Oceans

An Inquiry Unit

Carol Brieseman Primary Science Teacher Fellow 2012 The New Zealand Science, Mathematics and Technology Teacher Fellowship Scheme is funded by the New Zealand Government and administered by the Royal Society of New Zealand.

Outline

This Inquiry Unit follows a 10 week guide. The first 7 weeks being the 'teacher-directed' Inquiry and the last 3 being time for individual research. Each topic here has related science activities and they are shown in the green arrow at the top of each new topic page.

Science Experiments: Cartesian Diver and Salt Water circuit
Pages 25, 26

Big Ideas/Key Understandings

- Planet Earth is a blue planet.
- The Ocean is a major influence on weather and climate.

  The ocean supports a great diversity of life and ecosystems.
- The ocean covers over 70% of the Earth.
- Understanding the importance of our oceans, the interdependence of parts of the planet

Concepts

- Interdependence
- Sustainability

Principles

- High Expectations
- Learning to learn

Values

- Excellence
- Innovation, inquiry, and curiosity
- Ecological sustainability

Key Competencies

- Thinking
- Participating and Contributing
- Using language, symbols and texts

Driving Question

Why is the ocean so important to us?

Subsidiary Questions

- What is an ocean current?
- How does the ocean affect weather and the climate?
- What is it like under the ocean?
- What do animals that live under water do all day?

Level 1 and 2
Achievement objectives

Nature of science

Students will:

Investigating in science

Extend their experiences and personal explanations of the natural world through exploration, play, asking questions, and discussing simple models.

Living world

Students will:

Life processes

Recognise that all living things have certain requirements so they can stay alive.

Planet Earth and beyond

Students will:

Earth systems

Explore and describe natural features and resources.

Interacting systems

Describe how natural features are changed and resources affected by natural events and human actions.

Physical world

Students will:

Physical inquiry and physics concepts

Explore everyday examples of physical phenomena, such as movement, forces, electricity and magnetism, light, sound, waves, and heat.

Seek and describe simple patterns in physical phenomena.

Level 3
Achievement objectives

Nature of science

Students will:

Understanding about science

Appreciate that science is a way of explaining the world and that science knowledge changes over time.

Identify ways in which scientists work together and provide evidence to support their ideas.

Communicating in science

Begin to use a range of scientific symbols, conventions, and vocabulary.

Engage with a range of science texts and begin to question the purposes for which these texts are constructed.

Living world

Students will:

Ecology

Explain how living things are suited to their particular habitat and how they respond to environmental changes, both natural and human-induced.

Planet Earth and beyond

Students will:

Earth systems

Appreciate that water, air, rocks and soil, and life forms make up our planet and recognise that these are also Earth's resources.

Interacting systems

Investigate the water cycle and its effect on climate, landforms, and life.

Level 4
Achievement objectives

Nature of science

Students will:

Understanding about science

Appreciate that science is a way of explaining the world and that science knowledge changes over time.

Identify ways in which scientists work together and provide evidence to support their ideas..

Communicating in science

Begin to use a range of scientific symbols, conventions, and vocabulary.

Engage with a range of science texts and begin to question the purposes for which these texts are constructed.

Participating and contributing

Use their growing science knowledge when considering issues of concern to them.

Explore various aspects of an issue and make decisions about possible actions.

Living world

Students will:

Life processes

Recognise that there are life processes common to all living things and that these occur in different ways.

Ecology

Explain how living things are suited to their particular habitat and how they respond to environmental changes, both natural and human-induced.

Planet Earth and beyond

Students will:

Earth systems

Develop an understanding that water, air, rocks and soil, and life forms make up our planet and recognise that these are also Earth's resources.

Physical world

Students will:

Physical inquiry and physics concepts

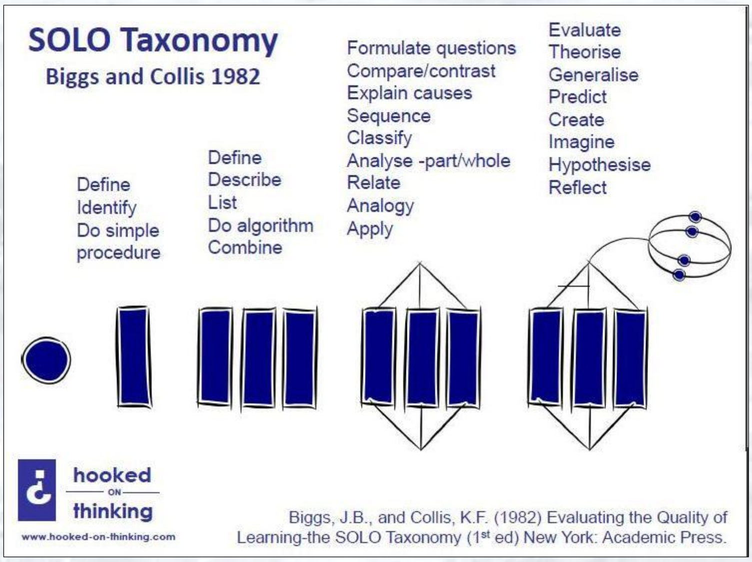
- Explore, describe, and represent patterns and trends for everyday examples of physical phenomena, such as movement, forces, electricity and magnetism, light, sound, waves, and heat. For example, identify and describe the effect of forces (contact and non-contact) on the motion of objects; identify and describe everyday examples of sources of energy, forms of energy, and energy transformations

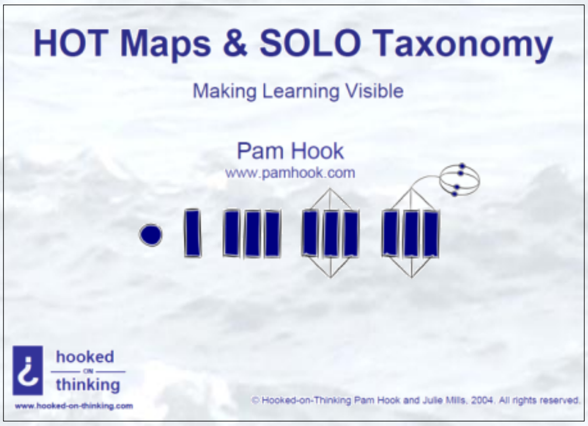
The progression of this Inquiry

Week 1	2	3	4	5	6	7	8 ,9, 10
Introduction: What we know already	The Importance of the Ocean	Ocean Currents	Argo Floats	Marine Food Web	Climate Change	Ocean Acidification	Individual Inquiry

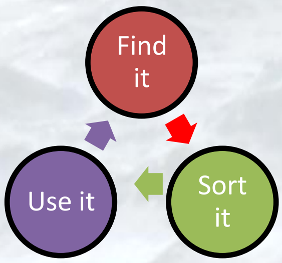
Using SOLO

SOLO is a taxonomy which guides the progression of how the learner learns. (Structure Of Learning Outcomes) There are 5 stages with SOLO. This taxonomy structures learning in a clear and purposeful way.





Find it: SOLO Multistructural LO
Sort it: SOLO Relational LO
Use it: SOLO Extended abstract LO



There are 3 questions that are terrific for self-motivation and assessment. Make it a habit to always have these in mind.

HOT Maps or similar graphic organisers will help the process of demonstrating understanding and connecting to new learning

Free SOLO Resources

Many resources are available here (and on the HookED wiki) to help you introduce SOLO Taxonomy as a model of learning with students, teachers, parents, whānau and community.

For example the SOLO Symbol Generator, resources on the Downloadable Resources page and the new addition the SOLO Learning Intention Generator.

Look for SOLO posters and templates, SOLO coded self-assessment rubrics for the key competencies, (e) competencies, IEPs, teacher reflection and the effective pedagogies, SOLO symbols, and SOLO differentiated planning templates and constructive alignment tools for the NZ Curriculum achievement objectives and achievement standards

What do we know already?

Key ideas: Stimulate questions and interest, find out what already know

Session 1
View a short video clip about Oceans
Suggestons:
BBC seas and oceans
http://www.youtube.com/watch?v=qwIRW_Rx6KA

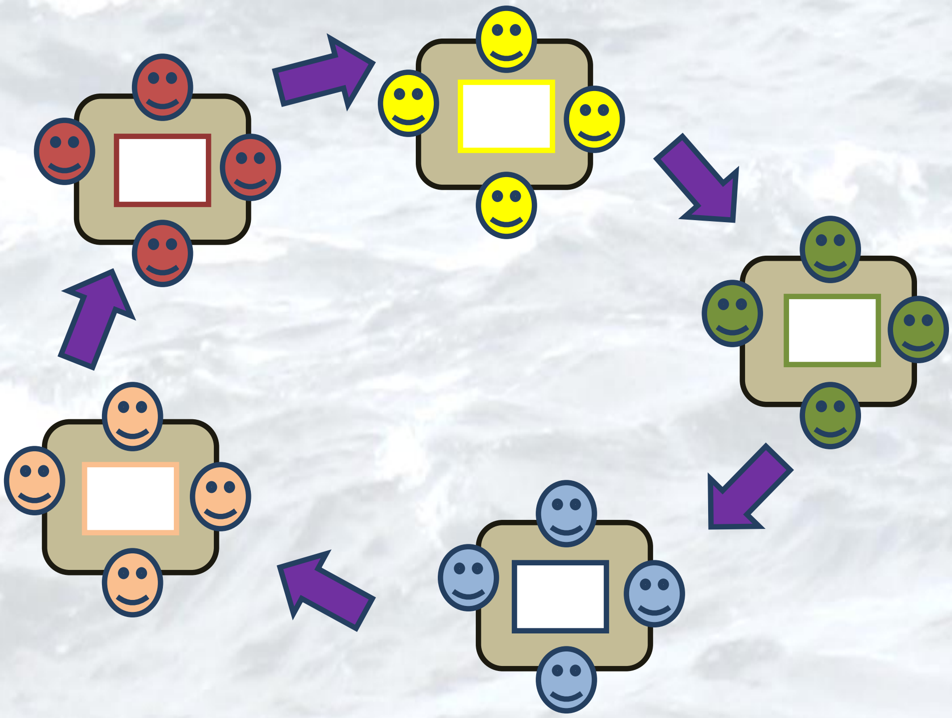
Oceans - Disney Nature Official Trailer 2010
http://www.youtube.com/watch?v=fwxZuKErHs8&feature=results_video&playnext=1&list=PL4B6297DC168ABBCB

BBC HD Oceans Mediterranean Sea 720p AC3 5.1 (part of this)
http://www.youtube.com/watch?v=J4HB_pQ_9m0

Brainstorm all the things you know about the Ocean in a noisy Round Robin.

