Term 2 – Human impacts and climate change

Kia ora, and welcome to the Love Rimurimu programme. We look forward to taking your students on a journey of discovery, diving into your local marine environment and exploring the potential of seaweed to solve some of the biggest issues we face today.

Programme Information

The full Love Rimurimu programme is a year-long inquiry which focuses on a different element each term:

Term 1 - Seaweed diversity and its importance in the marine environment.
Term 2 – Human impacts and climate change.
Term 3 - Seaweed solutions and marine restoration.
Term 4 – Taking action, sharing knowledge and reflection.

These Teaching and Learning Activities have been adapted for your use independently. They focus on Human Impacts and Climate Change.

If you wish to take part in the full Love Rimurimu programme, with support from your local Experiencing Marine Reserves Coordinator please contact us at info@mtsw.org.nz.

Visit the Science Learning Hub for an overview of the project, Love Rimurimu Project resources in downloadable PDF format, and planning pathways using MTSW and Hub resources.

These resources have been developed by the team at Mountains To Sea Wellington, www.mountainstoseawellington.org.

Information on Content, Activities and Resources: Term Two

Class Sessions and Resources

Learning Activity 1. Introduction to Human Impacts (intro session)

An introductory session on the effects of human activity on the marine environment

Focus and learning objectives:
- Understanding of human impacts on our oceans.
- Students can identify some human impacts and the changes they might cause to the ocean.

Resources needed
- Jenga-type game (optional)

Suggested activities and resources	
Human impacts in the ocean	List all of the things we do that might have an impact on seaweed/our ocean. Human impacts on marine environments – introductory article. Investigating marine and coastal tipping points – article and short videos. Threats to marine habitats – an interactive that features Department of Conservation infographics and text. Identifying marine stressors – use a drag and drop interactive or paper-based version to identify potential human-induced marine stressors. Modelling marine stressors and tipping points – a game, similar to Jenga, that simulates how small changes and stressors can lead to an ecosystem tipping point. **Suggested content, video and learning activities to introduce the concept and deepen understanding:** Investigate one of the human impacts we brainstormed today and what outcomes it might have on Rimurimu and wider ocean ecosystems. Human impacts on ecosystem interactions – coolaustralia.org. Human Impacts video – Fuse School. Solutions to Human Impacts video – California Academy of Science.

	How long will human impacts last? – TED Talk.

Learning Activity 2. Human Impacts – Overfishing and Shipping

Focus and learning objectives
- Understanding of human impacts on our oceans.
- Students can explain how over-fishing and shipping can affect marine ecosystems – including rimurimu.
- Students can explain a New Zealand example of over-fishing & the potential impact of marine protection.

Suggested activities and resources	
Background information	Fishing is a very important industry in Aotearoa, and we have one of the largest territorial waters in the world. This timeline provides a look at some of the historical aspects of fisheries in New Zealand. However, fishing and other off-shore activities cause ecological issues.
Explore the impacts of kina barrens	Overfishing of desirable predators, such as snapper, has allowed kina to overgraze kelp forests. The once thriving ecosystem becomes a kina barren. Marine reserves can protect ocean forests. **Suggested content, video and learning activities to introduce the concept and deepen understanding:** Cool Australia Human impacts on food chain. Sections A/B/C (D unpacked later in Seaweed Solutions section) Kina barren video and sound – IMAS/Chris Cornwall's clip of kelp forest before and after a kina barren. Young Ocean Explorers video on solving kina barrens. TED Talk on overfishing impacts and solutions. Al-Jazeera video: Fishermen village use seaweed to stop overfishing.
Shipping impacts: invasive species	Coastal marine ecosystems can be affected by invasions of exotic species – often introduced by shipping in ballast water and fouled hulls. **Suggested content, video and learning activities to introduce the concept and deepen understanding:** New arrivals – an infographic that depicts the effects of *Undaria pinnatifida* on Aotearoa's kelp forests. MPI – New Zealand Marine Pest ID Guide MPI video on Marine pests.

	California Academy of Science [Introduced species and biodiversity](#) video Biosecurity New Zealand – list and info on common [marine pests in NZ](#).

