



Climate Change: prepare today, live well tomorrow

# Huringa Āhuarangi

WHAKARERI MAI KIA HAUMARU ĀPŌPŌ

## MODULE FIVE

Adapting to change

# HURINGA ĀHUARANGI: WHAKARERI MAI KIA HAUMARU ĀPŌPŌ

## Climate Change: prepare today, live well tomorrow

### Introduction

The term 'wicked problem' is used in science, planning and education to describe problems that are extremely complex in nature. Anthropogenic climate change is one such problem. Because there is no one-size-fits-all solution, no quick fix, climate change can be difficult to get your head around, let alone teach or respond to. This resource aims to help teachers/kaiako and their learners to understand the immediacy and complexity of this 'wicked problem'. It offers a range of practical and proactive strategies for responding to the challenges.

A collective and inclusive response is needed to mitigate and adapt to the predicted impacts of climate change. This response asks that we recognise the interconnectedness of all life on earth, as the impacts of climate change will be widely and diversely felt by all living things. Also essential to this response is the ability to communicate, listen to and respect varying perspectives and ideas. We are all in this together and can all be part of the solution.

'Huringa Āhuarangi: whakareri mai kia haumarū āpōpō | Climate Change: prepare today, live well tomorrow' is a science-based, integrated learning programme. It focuses on Earth's systems, the interconnectedness of the living world, and the impacts of anthropogenic climate change.

It encourages learners to interpret, analyse and engage with science, and to understand that science knowledge changes over time.

There is opportunity to consider a mātauranga Māori perspective in the learning programme, particularly around the interconnectedness of life on earth as expressed through the relationship between Papatūānuku and Ranginui. Other indigenous knowledge bases will contribute to a broader understanding of the interconnectedness of life on earth and help to inform possible responses.

The programme builds understanding of climate change through an exploration of critical global, national, and local responses aimed at mitigating and adapting to predicted impacts. It is critical to consider indigenous responses, and – in particular for Aotearoa – to include those of whānau, hapū and iwi.

In exploring the challenges of climate change, ākonga are encouraged to develop and apply critical thinking, literacy skills, and communication competencies. They are prompted to think beyond themselves, to tautoko/support others, and to connect with the intergenerational community responding to the problem.

Most importantly, the resource supports and empowers all learners to have a voice, to take action, and to play their part in a larger, systematic response.

### Teaching and learning modules




The modules can be applied in sequence or independently, depending on learners' existing awareness of climate change. For those who have limited prior learning it is suggested that the programme be followed in its entirety, and in the order suggested in the 'User guide'. This will encourage a sound understanding of climate change science and explore potential responses to the challenges of climate change, whilst also supporting wellbeing.

### Climate change wellbeing guide



Teachers/kaiako and ākonga will have different reactions when learning about and responding to climate change, with some experiencing strong emotions. Background information and activities to support wellbeing are included. Look for 😊 to connect to the 'Climate Change Wellbeing Guide', a companion resource to the learning programme.



A photograph of two young girls playing in a park. The girl on the left has dark curly hair and is wearing a pink long-sleeved shirt under a light blue denim vest. She is smiling and looking up at falling brown leaves. The girl on the right has straight brown hair and is wearing a white long-sleeved shirt with a unicorn design. She is also smiling and looking up, with her arms raised. The background shows a large tree trunk on the left and a grassy area with more trees in the distance. The ground is covered in fallen leaves.

