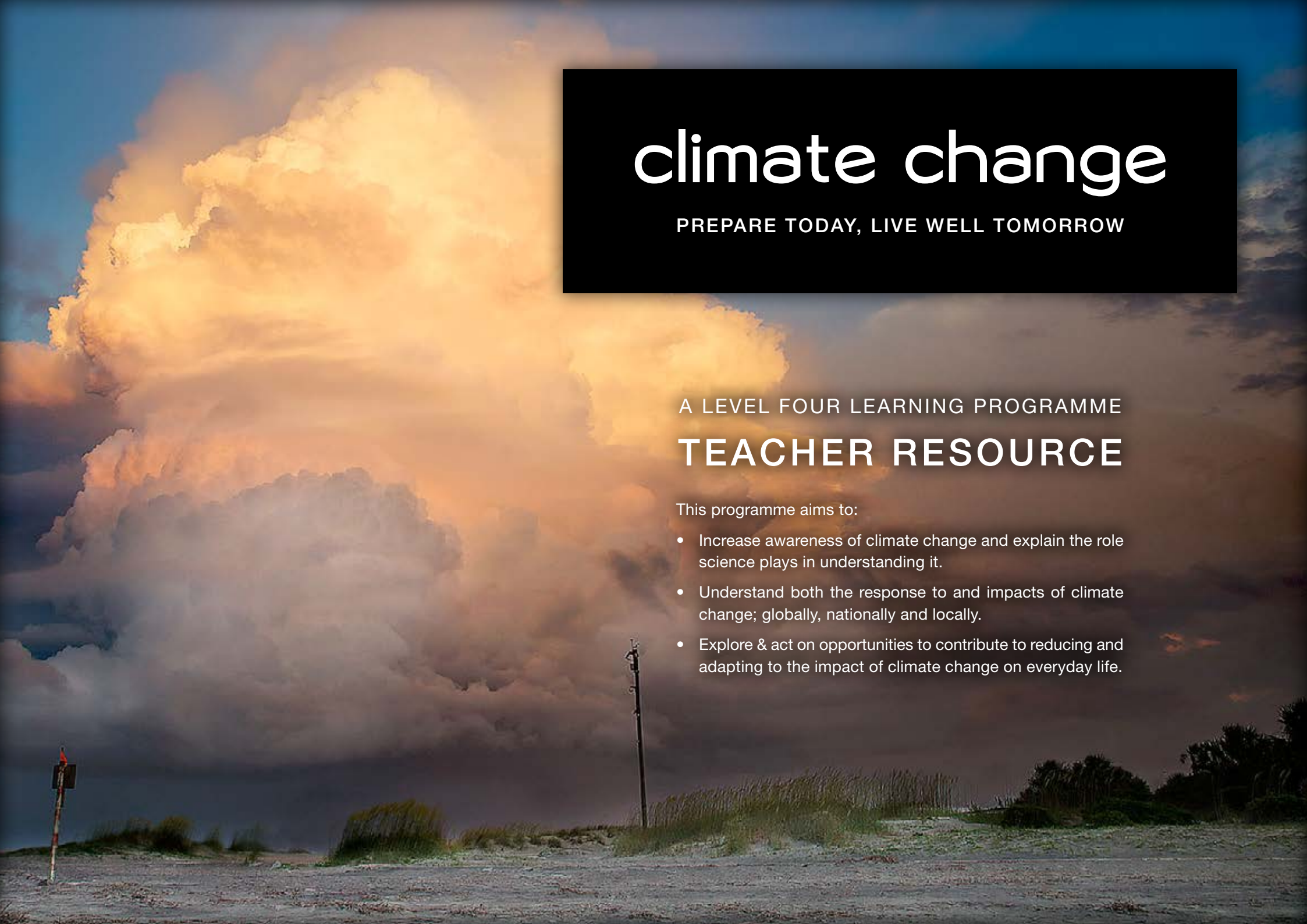

climate change

PREPARE TODAY, LIVE WELL TOMORROW

A LEVEL FOUR LEARNING PROGRAMME

TEACHER RESOURCE

This programme aims to:

- Increase awareness of climate change and explain the role science plays in understanding it.
- Understand both the response to and impacts of climate change; globally, nationally and locally.
- Explore & act on opportunities to contribute to reducing and adapting to the impact of climate change on everyday life.

"If one person can make a difference, imagine more!"

REMY, 11

ACKNOWLEDGEMENTS

Ministry of Education Te Tāhuhu o te Mātauranga for their funding and support for the final programme, including the Wellbeing Guide and videos.

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Finally, we'd like to acknowledge the following organisations for the use of their information and resources in the development of the programme:

Enviro-Mark Solutions Limited, a wholly owned subsidiary of Manaaki-Whenua Landcare Research

Ministry for the Environment **Manatū Mō te Taiao**

National Institute of Water and Atmospheric Research Ltd (NIWA) Taihoro Nukurangi

Ministry of Education **Te Tāhuhu o te Mātauranga** - Te Kete Ipurangi (TKI) ESOL Online

Department of Conservation Te Papa Atawhai

Manaaki Whenua Landcare Research NZ

Christchurch City Council

Coast Adapt

NASA

National Geographic Kids

MetService NZ

Stats NZ

Contents

Programme description

The climate change learning programme is targeted at **level 4** learners.