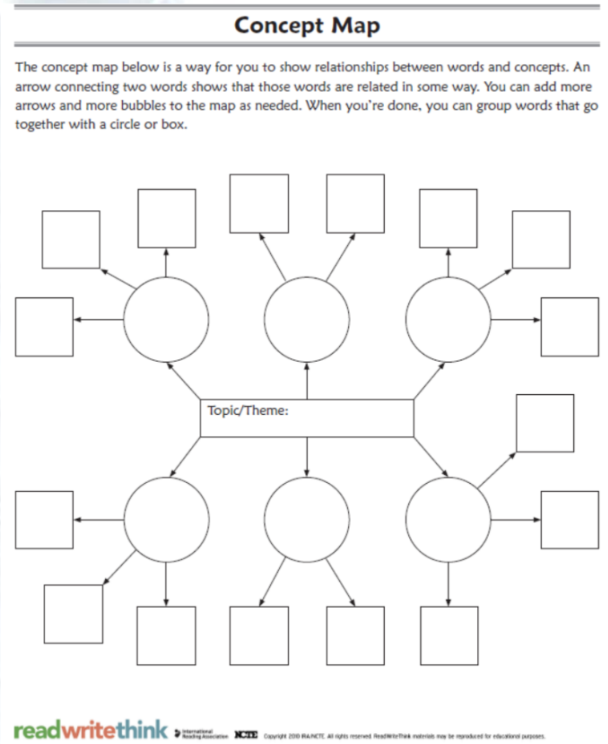
Noisy Round Robin

Session 2
- Divide the class up into groups of 4-5.
- Give each group a large sheet of paper and a felt pen.
- For the next 2 minutes, each group is to brainstorm as many things as possible relating to topic given.
- When 2 minutes is up the Teacher calls out "Yoplait" (from Eric Frangenheim who explains to students that *Yoplait* is French for *Yum*, *Yoghurt* and is also French for '*Pay Attention*' or in this case it means '*Finish the sentence and pass the sheet to the next person or group in a clockwise direction*.'. (You could choose some other word that gives the signal to change and write),
- Hand the paper on to the next group, receive another group's sheet and generate more ideas. New ideas only. Discussing as a group hence the "Noisy" Round Robin.
- Once all groups have written on the sheets, finish up and the groups may then come together as a class to share and discuss their ideas.



Session 3

Take the Round Robin sheets and create a concept map like this. The template shown below is found on the 'read write think' website and is a free resource.



Understanding the Importance of our Oceans

Key ideas: Size of our oceans and how a healthy ocean means a healthy planet

http://video.nationalgeographic.com/video/environment/habitats-environment/habitats-oceans-env/why-ocean-matters/

Why the Ocean Matters

Covering 72 percent of the Earth and supplying half its oxygen, the ocean is our planet's life support system—and it's in danger. Watch this video to learn why a healthier ocean means a healthier planet, and find out how you can help.

The Importance of our ocean

This David Gallo clip is one of many TED talks relating to the ocean.

http://www.ted.com/talks/lang/en/deep_ocean_mysteries_and_wonders.html

The Importance of Ocean Currents

Because ocean currents circulate water worldwide, they have a significant impact on the movement of energy and moisture between the oceans and the atmosphere. As a result, they are important to the world's weather.

Science Experiments: Ocean Currents, Ocean Currents and convection Pages 23, 24

Ocean Currents

Background:
What are Ocean currents?

An **ocean current** is a continuous, directed movement of ocean water generated by the forces acting upon this mean flow, such as breaking waves, wind, Coriolis effect, cabbeling, temperature and salinity differences and tides caused by the gravitational pull of the Moon and the Sun. Depth contours, shoreline configurations and interaction with other currents influence a current's direction and strength. Ocean currents can flow for great distances, and together they create the great flow of the global conveyor belt which plays a dominant part in determining the climate of many of the Earth's regions http://en.wikipedia.org/wiki/Ocean_current

Activity:

- Explain that ocean currents are driven by the wind and influenced by the landmasses that obstruct the flow of water as well as the density and temperature of the water.
- Fill a large dish with cold water and sprinkle paprika (or any herb that floats!) over the surface. Gently blow across the surface using a straw. Students should observe that the water is rippled by the artificial wind created and that the currents on the surface circulate around the edges of the dish.

Key ideas:

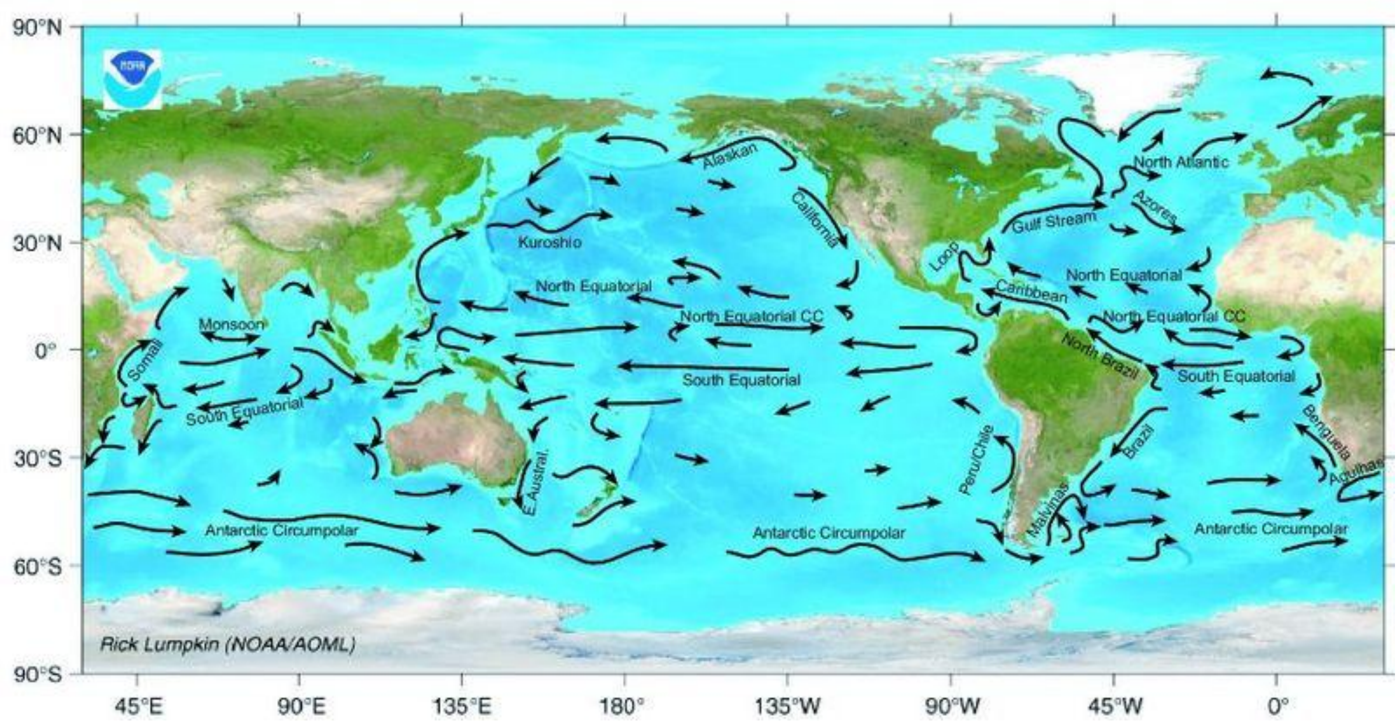
- All the oceans on Earth are really one "world ocean."
- Relationship with the world's weather, and distribution of sea life.
- Warm and cold currents. – density
- Salinity.
- The Antarctic Circumpolar current flows all the way around the world

NOAA have produced an in-depth narrated slide-show about Ocean Currents. It is found at this site http://www.montereyinstitute.org/noaa/lesson08.html Click on 'printable version' for the transcript)

It could be viewed as a whole or divided into sections with a class discussion along the way to make sure everyone understands. You may like to include some comprehension questions with this.

Activity:

Have a look at a world map and locate the major ocean currents.



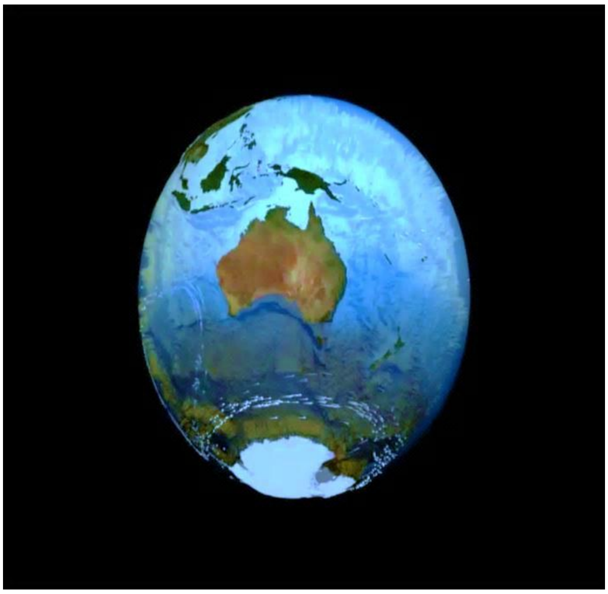
The major currents are

- the North and South Equatorial Currents,
- the Gulf Stream ,
- the Kuroshio Current,
- the Antarctic Circumpolar Current,
- the East Australian Current.

The largest ocean current on earth is the Antarctic Circumpolar Current, which circulates around Antarctica

Map work

Have students label the major ocean currents on a map of the world.



Part of the current systems results from changes in the density of the seawater. This is called the thermohaline circulation. This animation first depicts surface flows , which takes warm, salty water to the area near Iceland and Greenland. There the water cools, becomes more dense and sinks. The surface of the ocean then fades away and the animation pulls back to show the global thermohaline circulation at depth.

All credit due to NASA/Goddard Space Flight Center Scientific Visualization Studio. The Blue Marble Next Generation data is courtesy of Reto Stockli (NASA/GSFC) and NASA's Earth Observatory.

The Antarctic Circumpolar Current.