**“We need to make  
a difference now!”**

ZOE



## MODULE FIVE

# Climate change: adapting to change

### Specific learning intentions

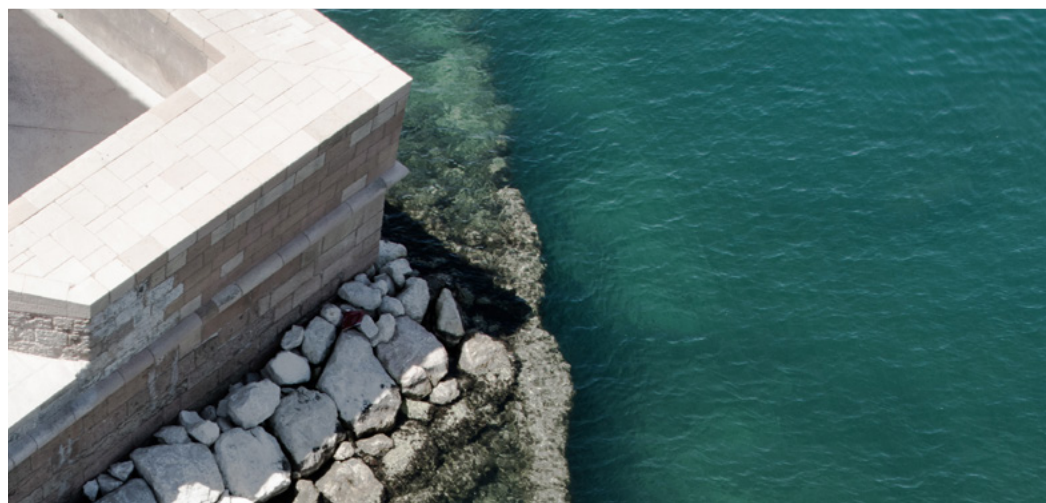
In alignment with Te Ao Māori and mātauranga Māori, learners will:

- learn how living things adapt and evolve to help them survive in their particular habitat and/or environment
- investigate how humans and other animals can adapt to the impacts of climate change
- explore climate change adaptation options with a particular focus on coastal hazards and sea level rise.

### Success criteria

Learners will be able to:

- explain the concept of adaptation as it applies to the impacts of climate change
- outline the predicted impacts of climate change on coastal communities; outline a range of potential options for adaptation
- consider different climate change adaptation options; consider the varying perspectives that will inform community choices
- relate how science and indigenous knowledge systems help to inform our behaviour, choices, and actions in relation to climate change.



## Background information for teachers and kaiako

Though our knowledge and understanding of climate change continues to evolve, it is widely accepted that the rapid change in the Earth's climate is caused by anthropogenic activity. Around the world, perspectives continue to develop regarding the best response to the environmental, social, economic and cultural impacts of climate change – both now, and in the future. The world as we know it – heavily reliant on fossil fuels for everyday life and function – is in unknown territory. However, due to a measurable increase in the release of heat trapping gases such as carbon dioxide (CO<sub>2</sub>), scientists do know that some impacts are already locked in. How severe those impacts will be for all living things – including humans – is not yet known. That will depend on the behaviours and actions of humans from this point on.

Planning for the impacts of climate change – both known and predicted – come under two main categories of response: mitigation and adaptation.

**Mitigation** strategies aim to limit the severity of climate change and related effects. This includes strategies to reduce human emissions of heat trapping gases, and actions aimed at reducing the concentrations already in the atmosphere. For example, combustion engine cars run on fossil fuels which release heat trapping gases. Changing to a mode of transport that uses less fossil fuels or runs on renewable energy – such as electric bikes or cars – reduces the emissions of heat trapping gases and therefore the potential impacts of climate change.

**Adaptation** strategies focus on adjusting to current or expected climate change and its effects. For humans, adaptation aims to moderate or avoid harm, and take advantage of opportunities. The natural environment will generally adapt unless humans restrict species' and ecosystems' capacity to do so. It is important to understand that, without mitigation, adaptation alone cannot avert the risk of severe, widespread and irreversible impacts from climate change.

*Please note: 'Module five: Climate Change: Adapting to Change' focuses on climate change adaptation. For more information on climate change mitigation, refer to 'Module six: Mitigating Climate Change Impacts'.*

### Adapting to a changing world

There is a high degree of certainty that the planet, including Aotearoa New Zealand, will experience increases in the frequency and intensity of extreme climactic events such as higher temperatures, flooding, droughts, and wildfires. Other emerging changes to our climate include ongoing sea-level rise, and warmer and more acidic oceans. Already, sea level rise and storm surges are threatening some coastal communities in Aotearoa New Zealand. Threatened areas are forced to choose between the major expense of building barriers between dwellings and the sea, or relocating habitation further inland. In South Dunedin, nearly 2,700 homes are less than 500 mm above the spring high-tide mark. The Dunedin City Council is currently considering a range of scenarios for dealing with this threat, including the option of “managed retreat” (*Source: Branz, 2021*).