Learning Activity 3. Human Impacts - Sedimentation

Focus and learning objectives
- Understanding of human impacts on our oceans.
- Sediment is a result of deforestation, land-use, climate change and natural processes.

Suggested activities and resources	
Sedimentation	In the marine environment, sediment reduces light availability and smothers algae and other organisms. This disrupts primary producers, food webs, habitats and ecosystem function. **Suggested content, video and learning activities to introduce the concept and deepen understanding:** Begin a discussion about the issue by viewing an [infographic](#) from the Department of Conservation. Professor Conrad Pilditch explains why sediment is an issue in this [video](#) and Mareike Babuder talks about sedimentation in this [video](#). Brainstorm how you might create an activity that demonstrates how sediments enter the marine environment and how you could model this in the classroom. What actions can be taken locally to help prevent sedimentation? Find out what students/citizen scientists did to [monitor sediments in the Otago Harbour](#).

Learning Activity 4. Human Impacts Pollution : Stormwater, Sewage and Nutrient Runoff
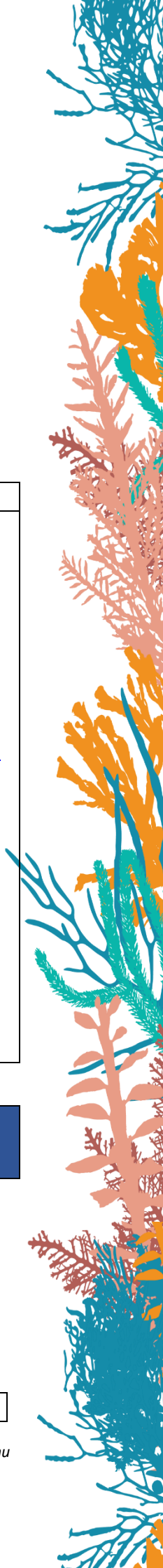
Focus and learning objectives
- Understanding of human impacts on our oceans.
- Understand some of the possible impacts on the marine ecosystem of agricultural nutrient run-off and leaching.
- Discuss human impacts on life in the sea and understand that land and coastal ecosystems are not discrete.

Suggested activities and resources

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Background information	Our oceans have long been used as an intentional dumping ground for all sorts of waste including sewage, industrial run-off and chemicals. In more recent times, policy changes have reflected the view that the ocean does not have an infinite capacity to absorb our waste. However, marine pollution remains a major problem and threatens life in the sea at all levels. Some marine pollution may be accidental, for example, oil spills caused by tanker accidents. Some may be indirect, when pollutants from our communities flow out to sea via stormwater drains and rivers.
Stormwater and sewage water	Stormwater drains often empty into the sea. At times, faulty and overburdened sewage lines also drain into the sea. These can be sources of rubbish and other pollution. Suggested content, video and learning activities to introduce the concept and deepen understanding: ESR Water Management Group has text and videos of water quality scientists and the methods they use to detect chemicals and bacteria associated with sewage. Down the Drain is a *Connected* article in which students from Wilford School in Petone, Lower Hutt investigate what ends up in storm drains. The Stormwater Problem is a graphic image that shows the links between our activities on land and their impacts on the aquatic environment. Litter Intelligence is a long-term citizen science programme run by Sustainable Coastlines in collaboration with the Ministry for the Environment, Department of Conservation and Statistics New Zealand. It aims to create a grassroots solution to litter in New Zealand. A national litter database – a first in New Zealand – is being established to record not only litter but also to track trends. The goal is to be able to use this data to change local behaviour, seeing which measures are the most effective in reducing rubbish long term.
Nutrients from the land to the sea	What we do on the land can have big impacts on the ocean. Land use practices can lead to excess nutrients entering marine environments. **Suggested content, video and learning activities to introduce the concept and deepen understanding:** This infographic has images, text and links about nutrient runoff from the land. The Nutrient impact experiment is a hands-on simulation of the impacts increased nutrients from the land have on the aquatic ecosystem.