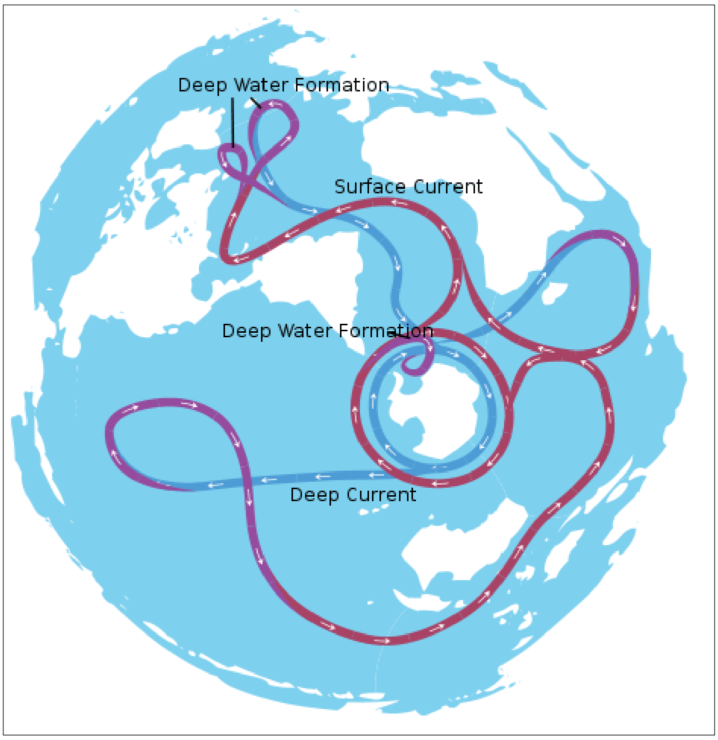
The region around latitude 60 south is the only part of the Earth where the ocean can flow all the way around the world with no land in the way. As a result, both the surface and deep waters flow from west to east around Antarctica. The main current in the Southern Ocean is the Antarctic Circumpolar Current - The big ACC! (Circumpolar means it encircles a polar region) It is a vital link between the global ocean conveyor, connecting the waters of the Atlantic, Indian and Pacific Oceans. It is also an important connection for the wind driven circulation.

Amazing facts!

- The ACC is the biggest current in the world
- It can move up to 150 billion litres per second of water.
- It can reach speeds in narrow channels of up to 1 metre per second (3.6 km per hour)
- This is the same as 150 times the water contained in all the rivers in the world, or the water contained in 75,000 Olympic swimming pools going past every second!

The volume of water that is transported by the ACC is so large, not because it flows fast, but because of the depth. It has a depth of up to 4000m and is from just south of New Zealand to most of the way to Antarctica.
The Southern Ocean is one of the top places for wind on Earth, and these winds move the currents. Friction between the sea water and the bottom of the ocean cause the movement of the water or current to slow down. It is the balance between these two forces that stop the currents from getting faster and faster.

In the above video clip, NIWA physical oceanographer Dr Mike Williams talks about the world's largest current -- the Antarctic Circumpolar Current (ACC) -- and its influence on the 'oceanography' (ocean characteristics) south of New Zealand. (0:00- 1:00 especially, from the 3 min clip)



The Antarctic Circumpolar Current is wind driven and is a critical component of the wind-driven flow

In this diagram, red indicates surface current and blue indicates deep water current.

Oceans and Seas

The following table lists the world's oceans and seas, according to area and average depth, including the Pacific Ocean, Atlantic Ocean, Indian Ocean, Southern Ocean, Mediterranean Sea, Arctic Ocean, Caribbean Sea, Bering Sea, and more.

Name	Area	Average depth	Greatest known depth	Place of greatest known depth
	sq. km	m	m	
Pacific Ocean	155,557,000	4,028	11,033	Mariana Trench
Atlantic Ocean	76,762,000	3,926	9,219	Puerto Rico Trench
Indian Ocean	68,556,000	3,963	7,455	Sunda Trench
Southern Ocean	20,327,000	4,000–5,000	7,235	South Sandwich Trench
Arctic Ocean	14,056,000	1,205	5,625	77°45'N; 175°W
Mediterranean Sea	2,965,800	1,429	4,632	Off Cape Matapan, Greece
Caribbean Sea	2,718,200	2,647	6,946	Off Cayman Islands
South China Sea	2,319,000	1,652	5,016	West of Luzon
Bering Sea	2,291,900	1,547	4,773	Off Buldir Island
Gulf of Mexico	1,592,800	1,486	3,787	Sigsbee Deep
Okhotsk Sea	1,589,700	838	3,658	146°10'E; 46°50'N
East China Sea	1,249,200	188	2,782	25°16'N; 125°E
Hudson Bay	1,232,300	128	183	Near entrance
Japan Sea	1,007,800	1,350	3,742	Central Basin
Andaman Sea	797,700	870	3,777	Off Car Nicobar Island
North Sea	575,200	94	660	Skagerrak
Red Sea	438,000	491	2,211	Off Port Sudan
Baltic Sea	422,200	55	421	Off Gotland

http://www.factmonster.com/ipka/A0001773.html

Argo Floats

Science Experiments: Cartesian Diver and Salt Water circuit
Pages 25, 26

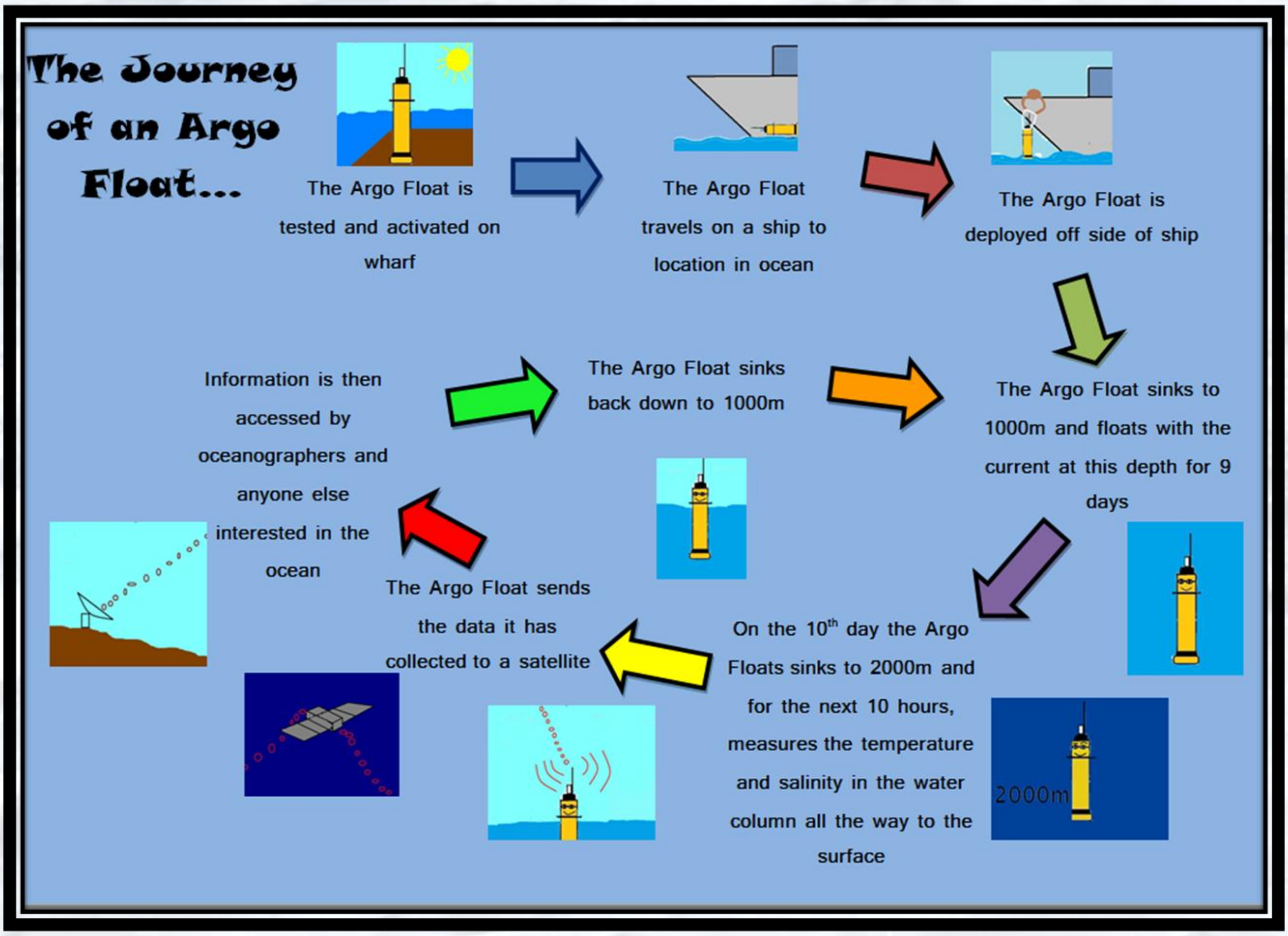
Argo Floats are a very cool technology that measures temperature and salinity in our oceans. We need this information to help us understand our climate, weather, and to advance ocean research.

Key ideas: over 3500 Argo Floats all over the world measuring temperature and salinity on a 10 day cycle.

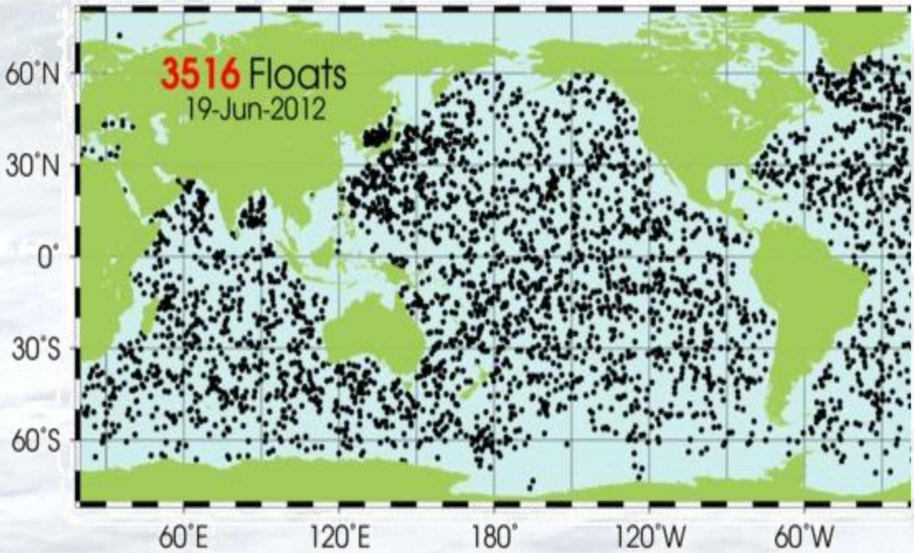
Argos are like Underwater Robots (about 1.5 m in height) that float around at about 1000m (1 km) below sea level. They float here for 9 days, then sink down to about 2 kilometres of depth before they come up to the surface. On its way up, an Argo Float measures temperature and salinity through the water column. Once it's on the surface, it transmits that data to a satellite and then repeats the process, sinking back down to 1,000 metres, and spending another 9 days drifting around.