Both current and emerging changes also threaten biodiversity, cities, infrastructure, human health, oceans, and the natural resource-based economy. There will be losses and damages but also opportunities for new and innovative ways to adapt. So, even though the impacts of climate change will differ depending on our location, all of us, regardless of where we live, will be required to make some adaptations. We need to act now to address the ongoing changes to our climate.







In 2018, the 'Climate Change Adaptation Technical Working Group' – set up by the Ministry for the Environment to provide advice on how Aotearoa New Zealand could adapt to the effects of climate change – developed a number of principles to guide, support and help sustain effective climate change adaptation. They recommended that Aotearoa New Zealand must:

- Anticipate change and focus on preventing future risks from climate change rather than responding as the changes occur.
- Take a long-term perspective when acting.
- Take actions which maximise co-benefits, and minimise actions which hinder adaptation.
- Act together in partnership, ara whakamua, and do this in a way that is based on the principles contained in Te Tiriti o Waitangi.
- Integrate climate change adaptation into decision-making.
- Make decisions based on the best available evidence, including science, data, knowledge, and mātauranga Māori.
- Approach adaptation action with flexibility and enable local circumstances to be reflected.

For more information, including recommended foundational and immediate actions, refer to [‘Adapting to Climate Change in New Zealand: Recommendations from the Climate Change Adaptation Technical Working Group’ report \(PDF\)](#).

While adaptation is necessary to respond to the effects of climate change, care must be taken to avoid maladaptation. Maladaptation is defined by the IPCC (2014) as ‘an action that may lead to increased risk of adverse climate-related outcomes, increased vulnerability to climate change, or diminished welfare, now or in the future’. In the report, authors Noble et al. (2014 Table 14–4) describe the following examples of actual or potential maladaptive actions:

- failure to anticipate future climates
- large engineering projects that are inadequate for future climates
- intensive use of non-renewable resources to solve immediate adaptation problems
- engineered defences that preclude alternative approaches such as ecosystem-based adaptation
- adaptation actions not taking wider impacts into account
- awaiting more information, or not doing so, and eventually acting either too early or too late
- awaiting better projections rather than using scenario planning and adaptive management approaches
- forgoing longer term benefits in favour of immediate adaptive actions; depletion of natural capital leading to greater vulnerability
- locking in to a path dependence, making path correction difficult and often too late
- unavoidable ex post maladaptation (e.g. expanding irrigation) that eventually will have to be replaced in the distant future
- moral hazard, such as encouraging inappropriate risk-taking e.g. based on insurance or social security net
- adopting actions that ignore local relationships, traditions, traditional knowledge, or property rights, leading to eventual failure
- adopting actions that favour – directly or indirectly – one group over others, leading to breakdown and possibly conflict
- retaining traditional responses that are no longer appropriate
- migration may be adaptive or maladaptive or both depending on context and the individuals involved.



## Climate change adaptation and community wellbeing

**Climate change, Māori and wellbeing** (Source: Pauline Waiti, Ahu Whakamua Ltd)

A set of concepts to identify wellbeing for Māori can include:

- wairuatanga (spirituality)
- tikanga (customs and practices)
- te Reo Māori (language)
- whanaungatanga (social connectedness).

In te Ao Māori these concepts are inter-related, meaning it is difficult to discuss them as separate ideas. Tikanga refers to the things Māori do and the way they do them within a Māori context, based on the mātauranga Māori of their tūpuna and mostly using te reo Māori. This includes everything around food (growing, gathering, preparation, and storage) including the types of food valued, engagement with the taiao, engagement with other hapū and iwi, and engagement with a Māori worldview based on Ranginui and Papatūānuku. Māori wellbeing is determined by the decisions they make around the use of the resources of Papatūānuku me Ranginui me ā rāua tamariki (Papatūānuku and Ranginui and their children) – that is, everything in the natural world. So, for Māori, climate change impacts upon their intimate relationship, through whakapapa, with the natural world. This, in turn, impacts their wairuatanga, tikanga, and whanaungatanga.