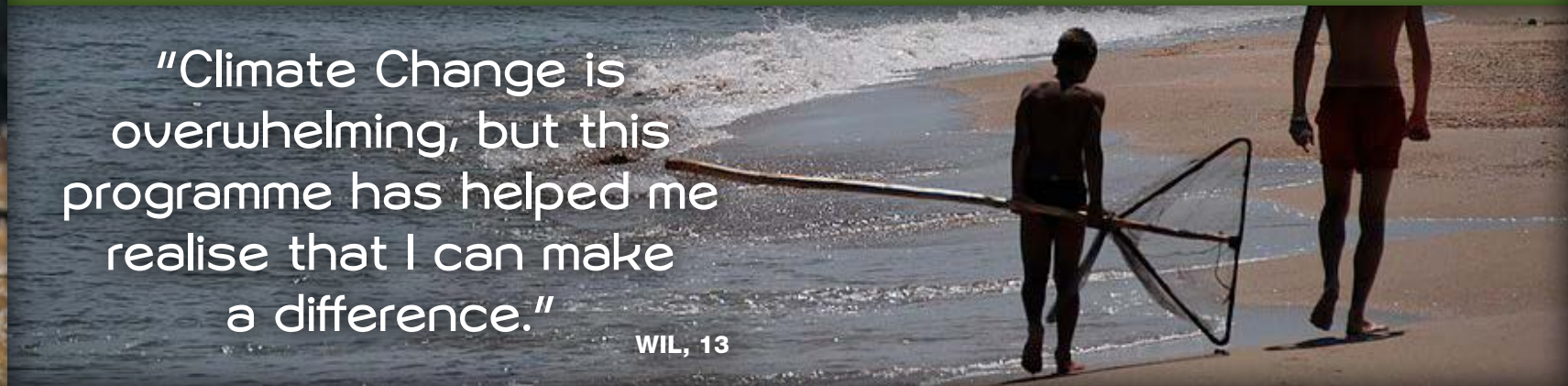
- The programme is divided into three sections and eight learning sessions. Each session is supported by lessons and student activities. Each lesson includes background information, with relevant activities and resources. Each lesson will take 60 - 90 mins, depending on the content and discussion generated.
- Students will have different reactions to learning about climate change and some may have strong emotions and struggle to cope. Therefore, it is important to check in with them on how they are feeling throughout the sessions.
- **Wellbeing activities** are embedded throughout the resource. For further support, background, resources, student worksheets and extension click on the *for the Wellbeing Guide.*
- This programme has **clickable links** throughout *- these are shown in orange.*
- **Lesson 3 and 5 & Session 8 are supported by videos from coastal and climate scientists and a youth ambassador for climate change.** However, you may wish to contact local experts to visit your class during these and other sessions.
- Each lesson will build on the students' prior knowledge and understanding gained from the previous lesson, so it is **important that all sessions are taught in sequence**.
- Most of the lessons run for **approximately 60 - 90 minutes**. However, some may take longer, depending on discussion generated.

The programme works most effectively as part of an inquiry learning programme. Teachers or facilitators using this approach seek to:

- Encourage students to formulate their own questions in a chosen area of study.
- Enable students to research their questions using a variety of methods and contexts.
- Provide opportunities for students to present their learning to their peers, and sometimes to the wider community, in a suitable way.
- Assist students to reflect upon and evaluate what they have learned.
- Generate ideas for further study and/or action based upon their learning.

This last point - **action** - is central to the approach of the climate change learning programme. The programme's **ultimate aim is for your students to create and implement their own plan to take action for climate change, in order to feel empowered and not overwhelmed by the issues**.

The action-inquiry method is the basis of Education for Sustainability, which seeks to engage students in contemporary environmental issues and to meet the challenges of living sustainably and reducing the impact of climate change.



Structure of the learning programme

The programme is divided into **three sections** and eight **learning sessions**. Each session is supported by **lessons and student activities**.
Each lesson includes background information, with relevant activities and resources. Each lesson will take **60 - 90 mins**, depending on the content and discussion generated.

LEARNING SESSIONS & TEACHER INFORMATION	LESSONS	STUDENT ACTVITIES
SECTION A: Tuning in - Exploring knowledge & understanding of Climate Change		
SESSION 1: Climate & weather	**LESSON 1:** Climate & weather	**Activity 1:** Understanding weather & climate **Activity 2:** Compare and contrast: Weather & climate
SESSION 2: What is Climate Change? What is the enhanced greenhouse gas effect?	**LESSON 2:** Climate Change & the greenhouse effect	**Activity 1:** What do you think? Getting to know the greenhouse effect - up close & personal **Activity 2:** Experiment - Observe the greenhouse effect **Activity 3:** Meet the greenhouse gases **Activity 4:** The Feelings Splash: How does this make us feel?
SESSION 3: Climate Change & the role of science	**LESSON 3:** Climate Change & the role of science	**Activity 1:** Video - A day in the life of a scientist: Annette Bolton, Senior Scientist, Institute of Environmental Science & Research Ltd (ESR) **Activity 2:** Experiment - Temperature, salinity & water density **Activity 3:** Feelings Thermometer. Can we measure our feelings?
SESSION 4: What could climate change look & feel like - globally, nationally, & regionally?	**LESSON 4:** What could Climate Change look & feel like?	**Activity 1:** What could happen to New Zealand's climate in the future? **Activity 2:** Regional snapshot: Calling for action in Thames - Coromandel **Activity 3:** What is happening around the world? **Activity 4:** Understanding our feelings about Climate Change.
SESSON 5: How will Climate Change affect us?	**LESSON 5:** How will Climate Change impact on our coast & your place?	**Activity 1:** Video - A day in the life Justin Cope, Natural Hazards Scientist, Environment Canterbury **Activity 2:** Living here and climate change **Activity 3**: Adaptation and mitigation – what does it mean and what does it look like? **Activity 4:** Introducing 'Psychological adaptation': Wellbeing action - what can I do?
SECTION B: Investigation - Living with Climate Change		
SESSION 6: Living with Climate Change - adaptation & mitigation - What can we do?	**LESSON 6:** Living with Climate Change - what can I do?	**Activity 1:** Video - Greta Thunberg **Activity 2:** Acting up for Climate Change **Activity 3:** What we will do - making a commitment
SESSION 7: Climate Change communication - having meaningful conversations and addressing scepticism.	**LESSON 7:** Climate Change conversations - the good, the hard & the respectful	**Activity 1:** Empathy/Outrage + Action = ACTIVISM **Activity 2:** Communication is key
SECTION C: It's not too late - Time for CLIMATE action!		
SESSIONS 8 & beyond: It's not too late to act - adaptation & mitigation - taking action for Climate Change.	**INSPIRATON & HOPE**	**Activity 1:** Video - A local inspiration: Lucy Gray **Activity 2:** Refining our ideas **Activity 3:** Video - NZ schools strike for Climate Change

Section A: Tuning in

Exploring knowledge & understanding of Climate Change

SPECIFIC LEARNING INTENTIONS

Develop an understanding of climate and weather - global, national and local.

Demonstrate a growing knowledge and understanding of climate change with a specific focus on greenhouse gases to explain the causes of climate change.

Explore the role of science in understanding and preparing for climate change.

Learn about anthropogenic or human activity as the main cause of an enhanced greenhouse effect.

Understand and apply knowledge about climate change and its impacts nationally and locally.

