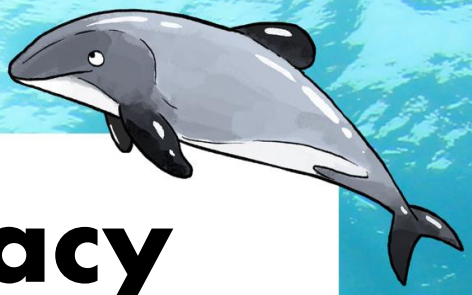


Ocean Literacy Educators Guide

Designed for learners aged 10-12+

Aligned with the Global Ocean Literacy Framework

What is Ocean Literacy?

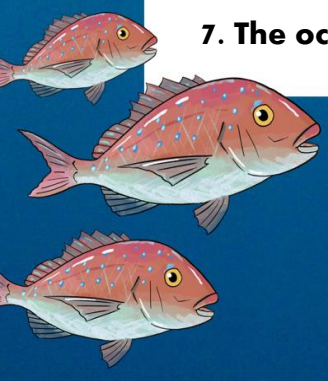
Ocean Literacy is an understanding of the ocean's influence on us and our influence on the ocean. Ocean Literacy Principles are part of an international framework designed to enhance ocean knowledge, advance sustainable practices, promote responsible citizenship and positive actions for our ocean.

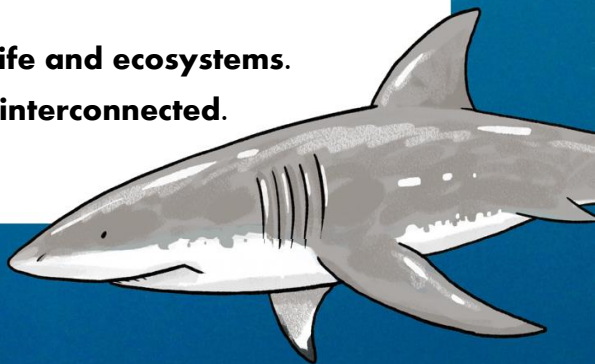
What's inside?

- Overview of the seven Ocean Literacy Principles – listed below
- Hands-on activities for intermediate students (NZ Yr. 7-8, Level 3-4)
- Curated videos, articles, and resources to build understanding
- Opportunities for student-led inquiry and further exploration

Ocean Literacy Principles

1. **The Earth has one big ocean with many features**.
2. **The ocean and life in the ocean shape the features of Earth**.
3. **The ocean is a major influence on weather and climate**.
4. **The ocean made the Earth habitable**.
5. **The ocean supports a great diversity of life and ecosystems**.
6. **The ocean and humans are inextricably interconnected**.
7. **The ocean is largely unexplored**.





SIR PETER BLAKE MERC

Seaweek

1. The world has one big ocean with many features.

The ocean is the defining feature of our planet – it covers 70% of Earth's surface.

The geological features of the ocean are not static. The size and shape of the ocean have changed over geological time and continue to move and change.

Seawater has unique properties. Most of the water on the earth (97%) is in the ocean, which is salty, denser than freshwater, and slightly basic.

The ocean is one interconnected circulation system. The 'ocean conveyor belt' is powered by wind, tides, the force of the earth's rotation, the sun and water density differences.

Drop in a Bucket

Explore the quantity of water in the ocean in comparison to accessible freshwater.

Background: The ocean holds 97% of Earth's water, therefore it has major influences on many biogeochemical cycles; pathways by which essential elements of living matter are circulated, like the water cycle. The water cycle helps to renew the relatively miniscule amount of freshwater that is available to humans.

Objective: Develop an understanding of the difference between the amount of available freshwater compared to saltwater on our planet.

Materials: Large bucket, pitcher, smaller cups or containers, teaspoon, pipette/dropper(optional)

Procedure: To introduce the concept, fill a **20 L** bucket with water and explain it represents all the water on Earth, which remains constant. Ask students where water is found (acceptable responses include: oceans, ice, lakes, rivers, groundwater, ponds, puddles, etc.).