Focus and learning objectives
- Understanding of human impacts on our oceans.
- How carbon cycles through the ocean and atmosphere.
- The impacts of global/oceanic warming

Suggested activities and resources	
Background information	Climate change and global warming are impacting our oceans and marine habitats. In addition to the well-known threats of sea level rise are changes to habitats and foodwebs via warming waters and stronger storms events.
The oceans and the carbon cycle	The ocean plays an important role in the global carbon cycle. Carbon moves in and out of the ocean daily, but it is also stored there for thousands of years. **Suggested content, video and learning activities to introduce the concept and deepen understanding:** This interactive explains some of the stores and processes in the carbon cycle on land and in the sea. This timeline tracks the ocean, CO_2 and climate change. We've known about the greenhouse effect and climate change for over a century! Play the Carbon Cycle Game from Sailors for the Sea.
Warming waters	Globally, oceans absorb 90% of the heat that we add to the atmosphere. Warming of the ocean has severe effects on marine life. • Zooplankton (the small animals that are a large part of the food chain) will grow smaller and have less fat, meaning that fish and marine mammals will have fewer calories available to them. • Warmer waters can mean more frequent harmful algal blooms and a better environment for pathogens such as bacteria to thrive. • As ocean temperatures continue to rise, tropical species will begin to move further from the equators towards the poles, displacing indigenous species such as bull kelp, which are less adaptable to rising temperatures. **Suggested content, video and learning activities to introduce the concept and deepen understanding:**

	View this [infographic](#) from the Department of Conservation to view the effects of marine heatwaves. Watch the video [Ocean Observations Biodiversity video](#) about the effects of changing ocean conditions. Read [Why climate change matters to Māori](#) and consider how warming waters impact manaakitanga, mātauranga and tikanga Māori. [Listening to the Land](#) is a *Connected* article that explores the work of Dr Pauline Harris to record mātauranga from iwi and hapū to increase understanding of how climate change is affecting Aotearoa's wildlife and ecosystems – knowledge that can then be used to plan for change. Read The Conversation article [Climate change is causing tuna to migrate, which could spell catastrophe for the small islands that depend on them](#). Discuss the effects on marine habitats and the Pacific Island states that depend on them.
Storm surges	By adding greenhouse gases to the atmosphere, we are changing the delicate balance of energy entering and leaving the Earth's atmosphere. This extra energy trapped in the atmosphere is leading to changes in local and global climates. Storms are increasing in their intensity, causing more [extreme weather](#). **Suggested content, video and learning activities to introduce the concept and deepen understanding:** NIWA has information on [coastal hazards](#) – use the navigation panel on the left hand side of the page to explore other coastal issues. What are the local impacts of extreme weather events in your area? Have your coastal areas been impacted by storm surges? Conduct a web search of media items and images to show impacts. Talk to locals about changes to the beaches and coastal areas.
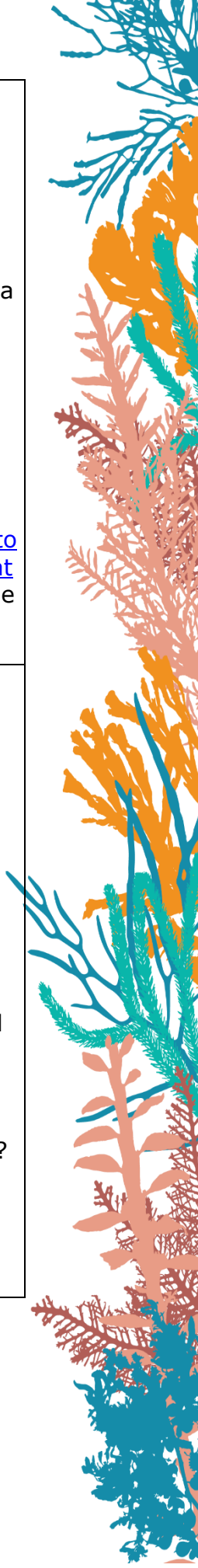
Focus and learning objectives
- Understanding of human impacts on our oceans.
- Understanding the processes involved in ocean acidification.
- Learn how ocean acidification affects marine biodiversity/ecosystems.