For example, important food growing and gathering sites can be impacted by rising water levels, dried up water sources, poisoning of water and land, and the often fast-paced changes to ecosystems. The marae (including the resting places of ancestors) and associated mahinga kai can be affected by climate change, and this in turn impacts upon wellbeing. Therefore an important question for Māori is: How can we ensure our ‘activity’ ensures that our wairuatanga, our tikanga, our use of te reo Māori and our whanaungatanga remain intact in order to nurture us into the future?

### Adaptation the ‘four community wellbeings’

One useful way to frame a discussion on adaptation is to think about four fundamental components of community wellbeing – environmental, economic, social and cultural. Under Aotearoa New Zealand law, these need to be accounted for when Local Government make decisions that impact communities.

**Environment:** In the environmental context, this means that the likely effects of climate change – including effects on ecosystems – must be factored in when decisions are made that will have implications for the natural environment. The Department of Conservation (DOC) has warned that one of the significant risks to Aotearoa New Zealand biodiversity from climate change may come from changes in land management practices by other sectors adapting to climate change. For example, in the course of developing infrastructure to protect coastal areas, damage to coastal ecosystems may occur. DOC has developed a five-year adaptation action plan aimed at increasing the resilience of Aotearoa New Zealand’s plants, animals and wild places to the impacts of climate change. That plan notes the interconnections between indigenous biodiversity and natural ecosystems and our basic needs and health. [View the DOC action plan \(PDF\).](#)





**Cultural:** Cultural wellbeing can broadly encompass values, shared beliefs, traditions, behaviours and identity. These sometimes intangible qualities help to shape and define who we are as New Zealanders, and are central to our diversity as a nation. The protection and enhancement of cultural wellbeing cannot occur in isolation from the other wellbeings. Because it is such a fundamental part of us – as individuals and communities, hapū and iwi – any adaptation strategies for climate change must place cultural considerations at their centre.

**Economic:** From an economic perspective, adapting to climate change means recognising and providing for the economic impacts that will be felt nationally, locally and individually. How, for example, given the strong influence of agricultural production on our country's economy, will Aotearoa New Zealand take advantage of opportunities to grow high value crops in new places, or prepare for shifts in productivity associated with extreme events? For vulnerable coastal communities, increased investment in coastal barriers to reduce the threat of inundation will affect the economic wellbeing of those communities, and possibly the wider population, depending on how those costs are distributed. Relocation further inland will also come at substantial cost as homes, businesses, services and infrastructure are rebuilt. For example, on one of the populated stretches of Hawke's Bay coastline, the cost of work such as sea walls, groynes and managed retreat has been estimated at roughly \$130–285 million. [A 2019 report by Local Government New Zealand \(LGNZ\)](#) found that rising sea levels could put \$2–14 billion of drinking water, wastewater and stormwater services, roading and other infrastructure at risk.

**Social:** Social wellbeing is about the ability of people, whānau, hapu, iwi and communities to live the lives they would like to lead. While it includes material conditions, it is more broadly focused on the quality of life that comes from such things as access to leisure and recreation, skills and educational opportunities, employment opportunities, good health, civil and political rights, feeling safe, and having good trustful connections with family, friends, and the surrounding community (*Source: Msd The Social Report 2016 – Te Pūrongo Oranga Tangata*). As we have seen, a changing climate has implications for many of these social factors ('A Local Response' and 'Health and Wellbeing' in Module 4). In planning for rising sea levels for coastal and low-lying communities we will need to recognise significant financial impacts, loss of assets and resources, loss of access to valued places, loss of physical and mental health, and loss of identity and sense of belonging. For more information, refer to 'Communities and climate change: Vulnerability to rising seas and more frequent flooding', (National Science Challenges – The Deep South, Jan. 2018).

**Everything is connected:** The concept of wellbeing is a holistic one. While the division into four components is helpful in understanding the particular emphasis each brings to the whole, there is a need to recognise that – like the Earth's systems – all aspects of wellbeing are interconnected. Changes to wellbeing in one area will ultimately impact on other areas, in a range of ways and over differing time scales. Adaptation strategies for managing the impacts of climate change need to recognise how those connections express the principles articulated by the Climate Change Adaptation Technical Working Group, in order to avoid the pitfalls of maladaptation described above.