Demonstrate Saltwater vs. Freshwater: Scoop **0.5 L** (2 cups) from the large bucket.
Explain: The large bucket = saltwater, the smaller amount = freshwater.

Accessible vs. Inaccessible Freshwater: Scoop **15 mL**(1tbsp) from the smaller amount.
Discuss: Most freshwater is non-accessible (frozen in ice or deep underground). This smaller portion represents accessible freshwater (in lakes and rivers).

Potable Water: Remove **1 drop** from the 15 mL and ask students what it represents.
Explain: This drop = safe, drinkable water (only **0.003%** of Earth's total water).

Alternatively, you can do this with a smaller quantity; using a 1L bottle, remove 30 mL (2 tbsp) = all freshwater. Then remove 10 mL (2 tsp) = accessible freshwater. From this, 1 drop = potable water.

Discussion: Discuss why it's important to conserve water and ways to conserve in our daily lives. Do humans have a way of creating more freshwater? Will we reach a point where there is none left?

Watch

How big is the ocean? (5:25) *and* How do Ocean Currents Work? *TED Ed* (4:33)

Ocean Motion via *Science Learning Hub (3:30,1:56)*

Read

Ducks in the Flow – *Where Did They Go?*
The story of 29,000 plastic bath toys spilled from a ship in the middle of the Northern Pacific in 1992, *Windows to the Universe*

Explore

MapMaker: Ocean;
a GIS tool for exploring currents, tectonic plate boundaries, biodiversity & more in the classroom, *National Geographic*

2. The ocean and life in the ocean shape the features of the Earth.

The ocean is the largest reservoir of rapidly cycling carbon on Earth. Weathering, erosion and deposition are destructive & constructive forces that occur where ocean meets land.

Changes in many coastal geologic features are caused by the ocean. Sea level change and the force of waves influence the physical structures and landforms of the coast.

Plate tectonics influence physical structure and landforms. Tectonic activity between oceanic and continental plates can form volcanoes, earthquakes and mountains along plate boundaries.

Many sedimentary rocks on land formed in the ocean. A large proportion of Earth's sediments originated in the ocean; decaying marine life provides siliceous and carbonate material.

Make your own sedimentary rock

Explore the processes involved in the formation of sedimentary rock

Background: Sedimentary rock formation begins with materials like soil, rock fragments, and remains of organisms. The process involves five steps. First, *weathering* breaks down materials through natural forces like wave action. Next, sediment is *transported* via tides and currents. Once relocated, materials undergo *deposition*, settling on the sea floor. Over time, layers are pressed together in the *compaction* stage due to the weight of overlying sediments and water. Finally, during *cementation*, minerals and salts in seawater bind the compacted particles, solidifying them into sedimentary rock

Objective: Learn about the ocean's role in the formation of sedimentary rocks; as a weathering agent, a primary deposition basin and through compacting materials.

Materials: Hard candies (different colours), paper cups, plastic bags & candy crushing tools

Procedure: Start with a selection of candies that in different colours. Put a few (unwrapped) candies of the same colour into a bag and use a hammer or strong wooden block to break them into tiny pieces, making them sand or gravel – to mimic how waves cause weathering. Create several colours of candy 'sediment'.

Next, either independently or in small groups, using a paper cup as the mould, pour or scoop one colour of candy sediment into the bottom. Repeat with another colour, and another. Add as many layers as you like but 4-5 will give students a good view of sedimentary layering. Once all the layers are inside the cup, put something heavy on top, like a can of food or carefully fold in the sides of the cup and place a heavy book on top and allow it to sit overnight, ensure pressure is placed on the 'sediment' and not just on the cup.

The next day, remove the weight and gently pull the candy 'rock' out of the cup, or peel the paper cup away. You'll be able to see distinctive layers, explain how the oldest layers are at the bottom of the rock, with the newest layer on top.