SUCCESS CRITERIA

I can:

- Describe the difference between weather and climate.
- Describe the different climate zones in New Zealand and how and why each are different.
- Define climate change, understand why it's happening and how will it affect the climate.
- Explain the greenhouse effect (including the enhanced greenhouse effect), and its role in climate change.
- Identify and understand the role of science in learning about, managing, and preparing for climate change.
- Identify how climate change might look and feel where I live.

Introduction

As an island country, we often experience four seasons in one day. The weather isn't just a polite topic of conversation - it has real impact and interest for us. Increasingly, the topic of climate change and its impact on the weather - and our lives - is becoming part of that conversation. We hear discussions in our families, our communities, and in the media, and are regularly encouraged to, **"take action for climate change!"**

This creates many questions. What is climate change? Why is it happening? How do we learn more about its implications - global, national and in our own backyards? And perhaps the biggest question of all - how do we prepare for, manage and adapt to its impact?

SESSION 1

Climate & weather

BACKGROUND INFORMATION FOR TEACHERS

To get to grips with climate change and its effects, it's important to understand the difference between **climate** and **weather**.

When we talk about **weather**, we are talking about **day-to-day conditions** – sunny, windy, cloudy, rainy, snowy, and so on. For example, a rainstorm can quickly turn into flooding over just a day or two.

Climate, on the other hand, is more than just a few warm, wet, or cool days. Climate describes the **typical weather conditions** over a long period of time, i.e. 30 years or more for a country, region, and/or town.

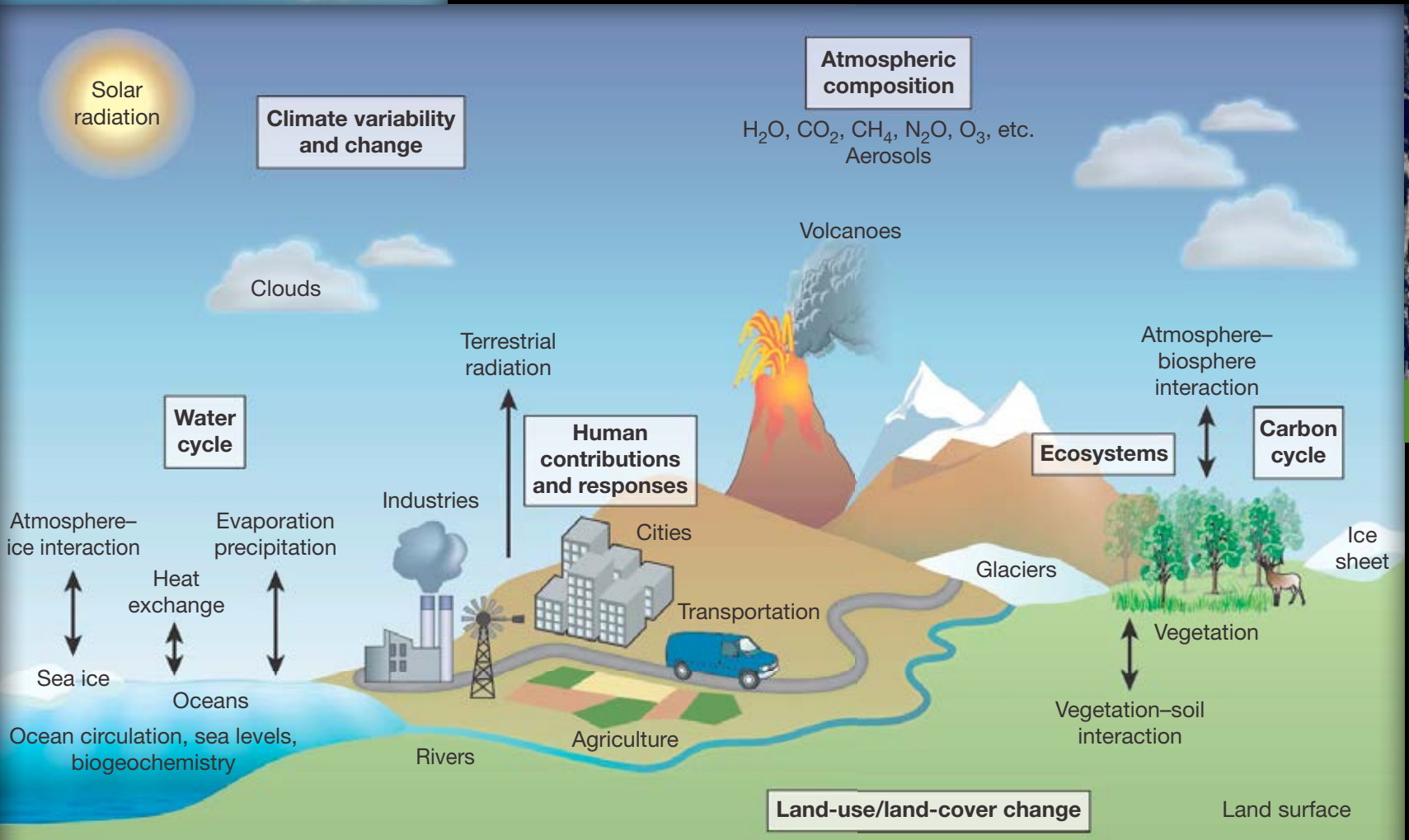


Figure 1: Major natural & anthropogenic (human activity) processes & influences on the climate system addressed in scenarios. SOURCE: NATURE, MOSS ET AL. 2010