## In our neighbourhood – A coastal snapshot

Approximately 65% of New Zealanders live within five km of the coast. In fact, there is no location in Aotearoa New Zealand that is more than 130 km from the sea. Our predominantly coastal populations mean that climate change impacts such as sea-level rise and extreme weather will be significantly felt in Aotearoa New Zealand, as well as in the Pacific Islands.

Climate change is not a natural hazard. However, it does worsen hazards such as flooding from rivers, increased rainfall, rising groundwater, coastal erosion and inundation.

### Coastal inundation and erosion

Coastal processes can create hazards onshore either by flooding or by wearing away or removing sediment from the coastline.

- Coastal inundation is caused by storm tides and larger than normal waves. A storm tide is the normal tide plus the effects of low air pressure during storms, which temporarily raises the sea-level, plus strong onshore winds pushing more water against the shoreline. This effect is called a storm surge.
- Coastal erosion: Long-term increases in sea-level will worsen both long-term and short-term erosion. This is because a rise in sea-level can cause normal coastal storm processes such as storm surge and wave run-up to reach higher up the beach. This means each storm can cause more erosion than would have occurred if the sea-level had not risen.

### Sea-level rise

Aotearoa New Zealand tide records show an average rise in relative mean sea-level of 1.7 mm per year over the 20<sup>th</sup> century. Globally, the rate of rise has increased, and further rise is expected in the future.

### Coastal hazards

Coastal roads and infrastructure may face increased risk from coastal erosion and inundation, increased storminess and sea-level rise. Sea-level rise and increased storminess will increase the impacts of high tides and storm surge on coastal erosion and flooding. Sea-level rise can also make aquifers near the coast more vulnerable to salt-water intrusion.



### Storms

Future changes in the frequency of storms are likely to be small compared to natural inter-annual variability. Some increase in storm intensity, local wind extremes and thunderstorms is likely to occur. The frequency of ex-tropical cyclones is projected to either decrease or remain unchanged over the 21<sup>st</sup> century. However, when storms do occur, they are likely to be stronger, and to cause more damage as a result of heavy rain and strong winds.

### Flooding

Flooding is a common natural hazard in Aotearoa New Zealand. River flooding will be exacerbated by climate change. Sea-level rise will also increase flood risk.

### Tsunamis

Tsunamis are waves created when earthquakes, landslides or volcanoes displace the ocean floor. Changes in long-term sea-level will have no impact on the occurrence of tsunamis, so will not affect the likelihood of a tsunami occurring. However, increases to sea level could mean that when tsunamis occur their impacts could be greater.

## Session one: Adaptation

### Learning intentions

Ākonga explore the concept of adaptation and investigate how adaptation helps animals and plants to survive in their environments.

### Activity: What is adaptation?

Discuss with ākonga their understanding of adaptation. What does it mean for them and for other animals? Invite them to share examples of when they have needed to adapt in their own lives. Note any similarities such as change of circumstances, change of diet, injury, etc.

Teachers/Kaiako share the concept of adaptation: An adaptation is a characteristic that helps a living thing to survive in its environment. (An 'environment' includes everything living and non-living in the area in which a plant or animal lives.) All living things adapt, even humans. After sharing the definition, teachers and kaiako may want to revisit the discussion and examples shared and ask the ākonga to consider how it applies to them.

Key animal adaptation ideas to share with ākonga:

- An adaptation may be a physical adaptation, such as a change in the way an animal's body works, or in the way it behaves.
- Each adaptation has been produced by evolution, the process by which living things can gradually change over time.
- As an environment changes, animals that cannot adapt die out, leaving those that could adapt to produce offspring. The remaining species are those that could adapt to the new and/or changing environment.

- The climate is an important part of an animal's environment. Whether it is hot, cold, dry, or wet will have an effect on all the creatures that live in a particular place.
- The kind of food growing in an animal's environment is also important, as are the other animals that live there. For example, if there are predators around, the prey animals will have to learn to defend themselves or learn how to escape effectively.