The buoyancy of an Argo float is controlled to make it rise or sink. This is done by pumping oil between internal and external bladders. A Cartesian diver works on similar scientific principles (see science experiment pg. 25)

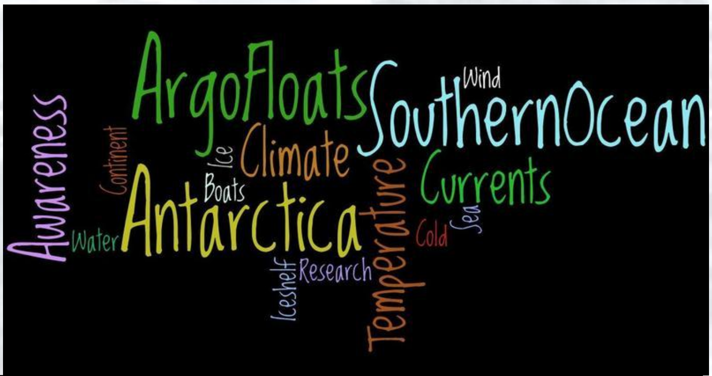
Argo data are easy to access and are truly global. They bring more awareness of how our oceans work and keep a watch on major temperature and salinity anomalies and changes in ocean circulation. Argo data also aid the monitoring of environmental conditions that affect fish stocks and biological productivity.



There are many countries involved in the Argo Project. A terrific collaboration between the countries sharing the data gathered. Each Argo Float costs about $30,000 NZ. New Zealand purchases 2 Argo Floats a year but is very involved in the deployment of Floats in the Southern Ocean for other countries.

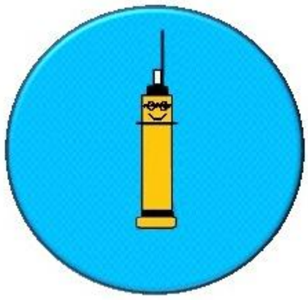


The **Science Learning Hub** has some valuable short video clips that can be easily used in the classroom. Here, NIWA physical oceanographer Dr Phil Sutton outlines the aims of the international Argo and Jason projects



Way Down South wiki*: For lots more information, videos and links about Argo Floats.*

Adopting an Argo Float



You can access real-time data about Argo Floats using a terrific Google Earth Application. Choose an area where you would like to find out information about the Ocean (e.g. somewhere in the Southern Ocean)

http://argo.jcommops.org/argo.kml

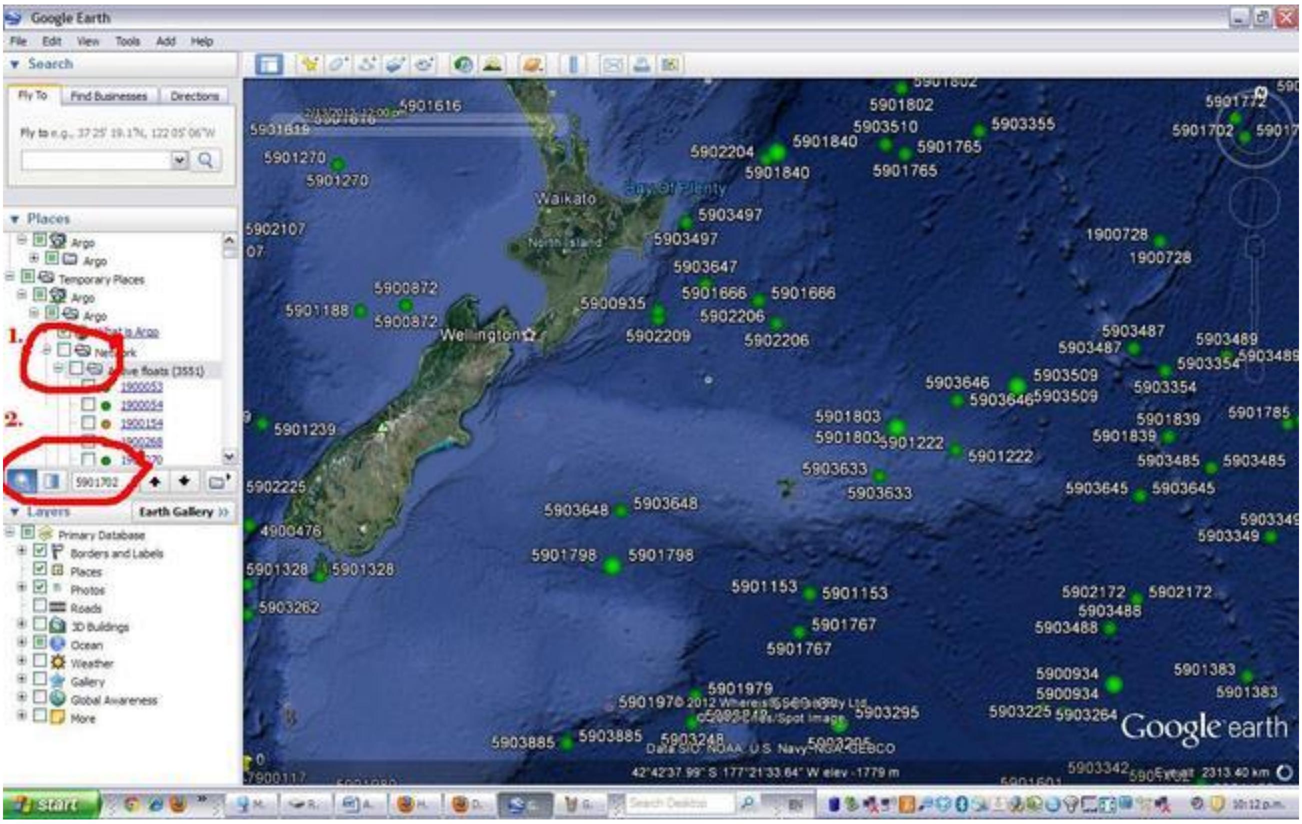
This application will put the location of all Argo floats (with their WMO ID numbers) on a Google Earth globe. Once installed it will update itself automatically when you start Google Earth. You can click on any float and get a lot of information about that instrument.

Activity: Stick with one Argo Float (Adopt it!) and follow it every 10 days. Make comparisons between one in the Southern Ocean, one around the Equator and one in the North. (Maybe working in groups to cover different areas of the world) Note the distance an Argo Float travels and its temperature for example at 1000m and at sea level. Graph your results.

Please note: Argo Floats have 2 different numbering systems. Use their WMO ID Number with Google Earth

Using the WMO Search tool on Google Earth

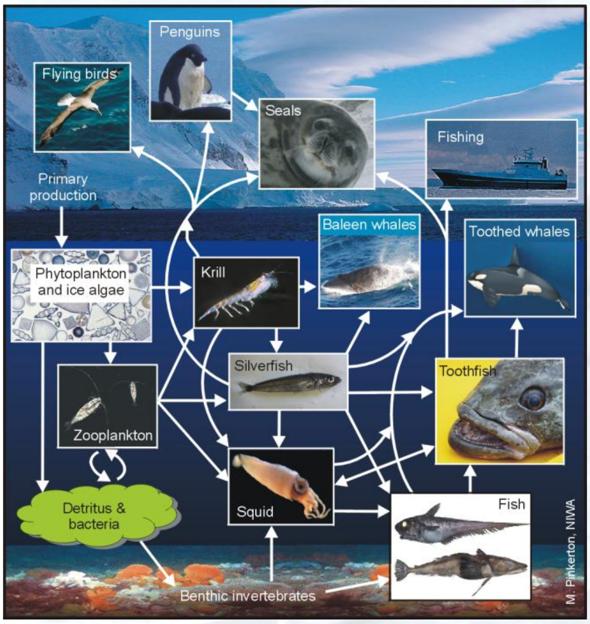
It can be difficult finding your Argo Float after 10 days sometimes. However the Argo Float Application does have a 'search' tool. Unselect the 'Active Floats' box as circled below (1.) and type the WMO number you are looking for in the box by the magnifying glass and shaded square (2.)   If the search bar is not there then type "Ctrl + F"



Marine Food Web

Science Experiment: The Incredible Feasting of Whales, Page 27

Key ideas: Phytoplankton are main food for Krill (and other zooplankton) that feed many other species



The Marine Food Web is rather complex. It all starts with the tiny organisms called Phytoplankton. These tiny plants use sunlight to photosynthesise. They produce food and energy at the bottom of the food web- a bit like the 'grass of the sea'. Phytoplankton are really important as they make it possible for every other member of the food web (Orca included) to survive in a freezing Antarctic climate as well as in the subtropical and tropical oceans. This is because phytoplankton is the main food source for zooplankton. Krill is a type of zooplankton and Zooplankton, such as Krill, are the main food for a many other species

The Science Learning Hub has a fantastic activity to build a marine food web

In this activity, students build their own food web using images of organisms from the marine ecosystem. This activity can be done indoors on paper or outdoors on a tarmac surface using chalk.

By the end of this activity, students should be able to:

- understand the difference between a food chain and a food web
- understand that food webs are made up of producers, consumers and decomposers
- build and revise their own food web to show the interdependence of organisms in an ecosystem
- understand the potential impact of the removal or reduction of one species on the rest of the food web.

Did you know? http://www.classroomatsea.net/facts/

- The weight of all the plankton in the oceans is greater than that of all the dolphins, fish and whales put together. Amazing when you think that many plankton are microscopic in size!
- If size is taken into consideration, the copepod (a type of plankton) is the fastest animal on the planet. If it were the size of a cheetah it would be able to run at 3,218 km/hr. Copepods are also said to be the richest source of protein in the ocean.
- Approximately 40% of photosynthesis on Earth is carried out by planktonic organisms. That means that nearly half of the world's oxygen is generated by phytoplankton!

