

Activity 8: Healthy estuaries



Let's find out how we can tell if an estuary is healthy



CURRICULUM LINKS

Learning areas

Science: Levels 1–4

- Living world: Ecology.
- Nature of Science: Understanding about science; Investigating in science; Participating and contributing.
- Health: Healthy communities and environments: Community resources.

Science capabilities

- Use evidence.
- Interpret representations.
- Critique evidence.

Te Marautanga o Aotearoa

- Tikanga ā iwi.
- Pūtaiao: The natural world.

Te Marautanga o Aotearoa

- Social Sciences.

Learning intentions

Students are learning to:

- discover the features of a healthy estuary
- identify environmental issues for estuaries.

Success criteria

Students can:

- describe the features of a healthy estuary and identify healthy estuaries
- understand several human impacts or environmental issues that can affect estuary health.

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BACKGROUND NOTES

WHAT IS A HEALTHY ESTUARY?

Healthy estuaries have clean water, native plants around the edges, few pests, small amounts of sediment and healthy living things.

To learn more about the features of a healthy estuary and see examples, view DOC's healthy estuaries slideshow.

 Healthy Estuaries slideshow



Estuary vegetation sequences in Tauranga Harbour.
Photo: Helen Kettles, DOC

WHY DO WE NEED HEALTHY ESTUARIES?

Estuaries are important for maintaining the functioning and health of the wider environment, especially the waterways and oceans. Healthy estuaries can support a wide range of animal species on and in their sediments, whereas unhealthy estuaries can only support small numbers of pollution-tolerant species (eg worms). Furthermore, clean and unpolluted estuaries contain uncontaminated fish, shellfish and other food species, allowing people to eat healthy kai moana.

WHAT ARE SOME ISSUES FOR ESTUARIES?

Several issues can affect estuaries.

- **Sedimentation:** Particles (tiny pieces) of soil and silt are carried in water and swept down a catchment into estuaries. Sedimentation is a natural process, but the presence of too much sediment can drastically change estuary habitats, interfering with the feeding relationships of living things and disrupting the whole ecosystem. Fine sediments are a big problem for many of our estuaries.
- **Invasive species:** Marine pests can change an estuary habitat and take over the environment, removing valuable food and resources from the normal ecosystem.
- **Pollution, waste and toxins:** The presence of contaminants such as chemicals, heavy metals, waste products and bugs/pathogens in estuary water can create an unhealthy environment, making it difficult for living things to survive.



Asian paddle crab. Photo: Northland Regional Council



- **Lack of oxygen:** Insufficient oxygen in the sediment can affect which animals and plants can survive in an estuary and cause problems with nutrient cycling.
- **Climate change:** Changes in our climate can cause unusual temperatures and variations in weather patterns, rainfall and water flow in estuaries. These changes can affect the conditions in our estuaries, making it difficult for living things to stay healthy.
- **Habitat destruction:** The reclamation of wetlands, trampling of vegetation at the edges and deforestation can remove suitable habitat from estuaries, affecting native plants and animals and reducing the filtering of dirty water from upstream.



Nelson industrial area showing modified estuary edges and pollution. Photo: Helen Kettles, DOC

HOW CAN WE DETERMINE THE HEALTH OF AN ESTUARY?

Several methods can be used to gather data and make observations to help us assess the health of an estuary.

- Biodiversity surveys, eg the  Marine Metre Squared project.
- Measuring oxygenation or the Redox Potential Discontinuity (RPD) in the sediment.
- Measuring temperature, salinity and turbidity.
- Community shellfish monitoring.

Information on these methods of data collection and investigation is provided below and expanded on in  *Activity 9: Visiting estuaries*.

Measuring oxygenation

The RPD layer is a recognisable division between brown sediment that contains oxygen and black sediment that does not contain oxygen.

Students can measure the depth of the RPD layer below the surface to assess the health of the sediment – an RPD that is close to the surface means that there is a lack of oxygen in the sediment and so living things will find it hard to survive in that environment. For more information, see the New Zealand Marine Studies Centre's *Health of Mudflats* video.

 Health of Mudflats video

Measuring the overall health – indicator species

Indicator species are living things that can quickly show us if there are any problems in a particular environment as they may become sick or less abundant if an issue is present. Examples of indicator species in estuaries are cockles, īnanga and seagrass.