Discussion: How do scientists use sedimentary rock to learn about different eras in our planet's history? Where do we commonly see sedimentary rock? How does it end up above sea level?

Watch

The Birth of New Zealand; an 85-million year old journey, the geological history of the Tasman Sea (5:04), *OZGeology*

Read

The rock cycle; explore the oceans influence in the creation and transformation of rocks, *Science Learning Hub*

Play

Rock Cycle Roundabout; how to differentiate the three ways rocks can form, a print & play game, *Sailors for the Sea*

3. The ocean is a major influence on weather and climate.

The interaction of oceanic and atmospheric processes controls weather and climate by dominating the Earth's energy systems. Changes in the ocean and atmosphere can result in changes in our climate.

The ocean absorbs massive amounts of solar radiation. It acts as a heat sink, moderating global weather and climate as heat is transferred through ocean currents.

Heat exchange between the ocean and atmosphere propels the water cycle. The ocean is the largest storehouse of water, over half of evaporation and precipitation occurs above the ocean.

The ocean absorbs and stores carbon dioxide. Global climate is influenced by the amount of carbon dioxide in the atmosphere, warming our climate as CO_2 levels increase. The ocean helps regulate the climate by storing roughly half of all CO_2 and methane added to the atmosphere.

Ocean Currents and Weather in a Pan

A visual representation of processes that help to transfer heat around the globe.

Background: Ocean currents are continuous movements of seawater that flow across the world's oceans, driven by factors like wind, Earth's rotation, differences in water temperature, and salinity. These currents play a key role in distributing heat and nutrients around the globe, influencing both weather and climate.

Objective: Introduce the concept of thermohaline circulation, the movement of ocean water driven by differences in temperature and salinity, by using water of different temperatures and food colouring.

Materials: Large shallow pan or baking dish, food colouring (blue & red), room temperature / cool water, a few ice cubes, a cup of hot water (not boiling), spoon or straw (for stirring)

Procedure: To begin this activity learners could make a hypothesis of what they expect to happen where warm and cold water meet. Fill the pan halfway with room temperature water, representing the ocean.

Cold region: Add a few ice cubes on one side of the pan to create a colder polar region. Next, put a few drops of blue food colouring around the ice cubes so the cold water movement can be seen.

Warm region: On the opposite side of the pan, gently pour the cup of hot water in so there is minimal mixing. Add drops of red to the warm water area to see how the warm water, like the water at the equator, interacts when it mixes with cold water.

Observe: Watch as the blue and red water starts to mix. Notice how the cold water sinks and the warm water rises. This is similar to how ocean currents move warm and cold water around the Earth.

Stir Things Up: Use a spoon or gently blow with the straw to mimic the wind moving over the surface of the ocean. See how the colours swirl, representing the movement of currents.

Discussion: What happened? Did the colours mix? Or stay separate? Warmer water is less dense than colder water, so it will float to the top, this is how currents form and function. What role does wind play in the formation of ocean currents?

Watch

The oceans influence on weather & climate; overview of Principle 3 (1:11), *Nautilus Live*

Oceans and Climate; soaking up heat & storing CO_2 (3:33), *European Space Agency*

Read

Important but Mysterious Antarctic Krill; significant for many species & our planet

A Sea of Carbon; how the ocean stores large amounts of carbon, *Frontiers for Young Minds*

Expand

Climate change & the oceans; helping to explain the science of climate change, *NIWA*

Ocean currents in detail; infographics and videos, *Climate Change & Nature*

It provides water, oxygen, nutrients and climate regulation needed for life to exist on Earth.

The ocean is Earth's life support. Without the ocean, there would not be sufficient oxygen and water to support life on our planet – it is a major contributor to the water and carbon cycles.

Ocean organisms play a critical role in oxygen production. Most of the oxygen in the atmosphere originally came from photosynthetic organisms in the ocean. Oxygen gradually accumulated in the atmosphere, supporting the development of terrestrial life.