Climate Change

Science Experiments: What is CO_2,
Wild Weather
Pages 28, 29

What is climate?"

Climate" is a very general term that has a variety of closely related meanings. Usually, "climate" refers to the typical weather conditions observed over a long period of time for a given area.

Key ideas: Too much CO_2 in the atmosphere is having a negative effect on our oceans and atmosphere.

The difference between weather and climate is a measure of time. Weather is what conditions of the atmosphere are over a short period of time, and climate is how the atmosphere "behaves" over relatively long periods of time.

The ocean regulates heat. 90% of the heat (energy) changes in the world have been taken up by the ocean- because water has a much higher capability to absorb heat than air

The Earth's climate has changed before, but this time is different. This time the changes are bigger and happening faster than modern society has seen before.

In the atmosphere, carbon is joined to some oxygen in a gas - carbon dioxide (CO_2).

Oceans are carbon sponges. When there is too much CO_2 in the air, the sea takes up the slack, soaking up the extra CO2 like a sponge. problem- too much CO_2 means oceans, like our air, are getting warmer.

The ocean plays an important role in the climate system by regulating the amount of carbon dioxide in the atmosphere.

Polar Icecaps are melting- this is troubling as they are our natural cooling system for the earth

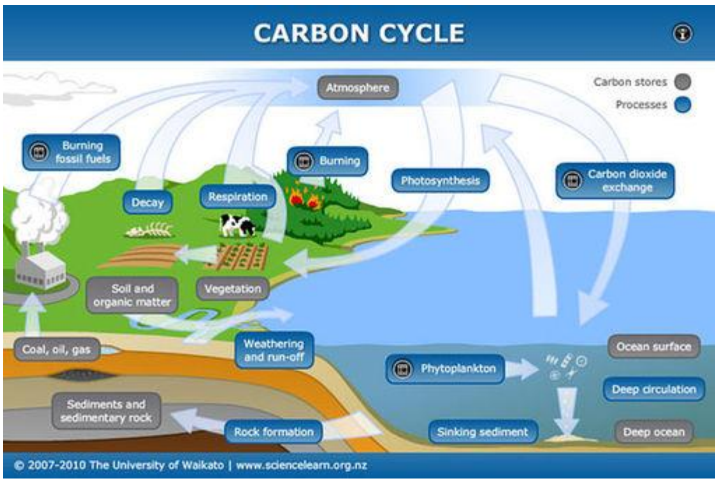
Carbon dioxide is a greenhouse gas and traps heat in the atmosphere. Without it and other greenhouse gases, Earth would be a frozen world

Humans have burned so much fuel that there is about 30% more CO_2in the air today than there was about 150 years ago, and Earth is becoming a warmer place.

Keeling Curve

The time series that a lot of modern climate science is built on.

Every living thing on our planet is part of the natural carbon cycle.



Explore this interactive diagram at the Science Learning Hub to learn more about the carbon cycle.

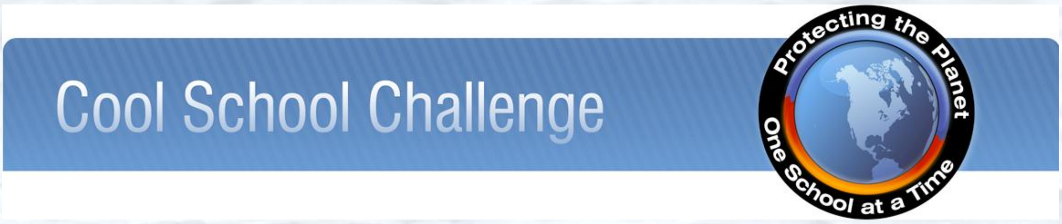
Some people have some questions about Climate Change - how much of it is caused by the CO_2 in the atmosphere and how much is just part of the regular cycles in our climate patterns. There have been times in our planet's history where we have had dramatic changes in climate in the past. However there is definitely evidence proving that the increasing CO_2 does have an effect on our climate.

What is really important is that we continue to take care of our environment. Reduce, reuse, recycle!

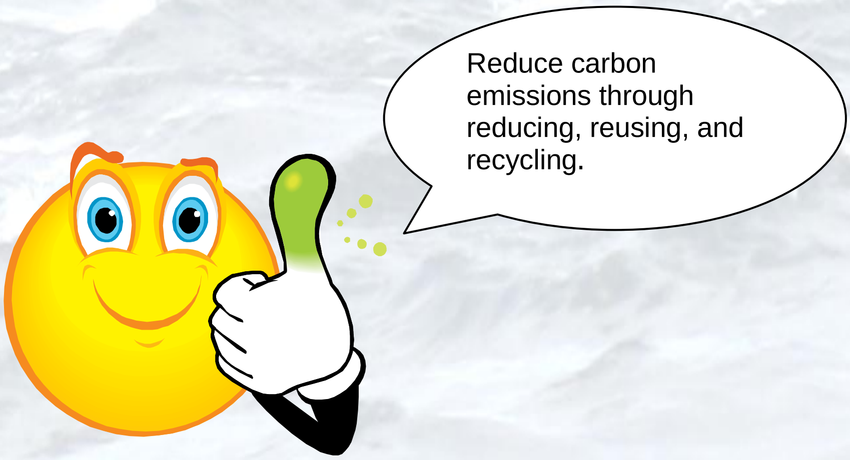
What could you as a class do?

Here are some suggestions:

- Start a no-idle rule outside your school. Cars that sit for more than 30 seconds with their engines running use up more petrol and emit more pollution than if the motor is turned off and on again.
- Recycling paper. Have a "GOOSE paper" box in your classroom (Good On One Side Environmental paper) Great for draft work, maths problems and doodling on a wet day.
- Start a no-waste policy for lunch and playtimes. All food brought in must be in reusable containers. You should leave nothing but a warm bench where you sat for lunch
- Start a School Compost and Worm Farm.



Art work using crayon and dye



Ocean Acidification

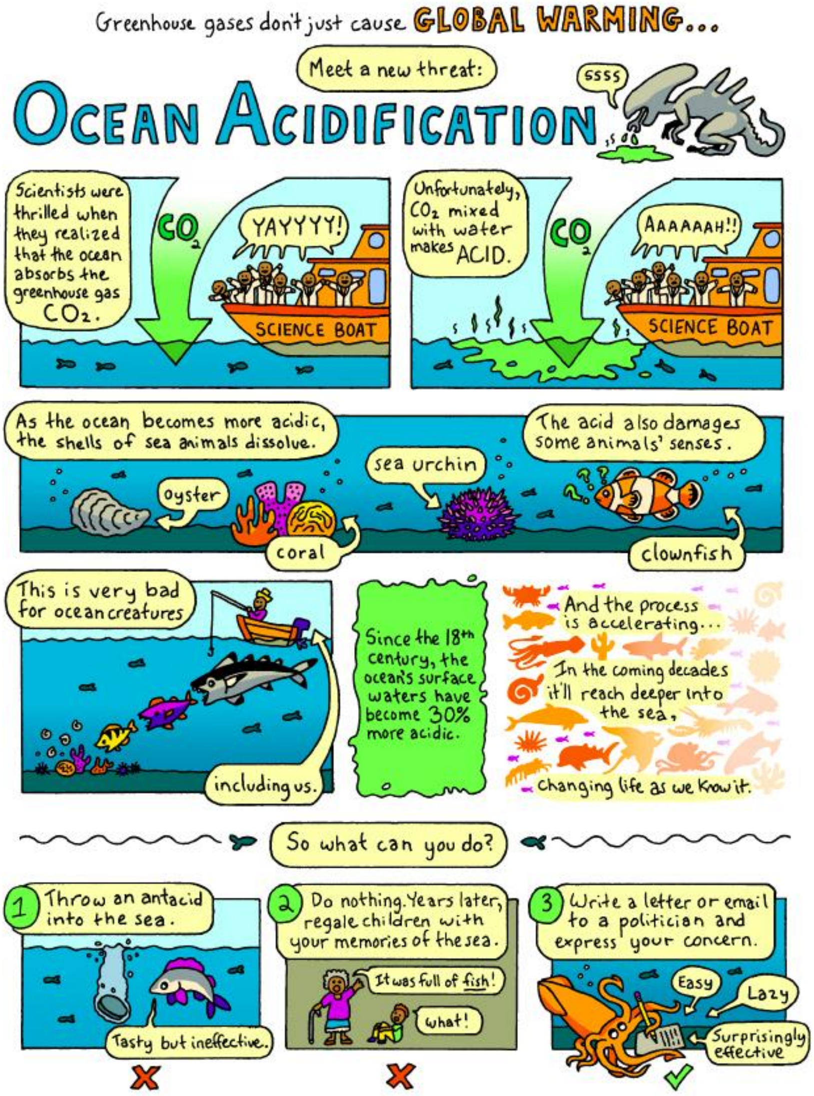
Science Experiments: Nude Egg, Breathe in…breathe out… Pages 30, 31

CO_2 is actually changing the chemistry of the sea and proving harmful for many forms of marine life. Increased acidity reduces carbonate, which is the mineral used to form the shells and skeletons of many shellfish and corals. Reducing carbonate slows growth and makes shells weaker. Many animals simply won't be able to form shells.

This process will injure some species of smaller marine organisms - things such as pteropods. You've probably never heard of them, but they are types zooplankton forming a vital part of the food web. If those smaller organisms are wiped out, the larger animals that feed on them could suffer, as well.

Key ideas: Too much CO_2 in the atmosphere is having a negative effect on our oceans and atmosphere.

Pteropods - Swimming Mollusks. Link to a beautiful video clip showing these planktonic snails known as sea butterflies.



The increasing acidity of the ocean also has an effect on habitat. Coral reefs provide habitat for a large and diverse number of organisms, including many species of fish and invertebrates. If the coral can no longer successfully grow at optimum rates they will not be able to maintain the reef. Without the reefs the biodiversity of the ocean will decrease.