Suggested activities and resources	
Background information	What is ocean acidification? Why do we want an alkaline ocean? [Oceans are becoming more acidic](#) due to increased levels of carbon dioxide (CO_2) in the atmosphere. Even small changes in water pH can have big impacts on marine biology. Ocean acidification is a worldwide issue. However, as CO_2 is more soluble in colder water, it is of particular concern in Aotearoa's temperate oceans. **Suggested content, video and learning activities to introduce the concept and deepen understanding:** The videos [Ocean acidification](#) and [Our role in ocean acidification](#) are brief introductions to the problems and solutions. Videos from NOAA [The Acid Test](#) and [Tracking an Ocean of Carbon](#) provide general background knowledge. [The Ocean of Tomorrow](#) is an Otago University educational resource unit for secondary schools that has a range of experiments and activities to build understanding. This poster provides [20 Facts about Ocean Acidification](#). [Acid Seas](#) is a New Zealand Geographic article that looks at the impact of ocean acidification on Aotearoa's ecosystems. Sailors for the Sea's [Increases in CO_2 Creates a More Acidic Ocean](#) activity uses red cabbage as a pH indicator and your exhaled breath to visualise how our oceans are becoming more acidic due to increasing carbon dioxide emissions.
Ocean acidification affects marine biodiversity and ecosystems	Many marine species rely on calcium carbonate to build a shell or skeleton. One of the effects of ocean acidification is a reduction in the availability of carbonate. This means that any animal that produces a calcium carbonate skeleton will find it much more difficult to do so as CO_2 levels in the atmosphere rise and oceans become more acidic. Organisms could grow more slowly, their shells could become thinner or they might dispense with shells altogether. **Suggested content, video and learning activities to**

	introduce the concept and deepen understanding: Increased acidity – an infographic that uses pāua as an example of the perils of ocean acidification. Bryozoans and ocean acidification has text and video about the impacts on these biogenic habitat builders. The Ocean acidification and eggshells activity uses chicken eggs to simulate the potential effects of increasing ocean acidity on marine animals with calcium carbonate shells or skeletons Our Acidifying Ocean is a virtual multi-step experiment to measure, analyse and interpret data about the impacts of acidification on sea urchins.

Learning Activity 6. Seaweed Solutions

Focus and learning objectives

- Using seaweed as a means to mitigate climate change through carbon sequestration.
- Sustainably grown and sourced seaweed adds to the blue economy.
- Discuss how seaweed contributes to our social, cultural, ecological and economic well being.
- Explore contributions to citizen science projects as one way of taking action.

Suggested activities and resources	
Background information	Rimurimu is 'blue carbon'. It removes carbon from the atmosphere, which becomes detritus and is sequestered in the deep ocean waters for a very, very long time. Rimurimu is also part of the blue economy: marine activities that create economic value and contribute positively to social, cultural and ecological well-being in Aotearoa New Zealand.
Seaweed as a solution	Explore seaweed as a solution to aid carbon sequestration and to add to the blue economy. **Suggested content, video and learning activities to introduce the concept and deepen understanding:** Watch this TED Talk. Tim Flannery asks: Can seaweed help curb global warming? Information is beautiful has the infographic Seaweed: food fertilizer, feed, fuel Can it be all these things and tackle our emissions problem? View the data behind the infographic here.

	The LEARNZ field trip [Seaweed: An Ocean of opportunity!](#) has video, text, images and quizzes that explore seaweed as a wonder crop of the future and the sectors that make it happen. AgriSea is a [blue economy success story](#). After reading the text on the Sustainable Seas Science Challenge webpage and watching the video, explore some of the key words and concepts that support cultural, scientific and economic values/endeavours.
Citizen science projects	Citizen science projects are a way in which students/volunteers are able to contribute to scientific projects, usually by collecting or analysing data. **Suggested content, video and learning activities to introduce the concept and deepen understanding:** Before starting a citizen science project, check out these supporting resources: [Planning for students to be citizen scientists](#) [Getting started with citizen science](#) [Teacher's Guide to using iNaturalist](#) [Floating forests](#) asks volunteers to trace patches of kelp in images taken by Landsat satellites. [Project Baseline Wellington](#) – a platform for divers, free divers and those interested in the local marine environment to contribute underwater and marine observations, help build a long-term record and inform the public about marine conservation. Observations of [large brown seaweed distributions](#) – iNaturalist .