Measuring temperature, turbidity and salinity

Estuary water is healthy when it is within the normal limits for the prevailing conditions, which will vary according to the tide, air temperature, season and water depth. Therefore, measuring the temperature (how hot or cold the water is), turbidity/clarity (how far you can see through the water) and salinity (how salty the water is) over time allows us to understand the normal range and patterns associated with a particular estuary. When observations exceed the normal range, there may be impacts on the estuary community.

View this clip to find out how Environment Canterbury measures water clarity using turbidity tubes.

 Sampling - water clarity tube

CLIMATE CHANGE, OCEAN ACIDIFICATION AND ESTUARIES

As temperatures around the globe slowly increase, the temperature of our oceans will also rise, with particularly marked changes occurring in shallow estuaries. High temperatures can affect the breeding, breathing, movement and migration of estuary animals. Climate scientists predict that climate change will also cause more frequent weather events such as floods and droughts in New Zealand, which will bring additional challenges for estuary life, as it may cause more fresh water and sediment to enter estuaries in some places.

For more information about climate change, visit:  [Climate change information for climate solvers.](#)

Estuaries are also affected by the increasing amounts of carbon dioxide in the air, as this gas dissolves into the water making it more acidic. This process is called ocean acidification and will make it harder for animals such as cockles to grow their shells. For more information about ocean acidification, see the New Zealand Marine Studies Centre's *Ocean of Tomorrow* teaching resource.

 [New Zealand Marine Studies Centre Resources](#)



LEARNING EXPERIENCE 7: ESTUARIES AND TE AO MĀORI

Resources for this activity

- Slideshow  Healthy Estuaries
- New Zealand Marine Studies Centre's video clip  Health of the mudflats
- *School Journal* Part 4, Number 3, 2008: 'Estuary Health Check' article
- *Connected 3*, 2006: 'The Secret Life of Estuaries' by Andrew Innes, pp. 18–25
- Environment Southland's February 2015 newsletter  Enviroteach
- Interactive game  *Safe or threatened in estuaries* (page 11).

Vocabulary

Sediment, sedimentation, inquiry, issue, waste, toxin, oxygenation, nutrients, habitat, chemicals, deforestation, climate change, pollution, redox potential discontinuity (RPD) layer, salinity, temperature, survey.

Links

To open the links throughout this resource without losing your place in the document, follow either of these steps:

- Right click on the link and click **Open Hyperlink**. Now the link will be opened in new tab.
- Hit the **Ctrl** key while you left click the link. This will also force the browser to open the page in a new tab.

Either of these methods will open the link in a new tab leaving the teaching resource open.



Focus question
How can we find out if our estuary is healthy?

INTRODUCING STUDENTS TO MONITORING THE HEALTH OF ESTUARIES

Note: These learning experiences are suggestions only. Teachers are encouraged to adapt and change the material to suit their students' needs and interests.

What are healthy estuaries and some issues for estuaries?

- View the *Healthy Estuaries* slideshow to learn about the features of estuaries and issues for estuaries, and to see real-life examples of healthy and unhealthy estuaries.

 Healthy Estuaries slideshow

- Students can explore this Padlet page, which includes information about climate change, sedimentation, pollution and other issues of relevance to estuaries.

 Padlet - Issues for estuaries



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Activity 8: Healthy estuaries
PROTECTING OUR ESTUARIES

- Find out about how estuaries are kept clean by natural processes and what happens when there are too many nutrients entering an estuary by reading *The Secret Life of Estuaries* by Andrew Innes (Connected 3, 2006, pp. 18–25). For a cloze reading activity and to find out more about the article, visit the Te Kete Ipurangi (TKI) website.

 Our Changing World (Reading): Unit Standard 2986 – The Secret Life of Estuaries

How do these issues affect estuary animals?

Issues in estuaries can affect the animals that live there.

- Read about why īnanga (a New Zealand freshwater fish) needs healthy streams and habitats in DOC's *Harbours, bays and estuaries: Whitebait in our waters* resource.

 Harbours, bays and estuaries: Whitebait in our waters

After reading, discuss which human impacts can affect īnanga.



Īnanga in seagrass. Photo: G.A. Eldon

Why monitor the health of an estuary?