This NRDC documentary explores the startling phenomenon of ocean acidification, which may soon challenge marine life on a scale not seen for tens of millions of years.
[Watch ACID TEST >>]

TEACHERS: [Download an ocean acidification lab kit]

Activity (individual or small group)

Write the word "oceanography" on the board, and ask students if they know what this word means. Explain that oceanographers are people who study the ocean's landforms and life from the shallow coastal areas to the deepest trenches. Tell the students they are going to become oceanographers! They can make up a badge or name plate for their desk.

As an oceanographer, they are going to select one (or more) topics to develop a mini Inquiry.

Topics could include:

Ocean currents
- Warm and cold currents
- Circumpolar current
- Conveyor belt
- Coriolis effect

Ocean floor
- Sediment
- Carbon sink
- Pressure at depths
- Coral

Sea birds
- Albatross
- Shearwater
- Flight
- Migration

Different oceans
- Temperature
- Latitude
- Characteristics

Ocean layers
- Mixed Layer
- Pressure at depths
- Temperature

Waves
- Wind
- Motion
- How they work

The Southern Ocean
- Significance
- Sea Ice
- Circles the globe
- Circumpolar Currents

Argo Floats
- Temperature
- Salinity
- Ocean Currents
- Technology

Ocean exploration
- Deep Ocean
- Map makers
- Ship wrecks

Marine Life
- Food Web
- Fisheries
- Endangered Species
- Phytoplankton

Climate change
- Sea level
- Temperature
- Carbon Sink

Caring for our oceans
- Protecting
- Pollution
- Endangered species
- Oil Spills

Climate and weather and the ocean
- Climate
- Weather Patterns
- Low and High Pressure

Salt water
- Density
- Argo Floats
- Temperature

Science Activities

Ocean Currents

Ocean circulation can be split into 2 parts- Thermohaline and the Wind-driven .
Ocean circulation is in part due to wind stress and in part due to changes in density caused by cooling, evaporation and rainfall at the surface.
Thermohaline Circulation (Thermal circulation)- the movement of water that takes place when it's density is changed by a change of temperature or of salinity in a suitable part of its bulk.

Level 1 2 3 4

What you need:

- 1 Large jar filled with water- let it sit for a couple of hours
- 1 Large jar of salted water- let it also sit for a couple of hours
- Food colouring
- Ice cubes

What to do:
With the jar of unsalted water- float an ice cube on the water. The cooled water by the ice will sink. Put a drop of food colouring on the ice cube to reveal the cooled water sinking to the bottom.

Try the same thing with the jar of salted water - float an ice cube on the water. The salt would have dissolved and increased the density of the water. Put a drop of food colouring on the ice cube to reveal the cooled water spreading out and sitting on the top. The dyed water will stop sinking at the top of the "bottom water".

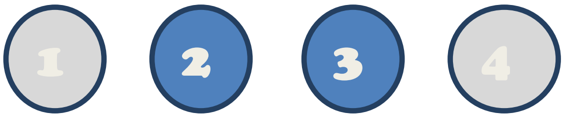
The Thermohaline circulation of the ocean is due to an increase of density at the upper surface, either directly by cooling or indirectly when ice forms, ejecting salt and increasing the density of the remaining water.

In the Antarctic, the freezing effect is important. Sea ice will not be all pure ice- as some salt usually remains trapped. - But it less salty than the sea water from which it is formed and the older the ice is, the fresher it gets. The remaining sea water is therefore more salty and denser than before causing it to sink.

Ocean Currents and Convection

This is an effective way to show students how salinity and temperature affect the density of water, an important concept in understanding ocean currents.

Level



What you need:

- Block of wood (or a book)
- Clear, deep rectangular container
- 800ml room temperature water
- 40ml water prepared with ½ teaspoon salt and 2 drops of yellow food colouring
- 40ml cold water prepared with 2 drops of blue food colouring
- 40ml hot water prepared with 2 drops of red food colouring

What to do:

Set the block of wood under one end of the container so the container is sitting on a slope. It is a great idea if this is placed at a level so the students can see what will be happening in the container.

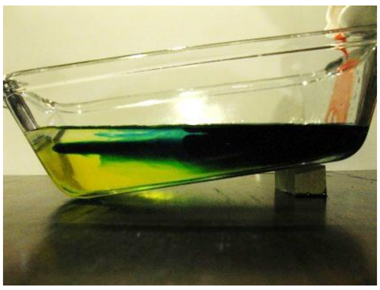
Fill the container with 800ml room temperature water. (Approximate- depending on size of container of course)

Make predictions about what will happen all the way through this activity

Slowly pour the yellow salt solution into the container. The salt water is denser than the room temperature water and will sink to bottom.

Next pour in the blue cold water. This will form a layer above the salt water but below the room temperature water as the cold water is not quite as dense as the room temperature salty water.

Finally add the hot, red water. This will sit on top of the other layers as hot water is less dense.



Cartesian Diver

A Cartesian diver demonstrates the relationship between volume, mass and density. A similar principle is used in Argo floats.

Level 1 2 3 4

What you need:

- Empty clear plastic drink bottle (1.5–2L size)
- Eye Dropper – one made all of soft plastic(pipette) is easiest to use, but a glass one with a soft bulb would do
- Modelling clay (such as plasticine)

What to do:

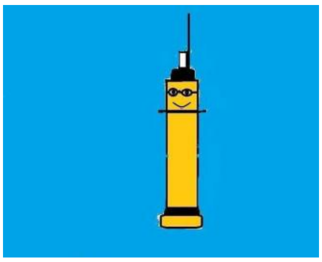
- Seal the Eye Dropper with a piece of modelling clay. Start with a ball of clay about 3cm in diameter (Shape the clay around the bottom of the dropper- making sure it is narrow enough to fit in the bottle!)
- Fill the drink bottle with water.
- Put the diver in – it should float at the top of the bottle. Adjust the amount of clay so that the diver only just floats.
- Make sure the water in the bottle comes to the very top, and screw the top on tight.
- Squeeze the sides of the bottle. The diver should sink.
- Release the bottle. The diver should rise.
- Try and get the diver to sit half way down.

Get students to explain what they think makes the diver sink and rise.

(Watching the bulb of the Eye Dropper as you squeeze the sides of the bottle should give a clue.)

What's going on?

This experiment demonstrates the property of **buoyancy**. An object is buoyant in water due to the amount of water it displaces or 'pushes aside'. If the weight of water that is displaced by an object in water exceeds the weight of the object then the object will float. As you apply pressure to the bottle, you apply pressure to the air bubble in the dropper reducing its size. As the bubble's size reduces, the dropper becomes less buoyant and begins to sink. Release the pressure on the bottle and the dropper begins to rise back to the top.



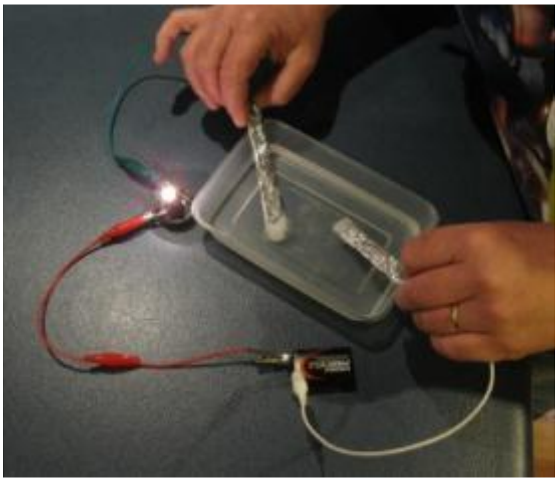
Many fish keep themselves from either sinking or floating to the surface by using muscles to squeeze or relax a small sac (with a small air bubble inside) in their bodies. By squeezing the sac smaller, the fish will sink. By relaxing their muscles, the sac increases in size- allowing the air inside to expand, displacing more water and the fish will begin to rise to the surface.

This same principle is used to control the buoyancy of an Argo Float. By pumping oil in and out of a bladder stored in the float, an Argo can be made to sink and rise.

Saltwater Circuit

Students investigate the conductivity of saltwater, and develop an understanding of how the amount of salt in a solution impacts how much electrical current flows through the circuit.

Level 1 2 3 4



What you need:

Masking tape
1.5 volt battery and holder
1.5 volt Light bulb and holder
Wire (and dog clips)
2 ice block sticks
aluminium foil
water in a small container
salt
a stirrer

What to do:

- First, completely cover two ice block sticks with aluminium foil. These are now your probes.
- Connect one wire to each probe.
- Connect the opposite end of one wire to one terminal of the light bulb socket.
- Connect a wire to the opposite terminal of the light bulb socket to the battery.
- Connect the wire from the other probe to the battery
- You can see if your tester is working by touching the metal together. This will complete the circuit and make the light bulb glow. If it doesn't glow, check your connections to make sure everything is taped together in the right way.

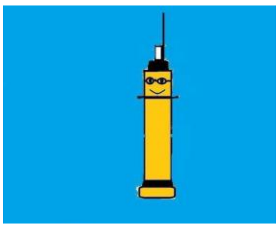
Now to use your saltwater tester, put just the tips of the metal in saltwater, about an inch apart. Make sure the two metal parts don't touch. The saltwater will act like a wire, connecting the metal sticks, completing the circuit, and making the light bulb glow. Try this in fresh (unsalted) water as well for comparison.

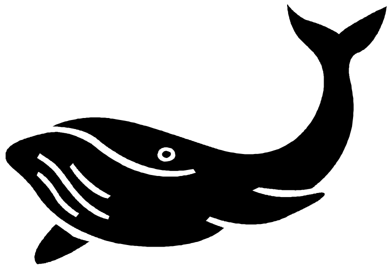
Measuring salinity on an Argo Float

What's going on?

The light bulb glows with the probes in saltwater because the saltwater acts like an invisible wire to connect the circuit. That's because when you add salt to water, the salt molecules dissolve in the water and break into smaller parts called ions. The ions carry electricity through the water.
Fresh water doesn't have these ions. So it's harder for the electricity to move through the water. It doesn't complete the circuit, and the light bulb doesn't glow.

Argo Floats measure salinity in a very similar way. Water passes through a cell on the float that records the conductivity and then converts this into a salinity reading.