Earth's climate system

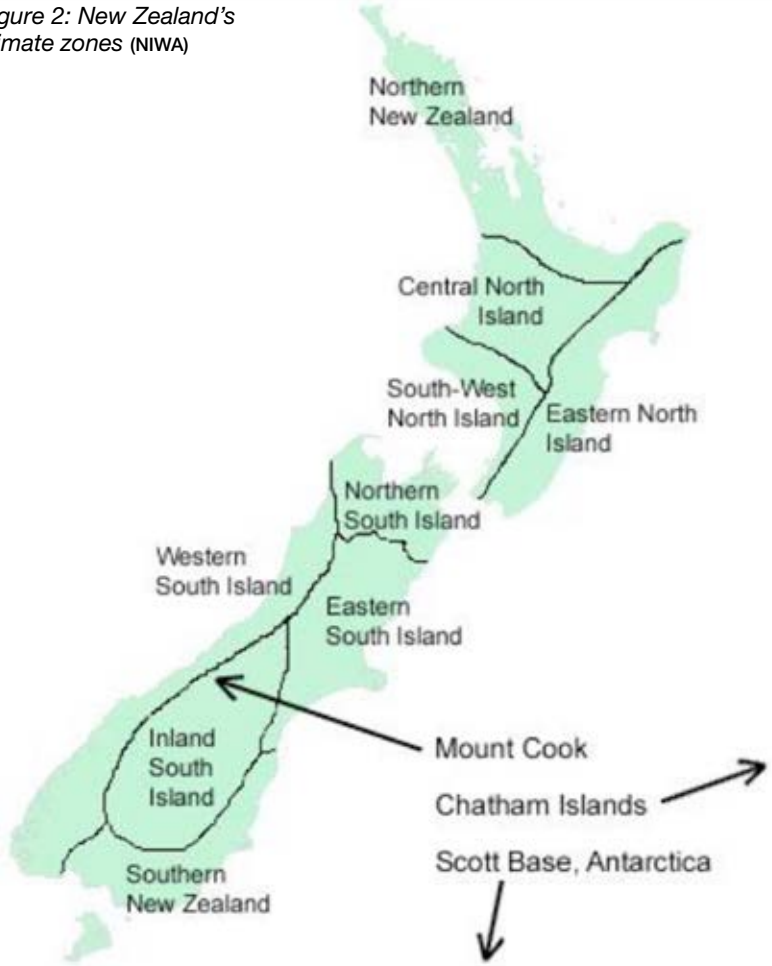
The Earth's climate results from interactions between many processes including the **hydrosphere** - oceans and atmospheric and terrestrial (land dwelling) water, the **cryosphere** (ice and snow), the **biosphere** (animals and plants), the **pedosphere** (soil), and the **lithosphere** (the Earth's crust and upper mantle). Natural and **anthropogenic** (human) activities and impacts can change the Earth's climate (Figure 1).

New Zealand's climate

The National Institute of Water and Atmospheric Research (NIWA) describes New Zealand's typical weather conditions as complex and variable - from warm subtropical in the far north, to cool temperate climates in the far south, with severe alpine conditions in the mountainous areas. Mountain chains extending the length of New Zealand provide a barrier for the prevailing westerly winds and divide the country into dramatically different climate regions. The West Coast of the South Island is the wettest area of New Zealand, whereas the area to the east of the mountains, just over 100 km away, is the driest. Our mean annual temperatures range from 10°C in the south to 16°C in the north.

Because of the variation in New Zealand's climate, NIWA has grouped selected locations into broad climate zones (Figure 2).

Figure 2: New Zealand's climate zones (NIWA)



REGIONAL SNAP SHOT

The climate in Christchurch

Christchurch is part of the Eastern South Island zone. It is greatly dependent on the lie of the massive Southern Alps to the west. Summers are warm, with highest temperatures occurring when hot dry northwesterlies blow over the Alps and plains. The average summer daytime temperatures range from 18°C to 26°C but may rise above 30°C. Christchurch is considered dry, with a low annual rainfall, and is prone to long dry spells, especially in summer. Winters are cold with frequent frost, with typical winter daytime maximum temperatures ranging from 7°C to 14°C.

Don't live in Christchurch?
Find your climate zone:
New Zealand's climate zones

What you will need

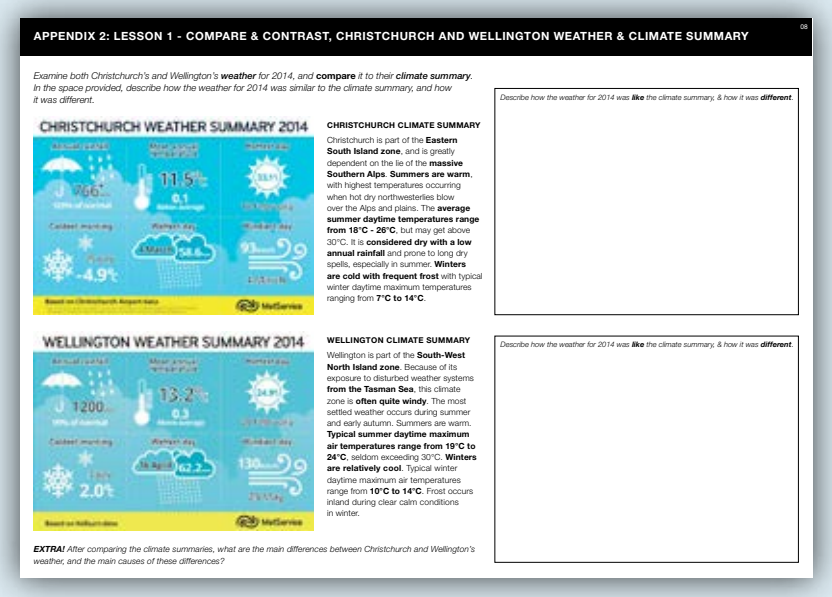
- Access to Wi-Fi, Smart TV or lap-top and projector.
- Topic book to record thoughts and information.
- ***Appendix 2: Lesson 1:*** Compare & contrast weather summaries - one per student ***OR*** to save paper, project it onto your smart TVs, and ask children to write their answers in their workbooks.

ACTIVITY 1 Understanding weather & climate

Watch the video clip about **weather and climate**:
What is the difference between climate and weather? *(2min)* **SOURCE: NASA**

Ask the children to reflect on the video clip and write down the **main points of difference between weather and climate in their workbooks.**

The students share their thoughts with a partner/group/ the class.



APPENDIX 2: LESSON 1 - COMPARE & CONTRAST, CHRISTCHURCH AND WELLINGTON WEATHER & CLIMATE SUMMARY

08

Examine both Christchurch's and Wellington's ***weather*** *for 2014, and* ***compare*** *it to their* ***climate summary****. In the space provided, describe how the weather for 2014 was similar to the climate summary, and how it was different.*

CHRISTCHURCH WEATHER SUMMARY 2014

CHRISTCHURCH CLIMATE SUMMARY

Christchurch is part of the **Eastern South Island zone**, and is greatly dependent on the lie of the **massive Southern Alps**. **Summers are warm**, with highest temperatures occurring when hot dry northwesterlies blow over the Alps and plains. The **average summer daytime temperatures range from 18°C - 26°C**, but may get above 30°C. It is **considered dry with a low annual rainfall** and prone to long dry spells, especially in summer. **Winters are cold with frequent frost** with typical winter daytime maximum temperatures ranging from **7°C to 14°C**.