### Activity: Videos on animal adaptation

1. Polar Bear Adaptations: Polar bears are perfectly adapted to live in the Arctic. They have many traits that help them to survive and thrive in some of the coldest places on the planet. This short video by 'Polar Bears International' shares the characteristics that help polar bears survive in the extreme environment of the Arctic. [Watch 'Polar Bear Adaptations' video on YouTube.](#) After the video, discuss with the ākonga the characteristics that have helped the polar bear adapt to its environment.
2. New Zealand Birds: Filmed in 2019, this 9 min video by Nicolas Perrot shows 25 bird species recorded in Aotearoa New Zealand over the course of a year. All these birds are indigenous to Aotearoa New Zealand and many of them are endemic (unique to NZ). [Watch 'New Zealand Birds' video on YouTube.](#) After watching all or some of the video, invite the ākonga to select an Aotearoa New Zealand bird of their choice and research the adaptation characteristics that help it to survive in its environment. A helpful site to visit is the [New Zealand Birds website.](#)



## Session two: Climate change adaptation: design for change

### Learning intentions

Building on their understanding from Session One, ākonga build on their knowledge of adaptation to climate change to further explore how humans, as well as other living things, are beginning to adapt to its impact. This session has a particular focus on coasts and sea level rise.

### What is climate change adaptation?

Building on their understanding of climate change and its impacts, and on adaptation from Session One, invite the ākonga to share their thoughts and ideas on what constitutes climate change adaptation.

Climate change adaptation is the process of adjusting to current or expected climate change and its effects. For humans, adaptation aims to moderate or avoid harm, and to take advantage of opportunities. Within the natural environment, adaptation generally occurs naturally unless humans restrict the capacity of species and ecosystems to adapt.

Discuss some of the impacts of climate change that humans and other living things will need to adapt to, e.g. sea level rise, habitat loss, flooding, droughts, hotter temperatures, extreme weather events. How does this relate to the understanding gained in Session One? How is climate change adaptation the same and how is it different from the general concept of adaptation?

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### Video: Animals and climate change adaptation

With rising temperatures and seas, massive droughts and changing landscapes, it is increasingly important that species can successfully adapt to climate change. For humans, technology can provide a limited range of solutions. But for some plants and animals, adapting to these changes involves the most ancient solution of all: evolution. Erin Eastwood (TED-Ed) explains how animals are adapting to climate change. [!\[\]\(17413706fd4997a1a4bdf85c6864eee1\_img.jpg\) Watch 'Can wildlife adapt to climate change?' on YouTube.](#)

### Activity: Climate change and us: four ways to adapt to sea level rise

#### What you need:

- [Worksheet 1: Four ways to adapt to sea level rise](#)
- scissors
- a pen for each group.

Share with the ākonga that approximately 65% of New Zealanders live within five km of the coast. This means that the sea and coastlines play a significant role in the lives of New Zealanders – socially, economically, culturally and environmentally. Revisiting climate change impacts, ask the ākonga to name one of the more significant impacts that Aotearoa New Zealand and our Pacific Island neighbours are experiencing and/or will experience. (NB: Refer them to sea level rise.)

Using Worksheet 1, share and discuss with the ākonga the four different adaptation options for people: avoid, accommodate, protect, and retreat. Split the class into groups and complete the worksheet exercises. Each group will need a copy of Worksheet 1, scissors and a pen.

The first step is to decide which picture matches the four adaptation options (accommodate, protect, avoid and retreat). Once they are matched up, ask the ākonga to consider one advantage and one disadvantage for each adaptation option. Ask them to think about the cost, the time the option would take to develop, how long it will take to fix the climate change impact, the effects on the natural environment, and the impact on people and other living things. Ask if they have seen an example of each option in their community. What would be the best option or combination of options to use in their school or community and why? For further information to support this activity, refer to the [!\[\]\(b4eeff342f60cc7bcd67d869b4fedca2\_img.jpg\) NIWA website.](#)

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### Activity: Experiment – Sea Level Rise

In this activity from the Science Learning Hub, ākonga build simple models to demonstrate the differing impacts of melting land ice and sea ice on sea level rise. For more details, [!\[\]\(3342c215b2a8b663596a81468d5dc314\_img.jpg\) visit the Science Learning Hub website.](#)

## Session three: Adaptation in practice

### ‘Adaptive Futures’ game (NIWA)

#### Learning intentions

‘Adaptive Futures’ is a ‘serious game’ designed to introduce ākonga to community-level decision-making and climate change adaptation.