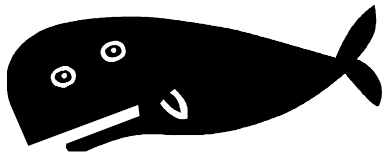




The Incredible Feasting of Whales

Students find out which prey toothed and baleen whales are best at catching

Level 1 2 3 4



What you need:
Large baking dish
tongs
Tea strainer/ sieve
Parsley flakes (“Krill”)
carrot slices ("fish")- cut to a size that can be picked up with the tongs easily
water

What to do:

- Fill the baking dish with water.
- Add carrots and parsley flakes to the water, explaining that they represent fish (such as herring, or cod) and krill (a shrimp-like creature which occurs in huge concentrations in cold oceans).
- Let students experiment with the tongs and the tea strainer to see which kind of prey each harvests more efficiently.
- Discuss the following:
- Which tool represents toothed whales? (tongs) Baleen whales?
- Is baleen more effective at picking up krill or fish? Why?
- For which foods are teeth more effective?
- A medium-sized blue whale weighing 100 tons probably eats up to 4 tons of krill a day. What does this suggest about the efficiency of baleen as a feeding mechanism?

What's going on?
Baleen whales have plates of baleen, made of the same material as our fingernails, hanging like broom bristles from their upper jaws. The baleen sieves plankton, krill, and small fish from sea water. The whale's flabby tongue squeezes water through the baleen and then licks the plankton off the baleen. Ten species of whales are baleen whales, including the largest animal that has ever lived, the blue whale. The right whale, humpback whale, fin whale, minke whale, and sei whale are all baleen whales.

Toothed whales use their teeth to grasp their prey, but don't chew their food. They eat fish, squid, and in some cases, other marine mammals. Toothed whales include the sperm whale (Moby Dick was one), orca (killer whale), pilot whale, narwhal, and dolphin.

Whale Jenga

A marine food web game. For lesson plan and materials go to http://www.cisanctuary.org/acidocean/hands_on_activities.php

What is CO_2?

To explore a simple demonstration of carbon dioxide gas- blow up a balloon without even using a pump!

Level 1 2 3 4

What you need:

- Small glass bottle
- Vinegar
- Funnel
- 1 Tablespoon Sodium Bicarbonate (Baking soda)
- A Balloon
- A tray

What to do:
Put some vinegar in a bottle. Using a funnel, fill a balloon with the Sodium Bicarbonate. Stretch the neck of the balloon over the bottle and lift the balloon so the Sodium Bicarbonate falls into the vinegar. (This is the same reaction you get when making volcanoes.)
Watch the balloon inflate!

What's going on?

The sodium bicarbonate is reacting with the vinegar to produce carbon dioxide gas. Carbon dioxide is a colourless and odourless gas. It makes up about 0.4% of the atmosphere. It is produced as a waste product when fuel is used to make energy and it is used as a raw material by plants to make their own food.
CO_2 is a gas that has a lot of different uses- from the production of lasers to putting the fizz in your soft drink.
Do not confuse carbon dioxide (CO_2) with carbon monoxide (CO).
Carbon monoxide is a toxic gas that is given off in car exhaust gases.

What does this have to do with Oceans?

Long-term studies show carbon dioxide levels in the atmosphere are rising. Radiocarbon carbon dioxide peaked in the 1960s but has since decreased. Much has been taken up by the ocean- but the Ocean can only take so much!

Wild Weather

Tropical cyclones may become more intense due to climate change. Make a twirling spiral snake to see why. **This activity works best in still air.**

Level 1 2 3 4

What you need:

- Tin foil
- scissors
- string
- 2 candles and candle holders
- Masking tape
- pencil

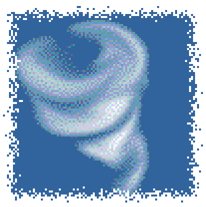
What to do:

Draw a circle about the size of a dessert bowl on a piece of tin foil and cut out
Draw a spiral within the foil circle and cut along the spiral towards the centre
Tape a piece of string to the centre of the spiral
Light a candle

Hold the spiral by the string about 2cm above the flame. (don't touch the flame) The spiral should start to spin.
Light the other candle and put it next to the first
Hold the spiral above both flames. What happens to the spiral when there is more heat coming from the candles?

What's going on?

The hot air from the flame rises and makes the spiral turn. This rising air is called convection current. Convection currents in the atmosphere are responsible for a lot of weather events, such as storms. The wind in storms swirls around in a circle above the oceans, just as the spiral snake swirls above the candle.
As the tropical ocean waters become warmer, convection currents will become bigger; the storms that form above them, such as hurricanes and cyclones, may become stronger.



Nude Eggs

The increase in ocean acidity will change ocean ecosystems. Observe why as you dissolve an eggshell in vinegar

Level 1 2 3 4

What you need:

- An egg
- Some white vinegar
- A jar with a lid

What to do:

- Place the egg in a jar and cover with vinegar. Place lid on jar and leave overnight
- The next day carefully pour off the vinegar and replace it with fresh vinegar. Be careful, as the egg may have lost its shell and be very fragile. Leave overnight again. The egg will have lost its hard shell and be held together only by a thin membrane that usually sits underneath the shell.
- Day 3 (or later) If you are very brave (and outside!) try to bounce the nude egg on the ground

What's going on?
Eggshell is made from calcium carbonate. Vinegar is an acid (acetic acid) that breaks apart the calcium carbonate. When calcium carbonate dissolves in water, it forms calcium irons and carbonate. The carbonate turns into CO_2.

You can see the bubbles of carbon dioxide on the shell when it is dissolving.

Shells you find on the beach are also made of calcium carbonate, as are other ocean life such as some algae plankton and tiny ocean molluscs.

Ocean water will not become as acidic as vinegar, but any increase in the acidity of ocean water will make it hard for these animals to make and keep their calcium carbonate shells.

Breathe in…breathe out…

Oceans absorb carbon dioxide like a sponge. When CO_2 dissolves in water it makes the water more acidic. Observe how this happens using your own breath!

Level 1 2 3 4

What you need:

- 2 clear plastic cups
- A straw
- Bromothymol blue pH indicator
- water

What to do:

1. Half fill each cup with water
2. Add a few drops of Bromothymol blue to each cup. (the water will turn a pale blue colour)
3. Place a straw into one cup and gently blow bubbles into the water. In less than a minute, the water will change colour to a green or possibly pale yellow colour.
4. Compare the 2 cups of water.

What's going on?

The water has changed from neutral to acidic. With every breath, we take in oxygen and breathe out some CO_2. By blowing into the water, you added CO_2. When CO_2 bubbles through water, some of it dissolves into the water. A small proportion of this dissolved carbon creates carbonic acid, which is a weak acid.

A glass of water sitting on a bench will absorb co_2 from the air in the same way that co_2 dissolves in the top 100m of ocean water.

Melting Ice

This experiment is from [Robert Krampf - The Happy Scientist]

This week's experiment comes from a report I recently heard on National Public Radio. Unfortunately, I was driving and could not write down the fellow's name, so I could give him proper credit. He was talking about the facts and fictions of global warming. One point that he mentioned was one that I had heard many times and had never thought all the way through. What would happen if the global temperature rose enough for much of the polar ice caps to melt? All of that extra water would cause worldwide flooding, right? Let's investigate.

You will need:

- a glass
- water
- ice cubes

Try to get a large lump of several ice cubes frozen together. You can place several ice cubes into a bowl and leave it in the freezer over night and they should freeze together. Place the ice cubes into a glass or bowl. Add enough water to fill the glass to the top. Add as much water as you can, until the glass will not hold any more without overflowing.

Now, look carefully at the glass, water and ice. There is quite a bit of ice sticking up above the glass. What will happen when the ice melts? Now that you have formed a hypothesis (a scientific guess), watch to see what happens. Be sure that the glass is not bumped or disturbed. As the ice melts, does the water overflow?

No, it does not. Even when all of the ice has melted, the glass is just as full as it was when you started. As water freezes, it expands. It still weighs the same, but it takes up more space. This means that it will float when you put it into water. As it floats, the part of the ice that is underwater takes up exactly as much space as the water that it formed from took up. When it melts, it will take up that amount of space again, and so the glass does not overflow.

Back to what would happen if the polar ice caps melted, there is a big difference between the two polar ice caps. The North polar ice is all ice, floating in water. If you could selectively melt just the northern ice cap, sea level would stay the same. The southern polar ice cap is not floating. Instead, it sits on the continent of Antarctica. If it melted, then the sea level would rise.

Primary CREST and NIWA Ocean Investigations

Classifying Marine Invertebrates	Acids and Bases
Classifying Marine Invertebrates (Dichotomous Key)	Ocean Acidification
Classifying Marine Invertebrates (Picture Cards)	Oil Spill
Cold Water vs Hot Water	Pollution Solution
Floating and Sinking	Where does the Water Go?
Salt Water vs Fresh Water	Evaporation
Floating Eggs	Global Warming

The Science Learning Hub has a wide selection of experiments for students.
http://www.sciencelearn.org.nz/

http://www.angelfire.com/la/kinderthemes/oscience.html

Ocean Transportation (Model Submarine)
Seawater Float
Which Freezes First?
Freeze
Seeing Sea Salt
Ocean Currents
Ocean Motion
Sea Breezes (a variation of the above activity)
"Making Waves"
Floating Hot and Cold
Sandy Shores
Making Sand
Examining Sand

How to create an Ocean in a bottle
http://www.youtube.com/watch?feature=endscreen&NR=1&v=iHh5bPKYe5c

Ocean Writing Activities

Any researching about the Ocean lends itself to procedural writing, research, factual writing and creative writing.

When looking at life cycles or patterns, this procedural writing activity is very useful.

Procedural Writing activity

List the procedure on one strip of coloured paper (The "What")

Draw a line after each step and take another strip of paper and match the lines up. In each section made, describe the "how" or "why"

What	How come or why
Argo Float on wharf	Oceanographer 'wakes up' the Argo Float and links communication between the Float and the satellite
Argo Float at sea on boat	Argo Float taken to precise location
Argo Float deployed	Argo Float lowered over the side in its cardboard box, the box disintegrates and the Float appears
Argo Float at 1000m	The Float sinks to 1000m for 9 days, following the ocean currents
Argo Float at 2000m	The Float sinks to 2000m and begins recording the ocean Temp and salinity
Argo Float moving up the water column	For the next 10 hours, the Argo Float takes readings of temperature and salinity moving up the water column
Argo Float sending data to satellite	The recorded data is transmitted to satellite
Satellite Info sent to Ocean Research Centre	Oceanographers review and use the information
Argo Float sinks back to 1000m	The Float sinks back down to 1000m for 9 days, following the ocean current, repeating the process.