Describe how the weather for 2014 was ***like*** *the climate summary, & how it was* ***different****.*

WELLINGTON WEATHER SUMMARY 2014

WELLINGTON CLIMATE SUMMARY

Wellington is part of the **South-West North Island zone**. Because of its exposure to disturbed weather systems **from the Tasman Sea**, this climate zone is **often quite windy**. The most settled weather occurs during summer and early autumn. Summers are warm. **Typical summer daytime maximum air temperatures range from 19°C to 24°C**, seldom exceeding 30°C. **Winters are relatively cool**. Typical winter daytime maximum air temperatures range from **10°C to 14°C**. Frost occurs inland during clear calm conditions in winter.

Describe how the weather for 2014 was ***like*** *the climate summary, & how it was* ***different****.*

EXTRA! *After comparing the climate summaries, what are the main differences between Christchurch and Wellington's weather, and the main causes of these differences?*

ACTIVITY 2 Compare & contrast – weather and climate

The aim of this activity is to emphasise the relationship between where you live and the climate you experience.

The direction of this activity will depend on where you live. For a quick understanding of how where you live effects the climate and weather you experience, refer to the activity below and ***Appendix 2***. However, if you want to relate the activity to your specific location, please refer to ***'Looking back at the weather for 2014'*** and New Zealand's broad ***climate zones***.

Description of activity

Hand out 'Appendix 2: Lesson 1: Compare & contrast Christchurch and Wellington weather and climate summary', one per student OR to save paper, project it onto your smart TVs, and ask children to write their answers in their workbooks.

Ask the students to examine both Christchurch's and Wellington's weather for 2014 and compare it to the climate summary. In the space provided below each, describe how the weather for 2014 was like the climate summary and how it was different.

SESSION 2

What is Climate Change?

BACKGROUND INFORMATION FOR TEACHERS

Imagine you are staying in a hut up in the mountains during winter. It's freezing, so you build yourself a huge fire and pile on all the wood you can find. To start with, the fire seems a great idea – especially since it's so cold outside. The hut warms up slowly, but predictably, and it's soon pretty cozy. Since the hut is much warmer than the atmosphere and ground that surround it, it loses heat quite quickly. If the fire supplies heat at the same rate as the hut loses it, the hut stays at roughly the same temperature. But if you make the fire too big, the hut will get hotter... and hotter... and hotter! Before long, you'll start feeling uncomfortable. You might wish you'd never made the fire so big in the first place. But once it's burning, there's nothing you can do to stop it. The hut will keep getting hotter long after you stop piling wood on the fire.

Climate change is a bit like what happened in the hut. Put simply, it is the process of our planet gradually heating up. It may not seem to be warming up noticeably - at least not in the short term. In fact, since 1900, the whole planet has warmed up by an average of 1°C. This might not seem like a lot when you think about everyday temperatures, but even small changes in the average global temperatures will have big effects on the Earth's climate system.

By the end of the 21st century, however, global warming is likely to cause an increase in Earth's temperature of around 2 - 5°C. This increase may lead to some of the major natural processes on Earth slowing down or even stopping. This is known as a **tipping point** and it's something that humans may not be able to reverse once it is reached.

Climate change describes how the average weather patterns and their extremes over the world - including New Zealand - will change from their current state. As temperatures rise, some areas will have more extreme weather more often, some will get wetter, some drier, and lots of animal species - including humans - could find they're not able to adapt to their changing climate.

The change in climate is caused by the release of **greenhouse gases**.

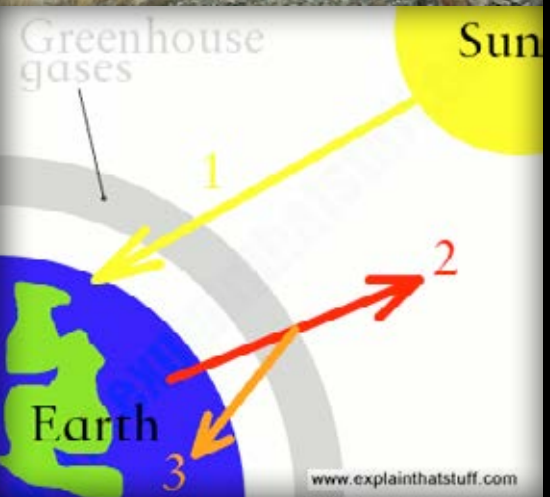


Figure 3: The Greenhouse Effect

1) *When the Sun's radiation enters our atmosphere, it heats our planet.*
2) *Like all hot objects, Earth gives off some of its heat as radiation of its own. Some of this radiation passes straight through the atmosphere and disappears off into space.*
3) *However, some is reflected back again by the "blanket" of greenhouse gases in the atmosphere. The more greenhouse gases there are, the more heat is trapped, and the hotter Earth becomes.*

SOURCE: WWW.EXPLAINTHATSTUFF.COM

TIPPING POINT

Like the game show on TV, when there are enough discs stacked on the edge of the shelf, one small shove and the whole pile spills over. When relating the 'tipping point' concept to climate change, an increase in temperature may also cause 'spill overs'. For example, the world's five major ocean currents essential for shifting and mixing warm and cold water and play a big part in the climate around the world, may slow down or even stop doing what they're doing.

Greenhouse gases

Climate change is caused by a phenomenon known as the **greenhouse effect**. A greenhouse (or glasshouse) is good for growing things because it **traps heat inside and stays hotter than the atmosphere around it**.