Life started in the ocean. The earliest evidence of life is found in ancient ocean sediments, from these ocean species millions of different species have evolved and continue to evolve today.



Reverse Race

Learn about plankton through designing & testing models – the slowest to sink wins.

Background: Coming from the Greek word *planktos, to* drift or float, plankton includes animals & plants which cannot swim against a current. Collectively, they form the basis of the marine food web. Most plankton are heavier than water and tend to sink. Phytoplankton, planktonic algae, create a large portion of the oxygen on our planet through photosynthesis and live in the sunlight zone. Zooplankton, planktonic animals, move up and down the water column to pursue food and escape predators.

Objective: Learn about the importance of plankton and adaptations they have that enable them to float and drift in the water column.

Materials: Clay (split into even pieces between groups), marbles, tall clear or opaque water-filled container for testing models & doing races, stopwatch/timer, optional extras: toothpicks, paperclips, etc.

Procedure: Start with observations of zooplankton and phytoplankton, noting shapes, projections (spines/bristles) and behaviours. Have students brainstorm designs which will help models to stay up in the water. After observing and discussing shapes, students will make a model phytoplankton or zooplankton organism. Slow their rate of sinking by increasing its resistance to movement through water. Have a variety of materials and containers of water available for testing.

Creations must fit in the palm of your hand and meet these criteria:

- They must be denser than water (not float at surface) or they will be seen & eaten!
- Each phytoplankton must contain one marble (representing body structures & chlorophyll)
- Each zooplankton must contain 2 marbles (representing body structures).

Phytoplankton race against other phytoplankton & zooplankton respectively. For race starts, place both on a sheet of cardboard so they can be tipped in at the same time for a fair start. The slowest from each pair goes into a second heat. Record which plankton sinks the slowest, this is the most successful!

Discussion: Which adaptations work the best? Which were not as successful? Did any adaptations mimic real phytoplankton or zooplankton? Would the results change if the tank was full of salty water?

This activity is an adaptation of 'Sinking Races' a lesson plan developed by SEA Semester, part of the Kids Environmental Lesson Plans collection by Sailors for the Sea.

Watch

The mysterious origins of life on Earth; how hydrothermal vents in Earth's crust gave way to complex life (4:56), *TED-Ed*

Read

The Importance of Dwarfs in an Ocean of Giants; microalgae in the ocean produces 50% of the oxygen in the atmosphere, *Frontiers for Young Minds*

Explore

An Ocean of Oxygen Producers; presentation, lesson plan & worksheets, *National Oceanic and Atmospheric Administration*

5. The ocean supports a great diversity of life and ecosystems.

Most of the earth's living space is in the ocean - it is home to both the smallest and largest organisms on the planet.

There is more diversity in the ocean than on land. A variety of ecosystems led to many unique lifeforms with specialised adaptations, many of which do not exist in terrestrial environments.

The ocean is made up of diverse ecosystems. Variations in environmental conditions from differences in abiotic factors result in different relationships among organisms.

Microbes are the most important primary producers. The fast growth rates and life cycles of microbes support constant and substantial production of carbon and oxygen on earth.

Build a Fish


Fish have some fascinating adaptations, design your own and test its viability.

Background: Adaptations are an essential skill in the survival of a species, organisms must adapt to their habitat to avoid extinction. Most physical adaptations will occur in body shape, feeding structures and colouration. Recommended resources build base knowledge for this activity; overview of ocean zones by Woods Hole Oceanographic Institution; fish adaptations key and lesson plan from *Te Kawa o Tangaroa;* critter cards from Monterey Bay Aquarium (check out deep sea species) and browse their Animals A-Z page.

Objective: Explore how adaptations such as body shape, colouration, and specialised behaviours optimise survival across different ocean zones.