#### Activity: ‘Adaptive Futures’ game

The objective of the game is to protect the ‘Seaview’ community from the adverse effects of climate change. The game requires players to carefully balance the wishes of the community with the need to mitigate the immediate and long-term effects of climate change. There are a range of different adaptation strategies available, all of which have benefits and costs. A strategic approach is needed, as selecting some options may constrain the players’ capacity to use other options.

At the end of the game, discuss the strategies each team took, how successful they were, and the reasons for success or otherwise. What were the main difficulties in deciding on the right option? How might they best overcome these difficulties? [!\[\]\(339a16584d5da0f0a3ca4e9ec17bf6a1\_img.jpg\) Connect with the ‘Adaptive Futures’ game.](#)

#### Wellbeing check

 [Student Tip Sheet – Climate change and wellbeing action pages 7-8.](#)



#### Additional resources and activities to support all sessions

**CoastAdapt:** CoastAdapt is an information delivery and decision support framework. Although focused on Australia, it provides some interesting and useful generic infographics about adaptation. For more information, [!\[\]\(c50c8b7b2cc2cf9ff925edec0ee94c0d\_img.jpg\) visit the CoastAdapt website.](#)

**‘Building for the Future’** by Adrienne Jansen, *Connected 2017 Level 3 – Mahi Tahi*. The Samoan village of Sa’anapu is under threat from tsunamis, cyclones, and rising sea levels. To protect their village, the Council of Matai is working with an architect and scientist from New Zealand. Together, they’re drawing on cultural, scientific, and technological knowledge to build a safer future for Sa’anapu. [!\[\]\(6a9b39b98eb945faa14c645ec99e4eaa\_img.jpg\) Read the article ‘Building for the Future’.](#)

**‘Rising Seas’** by Kate Potter, *Connected 2014 Level 3 – Why Is That?* Scientists know that global warming is leading to rising sea levels, but the rate of change and its likely impact are less clear. Scientists investigate what is happening and use the evidence to suggest how we might adapt to the changes. [!\[\]\(9c2e8d1b5bd77cb5c9f83b7a9cff79fd\_img.jpg\) Read the article ‘Rising Seas’.](#)

**‘A day in the life of Justin Cope, Science Advisor, Environment Canterbury’:** The video covers the role of science in understanding climate change, sea level changes, tides and weather and sea level rise. [!\[\]\(e3275251d0893157c3584e20c81dc3ba\_img.jpg\) Watch the video on Vimeo.](#)

**Sea level rise:** What does it mean to live in a country that has so many coastal communities? Using the [!\[\]\(f60b7a900783ac3fd531bfd9c111be6d\_img.jpg\) Coastal Risk Screening Tool Maps website](#) (Climate Central) explore which areas are most at risk from sea level rise in Aotearoa New Zealand. Hint: Zoom in and look for the red areas!

**‘Becoming a climate solver’ (NIWA):** Understanding our choices will help us adapt to a changing climate. Climate change is already affecting communities and livelihoods in Aotearoa New Zealand through increased temperatures, longer droughts and more intense storms. Understanding what is important to everyone helps us make choices about how to adapt to our changing climate in ways that suit the needs of our communities. For more information, [!\[\]\(f1c5da15572e3e09d343161be98f508d\_img.jpg\) visit the NIWA website ‘Becoming a climate solver’.](#)



# WORKSHEET 1: Four ways to adapt to sea level rise



## Instructions

In small groups cut out the **categories** and the **adaptation options** on the next pages and then complete the three tasks below.

1. There are a number of different ways we can adapt to coastal hazards in our communities. In this exercise you will be given a number of different adaptation options, for example – building a sea wall. You will need to decide which of the four categories: **Accommodate**, **Protect**, **Avoid** & **Retreat** these adaptation options match up to.
2. Once you have matched up all the adaptation options to a category, have a go at thinking about one advantage and one disadvantage for each adaptation option. Think about things such as: the cost, the time it would take to do, how long it will be before the solution takes effect, the impact on the environment, the impact on people and anything else you can think of!
3. Have a talk with your group about what adaptation measures could be used around your school or your community to protect against coastal hazards. What would be the best adaptation option/combination of options to use and why?