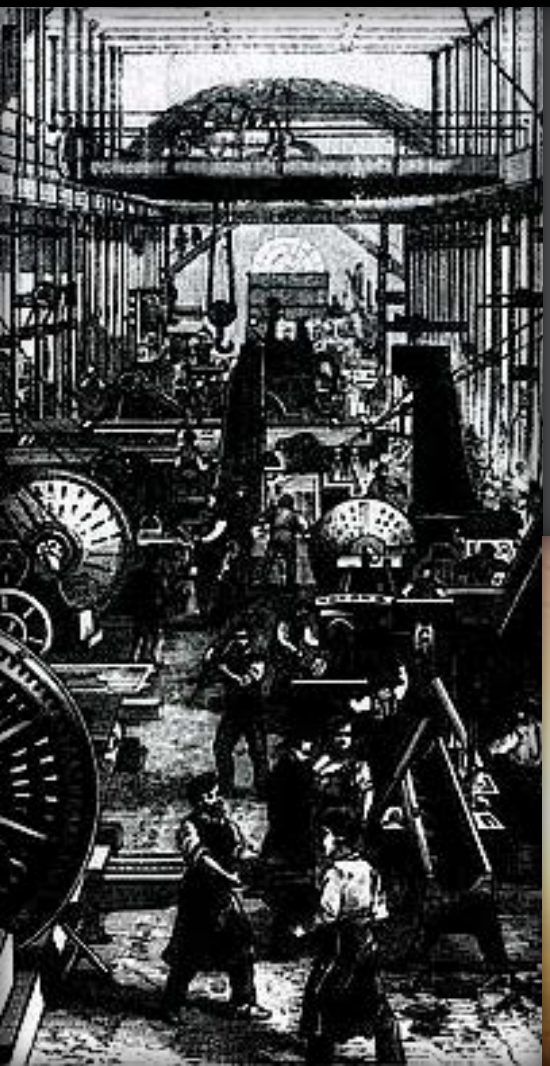
The natural greenhouse effect

Earth's atmosphere behaves like a gigantic greenhouse, though it traps heat a different way.

Earth's atmosphere is made up of **oxygen**, a large amount of **nitrogen** and a **small percentage of greenhouse gases**, such as **carbon dioxide** and **methane**.

Greenhouse gases act **like a blanket around the Earth**. They trap warmth from the sun and make life on Earth possible. Without them, too much heat would escape, and the surface of the planet would freeze. However, increasing the concentration of greenhouse gases in the atmosphere causes the Earth to heat more and the climate to change.

Burning fossil fuels such as oil, gas and coal give off carbon dioxide, which increases the greenhouse effect and heats the planet. This is often described as an anthropogenic process, which simply means that humans caused it.



The Industrial Revolution was a period that saw major changes in the way products are made. It began more than two hundred years ago and greatly affected the way people lived as well as the way they worked. In the earlier days, people made products by hand. They worked mostly in their own home or in small workshops. During the Industrial Revolution, many factories were built. Labourers began making large numbers of things using machines powered by engines.

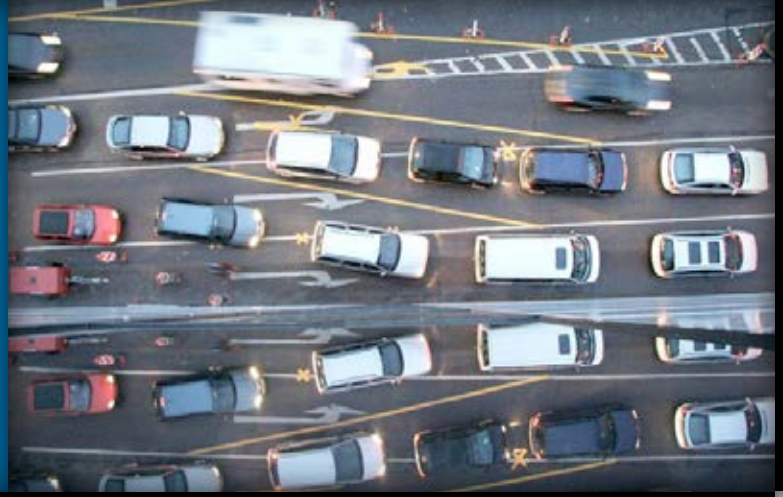
The enhanced greenhouse effect

The greenhouse effect would be nothing to worry about, were it not for one important thing - the **Industrial Revolution**. The Industrial Revolution, which began in the 1700s, resulted in an **increase in the concentration of carbon dioxide (CO2)** in the atmosphere.

Most of the energy people use is made by burning **fossil fuels** - formed in the earth from plant or animal remains. This produces huge clouds of carbon dioxide. The carbon dioxide drifts up into the atmosphere and makes Earth's greenhouse gas just a little thicker. As a result, more of the Sun's heat gets trapped inside the atmosphere and the planet warms up, resulting in the **enhanced greenhouse effect**. The magnitude of the enhanced greenhouse effect is influenced by various complex interactions in the earth-ocean-atmosphere system.

The important greenhouse gases that are directly influenced by human activities are **carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), chlorofluorocarbons (CFCs) and ozone**. Water vapour is also an important greenhouse gas.

Invented in the mid-19th century, car engines work by burning petrol with oxygen from the air to make heat in a chemical reaction called combustion. As a by-product, combustion gives off (or "emits") invisible carbon dioxide gas.



Cause & effect

Anthropogenic or human activity is the main cause of an enhanced greenhouse effect. Human actions - such as progressively **burning fossil fuels** over the past 150 years - have released gases into the atmosphere, thickening the greenhouse gas 'blanket' - a thickening we don't need or want!

Other anthropogenic causes include **deforestation** - because living trees absorb and store carbon dioxide - and **increasingly intensive agriculture** - which generates greenhouse gases like methane and nitrous oxide.

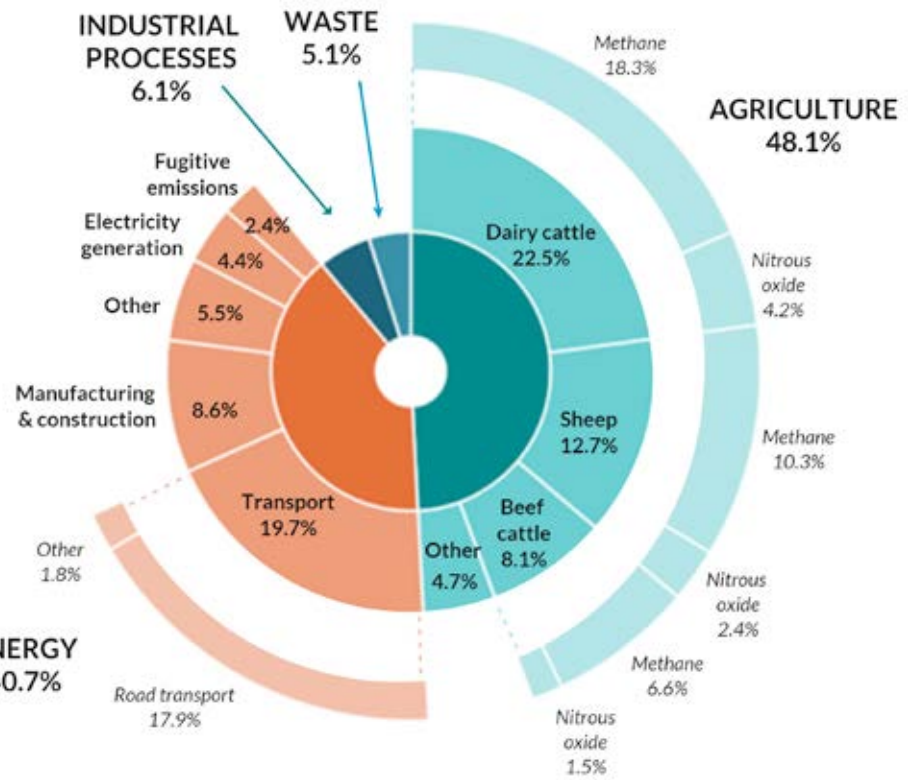
Did you know...?