From here, paragraphs can be drafted, using words like 'first, second etc., then, finally, proceeding, following'

There are many ideas on the web about Ocean Writing Activities

Ocean Writing Activities http://www.fi.edu/fellows/fellow8/dec98/writ.html

Wavy Sentences - This activity is to encourage second graders to be creative in their writing about the ocean. The students write their descriptive sentences about the ocean in up and down patterns, depicting the waves of the ocean. The students then add colour and ocean animals creating an exciting colourful language art experience.

Fishy Stories - Have students choose a sea animal from one of the books and write a story about it. They should tell about its environment, what it eats and how it protects itself. Students should make an illustration for their story. The stories and illustrations could be separated and used for a matching activity.

Guess Who? - On index cards write the names of different ocean animals. Students draw a card and research the animal on it. On the back of the card they should write facts about their animals such as; where it lives, what it eats, what colour/shape it is, is it a predator or prey? When finished, they can swap with a partner to guess what animal the description is for.

Poems - Read aloud some poems about the ocean. Then work on innovation. Brainstorm some things that could be changed about a particular poem-its title, the creatures mentioned, adjectives, etc. Make a Word Bank on the chalkboard, chart paper, or over-head. Then replace the words in the original poem with words from the Word Bank. Have students write a poem about "A Day in the Life of (their chosen sea animal)".

Sea Animal Acrostics - These are a great way for students to recall facts about sea animals. Write an ocean word down the chalkboard. Brainstorm words that begin with each letter. Be sure to use some ocean words. List them on the board. As a class use the words to create and acrostic about the animal. In no time at all students will be doing their own.

ABC Ocean Book - Write each letter of the alphabet on a sheet of paper. Have students draw a letter. They choose a sea animal whose name begins with that letter. Then draw the animal or find a picture of it to glue to the page. Write facts about the animal under the picture.

New Animal - Pretend you have just discovered a new animal in the ocean. Tell where you found it, what it looks like, what it eats, and what its name is. How would it behave?

Ocean Art Activities

Ocean Arts and Crafts

http://childfun.com/index.php/activity-themes/animals/108-ocean-activity-theme.html?start=1

Under the Sea Crafts for Kids

http://www.daniellesplace.com/html/under_the_sea.html

Aquarium- Cut the centres out of two paper plates. Fasten them together at the edges. Make seaweed out of tissue paper and attach it at the bottom of the cut out centre. Glue sea creatures to this seaweed. Cover the cut out centres with clear plastic wrap or blue cellophane.

A Puppet Story - Have students draw and colour pictures of fish, rocks, seaweed or any other object that might be in the ocean. Cut the pictures out and glue them to craft sticks to create hand puppets. Students can use the puppets to retell the stories or make up their own story to tell.

Sea Mobile - Have students work in groups to draw and colour pictures of sea animals that live in each zone of the ocean. Cut the pictures out and glue to heavy construction paper. Punch holes and tie them to a clothes hanger to make the mobile. Display them around the room and have students identify the area of the ocean represented.

Saltwater Paintings - Mix one fourth cup of warm water with six teaspoons of salt and 3 drops of food colouring in a small container. Mix well. Have students paint ocean pictures with the mixture on white paper. Let dry. The water evaporates but the coloured salt remains, creating beautiful pictures. This is a good chance to discuss evaporation with students. What evaporates and what didn't?

Imagining the Ocean: Art Mixes Well with Marine Science (useful with assessment)

http://www.edutopia.org/marine-science-art-integrated-studies

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Reading Resources

Across the Straits of Magellan **Pt 04 No. 3 1984 Pgs 29-33**
Article by COX, Lynne
What do you do after you have become the first woman to swim Cook Strait? Lynne Cox describes the training she needed to swim the Straits of Magellan where the temperature of the water is no more than four or five degrees Celsius.

All day I hear the noise of waters **Pt 02 No. 2 1987 Pg 9**
Poem by JOYCE, James

Dolphins at Flat Rock **Pt 02 No. 4 1983 Pgs 2-6**
Article by MOONEY, Kay
Day after day, throughout the summer, a small herd of dolphins accompanies Frank Robson's fishing boat. When the time comes for them to move off to another part of the sea, one young dolphin stays behind to wait for Frank. Although Frank is sad to see him go, he has to tell the dolphin to join his friends out in the deep water.

Make salt water into fresh water **Connected No. 2 1998 Pgs 10-11**
Article by ANDERSON, K.E.A demonstration, easy to reproduce in the classroom that shows how to produce salt and fresh water from sea water

New Zealand sea lions **JJ No. 38 2009 8-15**
Article by SORRELL, Paul
An article describing New Zealand sea lions and explaining features of their habitat and behaviour.

Salt from sea water **Pt 01 No. 4 1982 Pgs 25-27**
Article by THOMSON, Jane
Shows how salt is made by evaporation in huge ponds at Lake Grassmere.

Save the Whales! **L3 Sep 2011 34-42**
Article by GIBBISON, Sue
Fifty-eight upokohue have stranded on Karikari Beach. Help is needed!

Tiakina a Tangaroa - Protect Our Seas **L2 Oct 2011 2-11**
Article by MACGREGOR, Jill
This article describes two contrasting school visits - one to an unprotected beach and one to a marine reserve. Captioned photographs help to identify all the marine creatures found in these areas, with their names given in both English and te reo Maori. The MP3 audio file for this article can be found at: http://literacyonline.tki.org.nz/Literacy-Online/Teacher-needs/Instructional-Series/School-Journal/School-Journal-audio

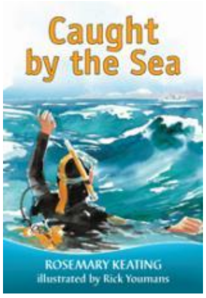
A tragedy at sea **Connected No. 3 2004 Pgs 10-14**
Article by WHITE, Kathy
The article is told from the perspective of Kirsty Russell, a marine ecologist. She is committed to researching Maui's dolphin in the field because "The more we know about an endangered species, the more we can do to protect it."

Tricky science **Pt 01 No. 3 1997 Pgs 18-20**
Article by ANDERSON, K. E.
This piece of science will allow you to amaze your friends. They will think you have the power to make eggs float or sink.

Under the sea **Pt 01 No. 2 2001 Pg 7**
Poem by BAGNALL, Alan

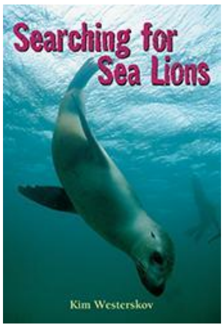
Learning Media
Te Pou Taki Kōrero

Great books and teacher resources



This is a true story of Rosemary Keating's ordeal at sea after she and her diving buddy became separated. The story explores the feelings of the narrator as she struggles to survive and find her way back to shore.

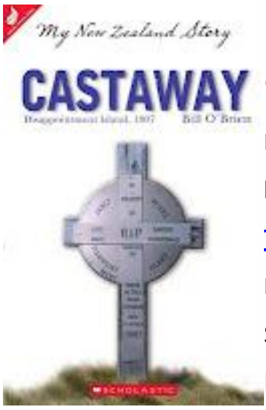
http://www.learningmedia.co.nz/resources/products/34387



Photographer and writer Kim Westerskov undertook an expedition to remote Campbell Island. The purpose of this visit was to take underwater photographs of rare species of sea lion for a film and a book about a remote South Pacific Island.

http://www.learningmedia.co.nz/resources/products/35170

SCHOLASTIC



My New Zealand Story
CASTAWAY

Disappointment Island, 1907

by Bill O'Brien

Teacher Resource

Description

Samuel, the keeper of this diary, is 13 when he signs on as a cabin boy aboard a vessel bound for Sydney. The barque Dundonald founders and sinks off Disappointment Island (part of the Auckland Islands group) in the ocean south of New Zealand on 6 March 1907. Fifteen survivors endure a harsh winter on this remote island until their rescue in late November that year.

Samuel Clark is a fictional character, however the other survivors are all based on the real people.

Music

Kiwi Kidsongs
(11) Six Months in a Leaky Boat
(12) Sea Song

Everything beneath the sea
http://learnenglishkids.britishcouncil.org/en/songs/everything-beneath-the-sea

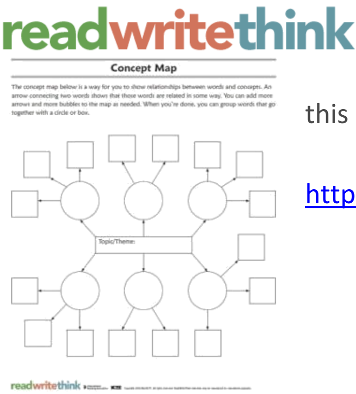
Instrumental-

Adagio from Spartacus (Khachaturian) http://www.youtube.com/watch?v=FFeTP10DnEM

Other Resources

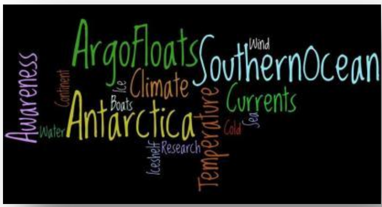

Photograph by Jennifer Hayes

Ocean Photographer David Doubilet Google images or look at his website http://www.daviddoubilet.com/



Concept maps, comic creators, and other graphic organisers free from this site

http://www.readwritethink.org/



Terrific Links

As well those that are mentioned throughout this unit here are a few interesting sites. (There are many more out there!!)

[waydownsouth.wikispaces.com]

[Science Learning Hub]

http://celebrating200years.noaa.gov/edufun/book/welcome.html#book

http://www.ted.com/talks/sylvia_earle_s_ted_prize_wish_to_protect_our_oceans.html

http://www.ted.com/talks/david_gallo_shows_underwater_astonishments.html

http://www.ted.com/talks/robert_ballard_on_exploring_the_oceans.html

http://www.ted.com/talks/lang/en/deep_ocean_mysteries_and_wonders.html

http://oceanservice.noaa.gov/education/pd/oceans_weather_climate/welcome.html

Robert Krampf - The Happy Scientist
Hundreds of little cool demonstrations and tidbits you can use in the classroom. There are many free samples.

http://climate.nasa.gov/kids/ Interactive site on climate change

http://www.epa.gov/climatechange/kids/ Another interactive site on climate change

Acknowledgments I would like to thank and acknowledge Dr Phil Sutton and Dr Julie Hall (NIWA) for their encouragement, support and sharing of knowledge.