Materials: Coloured paper for creating marine creature body parts (e.g., fins, tails, eyes), students can draw these or templates can be provided. scissors, glue, markers, and tape. Cards with adaptations (e.g. bioluminescence, streamlined body, large eyes), dice or spinner for random selection (opt. extension).

Procedure: A basic understanding of ocean zones would be helpful for this activity which connects well to the featured resources for Principle 7. Select/assign students a habitat; sunlight zone (epipelagic), twilight zone (mesopelagic), midnight zone (bathypelagic), abyssal zone (abyssopelagic) or hadal zone (trenches).

Research: Students explore and discuss challenges organisms face in the different zones (e.g. no light, extreme pressure, availability of food) then identify necessary adaptations for survival (e.g. large mouths, pressure-resistant bodies, bioluminescence, etc.)

Create: Draw or build a creature, ensuring the design addresses the environmental challenges. Encourage creativity while maintaining realistic adaptations suitable for the habitat.

Present: Students share their creatures, explain their choices and how each adaptation supports survival.

*Extensions: U*se a dice or spinner to assign random adaptations to create *Adaptation Roulette*. Teams get creative to explain how their creature could survive with these adaptations/ interact with other creatures.

Discussion: Which adaptations were most common across habitats? What would happen if a creature moved to a different zone? How do human activities (e.g. pollution/mining) impact these adaptations? Can creatures keep up with fast-changing environments? What does the concept 'survival of the fittest' mean?

Watch

Could you survive the twilight zone? Adaptations in the deep sea, *TED-Ed*(4:42)

A journey through habitats; *National Geographic* (2:20)

Read

Protecting Our Oceans; why the definition of biodiversity matters for conservation of endangered ecosystems, *Frontiers for Young Minds*

Explore

New Zealand's Marine Biodiversity; overview of our unique marine environments, *Department Of Conservation*

6. The ocean and humans are inextricably interconnected.

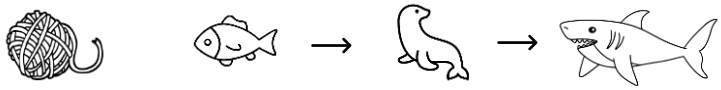
The ocean sustains life on Earth therefore it affects every human life. It provides nearly all of Earth's oxygen, food, medicines, minerals and energy resources.

Ocean affects weather and climate. The ocean absorbs and releases heat from the sun and distributes heat around the world, moderating Earth's temperature.

A large proportion of the population lives in coastal areas. Access to water influences the distribution of humans since we use the ocean for transportation, commerce and recreation.

Looking after our ocean is a shared responsibility. Our activities contribute to changes in the ocean and atmosphere. Individual and collective actions are needed for conserving and sustaining a healthy ocean.

Intertwined



Explore species connections through energy transfer - where do humans fit in?

Background: Humans rely on the ocean for many resources, however these resources are finite (limited), so we need to learn how to be mindful of how we use them and not take too much. All of our actions have an impact on our ocean, and learning how we can reduce negative impacts is critical to safeguarding the ocean and preserving its ability to sustain human lives on Earth.

Objective: Develop a deeper understanding of the importance of all species in the food web and the impacts that humans activities have on our ocean ecosystem.

Materials: Ball of string, species cards (printed out), worksheets for observations/questions (optional)

Procedure: Discuss the roles of species within a food web. *Producers* create energy from the sun. *Consumers* eat other organisms to gain energy. *Decomposers* break down matter/recycle nutrients.

Build the web: Simulate energy flow by starting with producers and having the students pass the string to any consumer who depends on them. E.g. sun → phytoplankton → zooplankton → mackerel → seal → shark. Each student will hold onto a segment of the string, and eventually, a web will be created. Note many stages will include multiple connections with many species eating the same organism.

Introduce scenarios

- If the snapper and crayfish are overfished how does this affect other parts of the food web?
- If snapper are overfished, what will happen to: a) kina and b) kelp?
- What will happen if a Rahui is put in place preventing the taking of any kaimoana?
- After the Rahui is lifted, fishing resumes as usual and snapper numbers dramatically drop again. What else could be done to keep snapper numbers healthy?