- Ask your students why they think we need to collect data in estuaries or monitor their health? Why is this important?
- Conduct a litter survey at your local estuary to investigate human impacts. The amount and type of litter at an estuary can give an indication of the issues that are present. For instructions on how to conduct a litter audit, see page 10 of DOC's *Habitat Heroes: Te tūhura i tō taiao moana rohe – explore your local marine environment* resource.

 Habitat Heroes: Te tūhura i tō taiao moana rohe – explore your local marine environment resource

Survey sheets and guidance for beach clean ups and litter audits are also available on the Love Your Coast website.

 Love Your Coast – Learn about the issue

Measuring the health of an estuary

- Read the *Estuary health check* article (School Journal Part 4, Number 3, 2008; noun frequency level: 11–13) with your students and discuss which factors were measured to determine the health of Pāuatahanui Estuary (eg number of cockles).
- Read the February 2015 edition of Environment Southland's newsletter *Enviroteach*.

 Enviroteach, February 2015

- This newsletter explains how Southland students are surveying their estuaries to find out more about how healthy they are. Ask your students which tests and/or surveys were used to provide information, data and/or observations on the health of the estuary (eg measuring temperature, turbidity, salinity, dissolved oxygen, doing a Marine Metre Squared quadrat survey).



Investigating oxygen in the sediment



- Students can share ideas about what sediment is to revise this concept. We can tell how healthy an estuary is by assessing how much oxygen is available in the sediment (see background notes). Simple tests can be used to measure the amount of oxygen that is present in the sediment of an estuary.
- Students can measure the depth of the RPD layer in your local estuary to detect oxygen levels in the sediment (see background notes page 3). Take a core sample by pressing a 10-cm-diameter plastic pipe or a large tin can that is open at both ends (be careful with sharp edges!) into the estuary sediment, removing it and extracting the sediment from the pipe/can. The colour of the sediment tells us how much oxygen is available to animals – a brown colour indicates that there is oxygen in the sediment, whereas a black colour indicates a lack of oxygen. Oxygenated sediment provides a healthy habitat for living things. For detailed instructions, see the New Zealand Marine Studies Centre's *Health of the Mudflats* video.



Measuring the depth of the RPD layer.
Photo: Shan Walker, EfS Initiatives

▶ Health of the mudflats

Inquiry stage 3: Investigate



Thinking about the health of your local estuary

- Discuss how you might know if your local estuary is healthy or unhealthy. Which tests and observations could you use to understand the health of your estuary? How often would you need to carry out these tests to check whether the observations were normal or unhealthy?
- Explore the environmental issues in your local catchment and estuary that affect your focus species (see 📍 *Activity 4: Life in an estuary*). Human impacts and environmental issues will vary between areas and may cause problems such as sedimentation, pollution, habitat destruction or lack of oxygen. For further ideas, see the *Issues for estuaries* Padlet page.

📌 Padlet- Issues for estuaries

REFLECTING ON LEARNING



- Try the *Safe or threatened in estuaries* activity on page 11 to revise learning about issues in estuaries and how they affect animals such as native fishes.
- View the Science Learning Hub's *Estuary issues and protection* video.

▶ Estuary issues and protection

What evidence do you have that your estuary is healthy? How can you critique your evidence?



EXTENDING LEARNING

Climate change and the future of estuaries

- Find out more about the impacts of climate change on estuaries by exploring the National Oceanic and Atmospheric Administration's (NOAA's) Climate Change Interactive.
 - 🔗 Exploring the estuary and climate change connection
- Discuss what could happen to cockles, seagrass and mangroves with climate change. (*Mangroves could become more common further south with increased temperatures, whereas cockles will lose their habitat if the beach disappears as a result of sea level rise and will make thinner shells due to ocean acidification. Seagrass needs more light than many other plants to grow, so an increased incidence of floods and erosion will prevent seagrass from growing due to the water becoming murkier.*)
- Compared with many other plants, mangroves are very good at absorbing carbon and storing it in the sediment – indeed, **mangroves forests are as much as ten times more efficient than other forests at storing carbon!** To see how mangroves can help to combat climate change and how you can monitor local mangroves, view the New Zealand Marine Studies Centre's *Surviving the odds: mangroves of Aotearoa* video.
 - ▶ Surviving the odds: The mangroves of Aotearoa
- See the Ministry of Education's Climate Change learning programme and wellbeing guide to support learning about climate change and taking action.
 - 🔗 Education for Sustainability tools and resources

