first computers took up the whole rooms- think of the rapid changes in computers today. This person ,just using their whole hand in 1 second was able to pick up more than all other ages

- The rest of the beans in the future.....tomorrow, 2020, 100 yrs from now.....

What else could the beans represent? Would they be different at different ages?

The different beans are to represent resources /materials.

Air, water, animals, fruit and vegetables, sun/energy, plants, fossil fuels (oil, coal, natural gas), soil

If the beans represent resources, what does the bowl represent? **THE EARTH.**

There are many resources but only 1 earth.

All the resources can be separated into 2 groups;

- a) Renewable- water, plants, air (these can be re- grown or used again)
- b) Non renewable-oil/gas/coal these things can' be remade. (once they are used they are gone)

The past and present have taken all these resources from the bowl. Look at what is left for the future. At this point what would the future say to the past and present?(students will probably respond with comments such as ; you've taken too much/ you have used up to much/ you haven't left us enough to last etc.

Ask students....**What could be done to improve this situation?**

- BY NOT TAKING AS MUCH!
- BY ONLY TAKING WHAT YOU NEED.
- BY REDUCING, REUSING, RECYCLING.

PLAY THE GAME AGAIN; Explain that from now on each person can only take from the bowl once but they can put back as many times as they want. You can recycle and replace. Now we can continue from our knowledge of what the beans represent. We know what they are and what this activity is about

Before we start again I want you to think about **WANTS and NEEDS**

Continue to the next person. They take from the bowl as they want/ need to

As the game continues people in the past and present should be recycling / replacing/renewing resources that they don't need. Draw attention to this eg. Some plants have been replaced, fruit and vegetables have been composted and renewed.

Hopefully students will be taken less and less from the bowl. If only a few of the particular resource exists draw attention to this... plants are dying out, animals are endangered, losing your water supply. This should cause students to replace more resources.

- When all the students have taken from the bowl, stop the activity. Ask students " **Is there more left for the future?"**
- Ask students; **What does this game mean? What's it all about? What can we do to ensure our resources aren't used up now?**
- Match a coloured bean to a resource eg plants. Ask Students; **What can we do to help the survival of plants? What can we do to reduce our impact**

on them? ... Students should have suggestions such as ; plant more trees, only use organic fertiliser, plant along stream, join groups to stop deforestation...

- Match a coloured bean to Water... Ask students: **What are you doing with water? What can you do to save water, to reduce the impact that YOU have on water?.....** turn off taps, fix washers, protect streams, don't dump pollutants into stormwater drains ... **what about connections of water with electricity? What are you going to do to save electricity?....** turn off switches, turn fridges down, turn off television sets at the wall..use energy efficient light bulbs
- Continue through the resources.

Think of what you are consuming now. What can you do to reduce, reuse, recycle?

Songs

E HARA I TE MEA C maj

<i>E hara i te mea,</i>	It is not a new thing
<i>no inaiane i te aroha</i>	now that is love
<i>No ngā tupuna</i>	comes from the ancestors
<i>I tuku iho, i tuku iho</i>	handed down through the
	passages of time

<i>Te <u>whenua</u>, te <u>whenua</u>,</i>	The land, the land
<i>hei oranga... mo te iwi</i>	is the life for the people
<i>No ngā tupuna</i>	comes from the ancestors
<i>I tuku iho, i tuku iho</i>	handed down through the
	passages of time

The Water Cycle Song Tune - Oh my Darling Clementine

Evaporation
Condensation
Precipitation all around
Accumulation
Evaporation
The Water Cycle goes round and round

Miti'ia
Suavaia
Timuia
Faasoloatoa
Faatupulaia toe
Miti'ia
Taamiloga ole vai e le motusia

Or:

What's the weather?
What's the weather?
What's the weather like today?
Is it rainy?
Is it windy?
Are there clouds or is there sun?

This Old Earth **(to the tune of "This Old Man")**

This old earth
Needs our help
To stay fresh and clean and green
With a pick it up; pitch it in; and throw it in the can--
This old earth needs a helping hand!

This old earth
Is running out
Of oil and water and fresh clean air
With a pick it up; pitch it in; and throw it in the can--
This old earth needs a helping hand!

This old earth
Is our home
Keep it clean and safe from harm
With a pick it up; pitch it in; and throw it in the can--
This old earth needs a helping hand!

Pick it up!!
tune: If you're happy and you know it.
If you see a piece of litter pick it up
(Yell-PICK IT UP!!) I

If you see a piece of litter pick it up
(PICK IT UP!)

You will make the world look better if you pick up all the litter.
If you see a piece of litter, pick it up
(PICK IT UP!!)