Visualise the effects of change in an ecosystem

- Select a random participant and have them sit down, any other participants who felt their string being pulled will have been affected by this change.

Discussion: What happens if a top predator is removed? How does it impact the rest of the ecosystem? How might an invasive species affect a food web?

TE KAWA O TANGAROA
OCEAN CENTRED LEARNING
www.msc.org/tangaroa

Activity adapted from String Game & Food Web Game; Te Kawa o Tangaroa by Marine Stewardship Council

Watch

Can the ocean run out of oxygen? How human actions are causing dead zones – *Ted-ED* (6:20)

Play

Bycatch in Bucket: investigate how fishing methods can impact marine habitats and non target species, *Te Kawa o Tangaroa*

Expand

Science & Sustainable Catch Topic Planner for teachers; links to other resources specific to NZ curriculum, *Te Kawa o Tangaroa*

7. The ocean is largely unexplored.

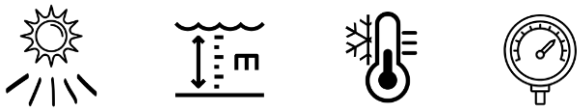
The ocean is the last and largest unexplored place on Earth! Every year, hundreds of new marine species are described and we continue to discover new features.

We are learning new things about our ocean every day. Exploration leads to a better understanding of ocean systems and how human activities impact these systems and processes.

The physical properties of the ocean make it difficult to explore. Technical advancements have led to increased deep-sea exploration, still less than 30% of the seafloor has been mapped.

Ocean exploration requires significant collaboration. Mapping, analysis and exploring requires experts from several fields and the sharing of information on many different levels.

Dive into Ocean Zones



Research the unique properties of ocean zones and design a visual display.

Background: The ocean is divided into 5 main zones from the surface to the depths, where light can no longer penetrate. *Recommended resources:* short video intro to Ocean Zones | Nautilus Live; details on zone features, seafloor habitats and exploration via Smithsonian Ocean and Let's Talk Science.

Objective: Build an understanding of what characterises the various ocean zones as well as the adaptations required for life to exist in different zones.

Materials: sections of butcher paper or large pieces of cardboard which can be measured and cut to scale (optional), markers, crayons, or pens, a large ruler or meterstick, tape or stapler to connect the zones.

Procedure: Divided into five groups, students are assigned one of the ocean zones; sunlit (0-200m), twilight (200-1,000m), midnight (1,000-4,000), abyssal (4,000-6,000m), and hadal (6,000-11,000). Students first research and identify the characteristics of the zone, and what animals are found there using prompts below. This sets the scene for creating an ocean depth profile display, made up of 5 separate posters. Using math skills this display could be drawn to scale and include depth profiles of temperature and light.

Student Investigation / Research Prompts:
1. What are some key characteristics (depth, light, temperature, pressure) of this zone?
2. What types of organisms typically live in this zone?
3. What adaptations do these organisms have to help them live in that particular environment?
4. What is the relationship between the organisms and the zone they live in?

After incorporating the above information into their posters groups share what they have learned and piece the zones together to be hung up on a wall.

Discussion: What does it mean to be an explorer? What challenges do ocean explorers face specifically? Independently, students could pick an underwater location where they would like to explore and conduct further research on what might be found there & share something that they learned about that place.

Watch

Otherworldly creatures in the ocean's depths, *TED-Ed* (5:02)

How deep the ocean really is, *Insider Tech Video* (3:39)

Read

How Do Scientists Explore the Deep Seafloor? It is big, deep, dark, and cold, learn about what it takes to understand how it works, *Frontiers for Young Minds*

Explore

Deep Ocean Education Project, marine exploration-based learning resource hub

10 minutes of fascinating deep-sea animal footage, *MBARI*