New Zealand makes a small contribution to global greenhouse gas emissions, yet has one of the highest per-person rates of emissions for an industrialised country. Most of our emissions come from **livestock** and **road transport**. In 2015, New Zealand emitted **17.5 tonnes of carbon dioxide** equivalent greenhouse gases per person - higher than all but five of the 43 industrialised countries signed up to the United Nations Climate Change Convention (known as Annex I countries). This is partly due to the large proportion of methane and nitrous oxide from agriculture, which has warmed the atmosphere more strongly than carbon dioxide, and increased the per-person CO2-equivalent greenhouse gas emissions. Road vehicles are the main source of CO2 emissions. New Zealand has the highest rate of car ownership in the OECD, and the cars are old compared to other countries. New Zealand's larger cities tend to have high levels of black carbon (soot), one of the most important contributors to global warming.

SOURCE: ENVIRONMENT AOTEAROA 2019 (MINISTRY FOR THE ENVIRONMENT AND STATS NZ)

NEW ZEALAND'S Greenhouse Gas Emissions

SOURCE: New Zealand's Greenhouse Gas Inventory 1990-2017, published April 2019



Note: Percentages in the graph may not add up to 100 due to rounding.

Fugitive emissions are from the leakage, burning and controlled release of gases in oil and gas operations as well as escaping gases from coal mining and geothermal operations. Agricultural methane is mainly from livestock digestive systems and nitrous oxide is mainly from manure on soil.

ACTIVITY 1 What do you think?

Getting to know the greenhouse effect – up close & personal

Discussion on **climate change**: What is it? Why is it is happening? What will it look like? What can we do?

Record on a large piece of paper.

CLIMATE RECAP

Climate is more than just a few warm, wet or cool days. Climate describes the typical weather conditions over a long period of time i.e. 30 years or more for a country, region, and/or town.

ACTIVITY 2 Observe the greenhouse effect

Conduct this 15min experiment: **Observe the 'Greenhouse Effect in a Jar'** with your class**.**

What you will need

- Two thermometers.
- A notebook.
- Pencil or pen.
- A clear container, such as a jar.
- Watch or clock.
- A sunny area, either outside or inside.

Method

- Lay the thermometers in direct sunlight. Let them sit in the sun for three minutes.
- Open up a page of the notebook and draw two columns, one labelled "Thermometer A", and one labelled "Thermometer B."
- After three minutes has passed, read and record the time and thermometer temperatures in the notebook.
- Place one of the thermometers in the jar or container and seal. Make sure the lid doesn't cast a shadow on either thermometer!
- Record the temperature of the thermometers every minute for ten minutes.
- Discuss how the container affected the temperature of the thermometers. How did the temperature inside the container change compared to outside the container?

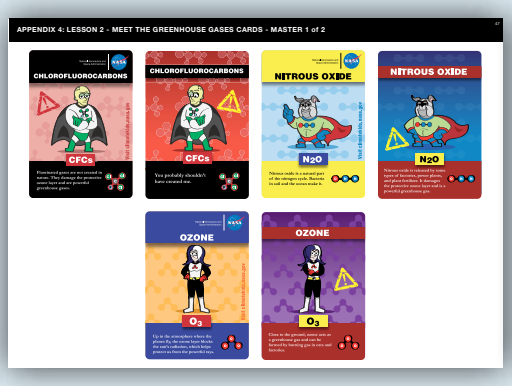
Please note: *'Greenhouse Effect in a Jar'* ***adapted with permission from*** *The Franklin Institute Resources for Science Learning.*

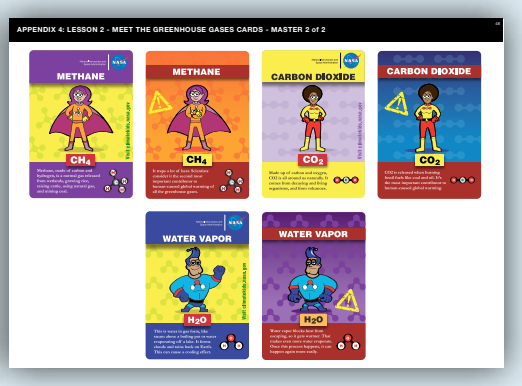
Discuss the results of the experiment

What's Going On? The thermometer outside of the container is being exposed to air that is constantly changing temperature, as the warm air mixes with passing cooler air. The air inside the container is trapped and can't mix with the cooler surrounding air - it just gets warmer as the sunlight heats it up. A greenhouse works in a similar way: solar energy in the form of light creates thermal energy, or heat, that can't escape through the glass. This activity mirrors how a greenhouse works, but it's not the same as the greenhouse effect that is taking place in the Earth's atmosphere. A complex interaction between light, heat, and chemicals make up the greenhouse effect, and the chemicals known as "greenhouse gases", in the environment. They cause the temperature of the Earth to be warmer than it would be without them, much like the glass in a greenhouse, or the jar in this activity.

Video: *Understanding the causes of climate change (1min 30secs)*

SOURCE: ABC AUSTRALIA





ACTIVITY 3 'Meet the Greenhouse Gases'

What you need

- *Appendix 3: NASA 'Meet the Greenhouse gases' cards*
  NB: Each greenhouse gas has a 'good side' and a 'bad side'.
  These need to be cut out and stapled together, with a total of six pairs.
- Six groups.
- Optional: Large piece of paper, glue and a marker pen for recording.

Divide the group into six smaller groups, and ask each to choose a leader.

Holding the six pairs so the children can't see them, ask the leader of each group to come up and select a pair, explaining they are to keep the greenhouse gas to themselves.