OTHER RESOURCES RELATING TO PEOPLE AND ESTUARIES

- The New Zealand Marine Studies Centre's *The Ocean of Tomorrow* education resource:
 - 🔗 The ocean of tomorrow
- Northland Regional Council's estuary school information on estuaries:
 - 🔗 Estuaries
- NIWA's article on marine pests:
 - 🔗 Summer Series 2017 - Look out for these marine pests
- NIWA's *What ails our estuaries?* webpage:
 - 🔗 What ails our estuaries – problems and solutions
- The Alliance for Climate Education's *Ocean Acidification* video:
 - ▶ ACE Science Short: Ocean Acidification
- Science Learning Hub's *Estuaries and farmland run-off* article:
 - 🔗 Estuaries and farmland run-off
- Science Learning Hub's *Why salinity and temperature are measured* video:
 - ▶ Why salinity and temperature are measured



- DOC's *Harbours, bays and estuaries: Our prized snapper* resource:
 - 🔗 Our prized snapper
- Curious Minds article *How is the Kaipara's health changing?* for ideas about how to monitor changes over time:
 - 🔗 How is the Kaipara's health changing?



SAFE OR THREATENED IN ESTUARIES?

This interactive game explores how estuary animals are affected by issues in the catchment.



Before starting the game

The students will be given three options for each scenario during the game: 1. you swim up the river, 2. you are in the estuary or 3. you are living out at sea. Write each option on a separate piece of paper or somewhere on the classroom walls in three separate locations. Alternatively, for an outdoor version, draw the river, estuary and sea options with chalk on your courts. Students should have space to gather at each option and walk between them.

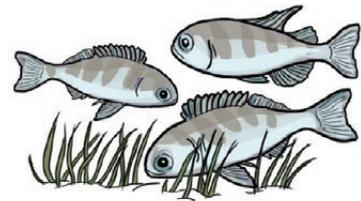
Instructions

Introduction (read aloud to students)

You are a migrating native fish and you spend different parts of your life living in the sea, in a river or in an estuary. Are you in the right place at the right time?

You have three options.

- You swim up the river.
- You are in the estuary.
- You are living out at sea.



Scenarios

Read the following scenarios. Students choose one of the three options for each scenario. After 10–15 seconds, ring a bell or set a timer and tell the students that they must stay at the nearest option. Read out the consequences of each option. If students are threatened/not safe, they lose one life. Students must keep a tally of the lives they have lost on their fingers. If they lose five lives, they are out (they must sit down).

Scenario 1: The estuary is calm and settled. The tide goes in and out. Where would it be safe?

Consequences: Everyone is safe as there are no issues. But watch out for predators – it's good weather for hunting ...!

Scenario 2: There is a big winter storm with very strong winds, heavy rain and large waves. A lot of sediment is being washed into the river and estuaries from nearby developments. Where is a good place to be?

Consequences: If you are living out at sea, you are safe. If you chose to swim up the river or you're in the estuary, you are most likely to be threatened (lose one life each).



Scenario 3: Trees near the river have been cut down to make way for new houses and car parks. Large amounts of sediment have washed down the drains because of poor sediment control. Where is a good place to be?

Consequences: If you are in the river or estuary, you are threatened (lose one life). If you are far out to sea, you are safe.

Scenario 4: It's spring which means it's time for breeding. Where will you lay your eggs?

Consequences: If you are in the river or estuary, you are safe. If you're out at sea, you are threatened (lose one life).

Scenario 5: There has been a weed infestation in the park and lots of weed killer has washed into the stream. Where is it safest to be?

Consequences: If you are in the river or estuary, you are threatened (lose one life). If you're at sea, you are safe.

Conclusion

Students who are still safe (have lost the least number of lives) after all of the scenarios win the game. Discuss what it takes for our native fishes to survive in estuaries. What other things could threaten them? Invent new scenarios and play again!

This game was inspired by the University of Otago's New Zealand Marine Studies Centre's game Survivor seashore: Are you a survivor?

 Survivor seashore: Are you a survivor?