**Here are a few definitions you might find useful:**

**Exposure** is the presence of people, buildings, infrastructure, ecosystems or places of economic, social or cultural importance in places that could be affected by a hazard. For example a house built very close to an estuary is more exposed to flooding.

**Vulnerability** is the chance of being negatively affected if a hazard event occurs. For example, if a house is raised by 1 metre, the risk of the water getting into the house if a flood happens is much less, reducing its vulnerability.

**Infrastructure** means human-made structures and facilities required for day to day living, such as roads, drains, electricity supply and street lighting, to name a few.

1. Cut out the four coloured boxes. These are your **categories**.



## Accommodate

**Accommodate** actions involve making changes to existing buildings and *infrastructure* to reduce *vulnerability* to the hazard.

## Protect

**Protect** actions aim to reduce vulnerability to a hazard by using hard options (such as sea walls) or soft options (such as dunes and vegetation) to protect the land from the sea.


## Avoid

**Avoid** actions are those we put in place before new development occurs to help prevent new *exposure* to the hazard.

## Retreat

**Retreat** actions aim to reduce exposure to a hazard by removing or relocating buildings and other *infrastructure* away from vulnerable areas in a planned way.



2. Cut out along the dotted line, fold in half. These are your **adaptation options**. 



### Build a stopbank


A stopbank is an embankment built to contain rivers and streams in flood. Stopbanks protect many Aotearoa New Zealand towns, cities and farm land from floodwater damage. An embankment is defined in the dictionary as “a wall or bank of earth or stone”.

- What category does a stopbank match with?
- What is one advantage and one disadvantage of building a stopbank?

ADVANTAGE	DISADVANTAGE





2. Cut out along the dotted line, fold in half. These are your **adaptation options**. 




### Build a seawall

An engineered wall to contain the ocean. Seawalls protect many Aotearoa New Zealand coastal towns and cities from seawater encroachment as a result of sea level rise, storm surges and waves at high tide.

- What category does a seawall match with?
- What is one advantage and one disadvantage of building a seawall?

ADVANTAGE	DISADVANTAGE



2. Cut out along the dotted line, fold in half. These are your **adaptation options**. 



**Beach renourishment**


Beach renourishment is when sand or gravel is added to the beach to replace sand/gravel lost through erosion.

- What category does beach renourishment match with?
- What is one advantage and one disadvantage of beach renourishment?

ADVANTAGE	DISADVANTAGE





2. Cut out along the dotted line, fold in half. These are your **adaptation options**. 




**Maintain and restore habitat**

Maintain and restore habitat e.g. restoring wetlands, planting trees. This can help prevent erosion.

- What category does maintain and restore habitat match with?
- What is one advantage and one disadvantage of maintaining and restoring habitat?

ADVANTAGE	DISADVANTAGE



2. Cut out along the dotted line, fold in half. These are your **adaptation options**. 



### Emergency planning for adverse events


This means developing a response plan and preparedness kit for hazardous events such as storms, floods and other climate change related events such as droughts and wildfires.

- What category does planning for adverse events match with?
- What is one advantage and one disadvantage of planning for adverse events?

ADVANTAGE	DISADVANTAGE





2. Cut out along the dotted line, fold in half. These are your **adaptation options**. 




**Redesign existing homes and infrastructure**

This means adapting existing assets for hazards. This may involve things like raising floor levels to reduce flooding.

- What category does redesigning existing homes and infrastructure match with?
- What is one advantage and one disadvantage of redesigning existing homes and infrastructure?

ADVANTAGE	DISADVANTAGE



2. Cut out along the dotted line, fold in half. These are your **adaptation options**. 



**Managed retreat and relocation**

Moving away from a hazard source permanently to an area with fewer hazards. This may involve moving houses, shops, roads or other infrastructure away from areas that are at high risk from inundation, flood events and erosion.

- What category does managed retreat and relocation match with?
- What is one advantage and one disadvantage of managed retreat and relocation?

ADVANTAGE	DISADVANTAGE