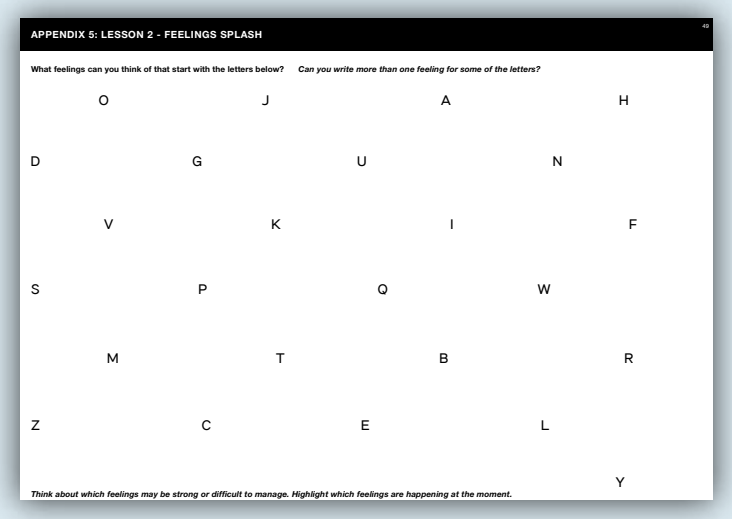
Explain to the groups that they have 10 mins to create a 1 - 2 min presentation, with the aim of teaching the rest of the class about the good and the bad side of their greenhouse gas. Explain they can use various forms of expression to get the main points across. This could include props, acting, presenting, dance etc. The only thing they can't do is read directly from their card!

At the end of each presentation, the presenting group asks the rest of the groups what they've learned about the greenhouse gas under discussion. Responses can be recorded on a large piece of paper, along with the cards to refer to later, in their books etc.

The group that gets most of their key points known becomes the greenhouse gurus!

EXTRA: The cards can be used in a variety of ways – charades, card games such as snap and the memory game, debates (between the good and the bad!)... The children can also come up with their own uses!

Video: *A year in the life of CO2 (3mins)* **SOURCE: NASA (VIA YOUTUBE)**



ACTIVITY 4 The Feelings Splash: How does this make us feel?

What you need

- *Appendix 4: Feelings Splash tip sheet*

Explain that we all respond to information, events and challenging situations differently. Introduce key messages: Everyone has feelings (emotions) and all feelings are important and okay.

A Feelings Splash is a good way to identify and reflect upon feelings. To create a 'Feelings Splash' for the class use one of the following ideas or a previous tool you've used in the classroom to identify names of feelings.

Show or create a poster with images of people's faces expressing a variety of emotions, e.g. anger, sadness, happiness, frustration, and fear.

Show or create a poster with words with the names of various emotions.

Provide students with *Feelings Splash Tip Sheet* and spend a few minutes reflecting on reactions so far about the climate change sessions. Then ask if any students would like to share their reflections with the group. When the children are talking, listen, show empathy, and reinforce the key messages.

Understanding Emotions

KEY MESSAGES

Everyone has feelings
Feelings are important
All feelings are OK

Climate Change & the role of science

BACKGROUND INFORMATION FOR TEACHERS

How do we know? It is all in the science!

Like a lot of things that we can take for granted - medical, technical and environmental advances - **science** is also behind our understanding of climate change, its causes, and the potential short, medium, and long-term effects.

Climate scientists agree that humanity is responsible for the vast majority of the enhanced greenhouse effect

The **Intergovernmental Panel on Climate Change** (IPCC), the United Nations Environment Program's climate body, has said for over a decade that there is "unequivocal" evidence that the planet is warming, and that the temperature increase is "very likely" due to human-made greenhouse gas emissions. The IPCC does not carry out research itself but bases its assessment on peer reviewed and published technical information.

The Panel is made up of 2500+ scientific expert reviewers, 800+ contributing authors, and 450+ lead authors from 130+ countries. New Zealand participates actively in the IPCC. University and Crown Research Institute scientists contributed as authors and reviewers of the Fourth and Fifth Assessment Reports, and various Special Reports and Methodological Guidelines.

Observe, measure, monitor

Scientists monitor the Earth's climate in various ways. The evidence that they have gathered shows that climate change is occurring. For example, there is a lot of evidence that tells us the average temperatures of the world's atmosphere and oceans have increased over the past 150 years.

The evidence includes:

- direct temperature measurements on land.
- changes in the dates when lakes and rivers freeze and their ice melts.
- a reduction in the amount and area of snow cover in the Northern Hemisphere.
- a reduction in glaciers.
- extended growing seasons of plants.
- changes in the heat stored in the ocean.
- changes in rainfall patterns, resulting in more floods, droughts and intense rain.

Several biological changes have also been observed, e.g. shifts in the ranges of some plant and animal species, earlier timing of spring events such as leaf-unfolding, bird migration and egg-laying for some species. Together, these indicators provide clear evidence that the climate is changing.

MĀTAURANGA MĀORI & SCIENCE

Mātauranga Māori is a modern term for the combined knowledge of Polynesian ancestors and the experiences of Māori living in the environment of Aotearoa. The term takes many forms, such as language (te reo), education (mātauranga), traditional environmental knowledge (taonga tuku iho, mātauranga o te taiao), traditional knowledge of cultural practice, such as healing and medicines (rongoā), fishing (hī ika) and cultivation (mahinga kai).

Mātauranga Māori is a knowledge base in its own right. It is Māori knowledge, including values and culture. It is different from modern science. Mātauranga Māori belongs to iwi and should remain under Māori control. Mātauranga Māori is taonga (a treasure) and as such should be protected.

Scientists are recognising the value of Māori knowledge, particularly that concerned with the natural world and ecology. Collaboration with hapū and iwi is becoming an important part of environmental science as we all endeavour to make our environment sustainable.

SOURCE: Science Learning Hub Pokapū Akoranga Pūtaiao

DID YOU KNOW?

New Zealand is measuring all the greenhouse gases in the atmosphere. The longest running measurements taken in the Southern Hemisphere are made at Baring Head, New Zealand.

The increase in greenhouse gases is very different to the past. From observing CO2 trapped in ice from hundreds of thousands of years ago, and, more recently, looking at changes in sea surface temperature over the last 1000 years, we have noticed that there have been changes.

LESSON 3: CLIMATE CHANGE & THE ROLE OF SCIENCE

What you will need

- Access to Wi-Fi, Smart TV or lap-top and projector.
- *Link to video: A day in the life of a scientist - Annette Bolton, Senior Scientist*

And for the experiment 'Temperature, salinity and water density'

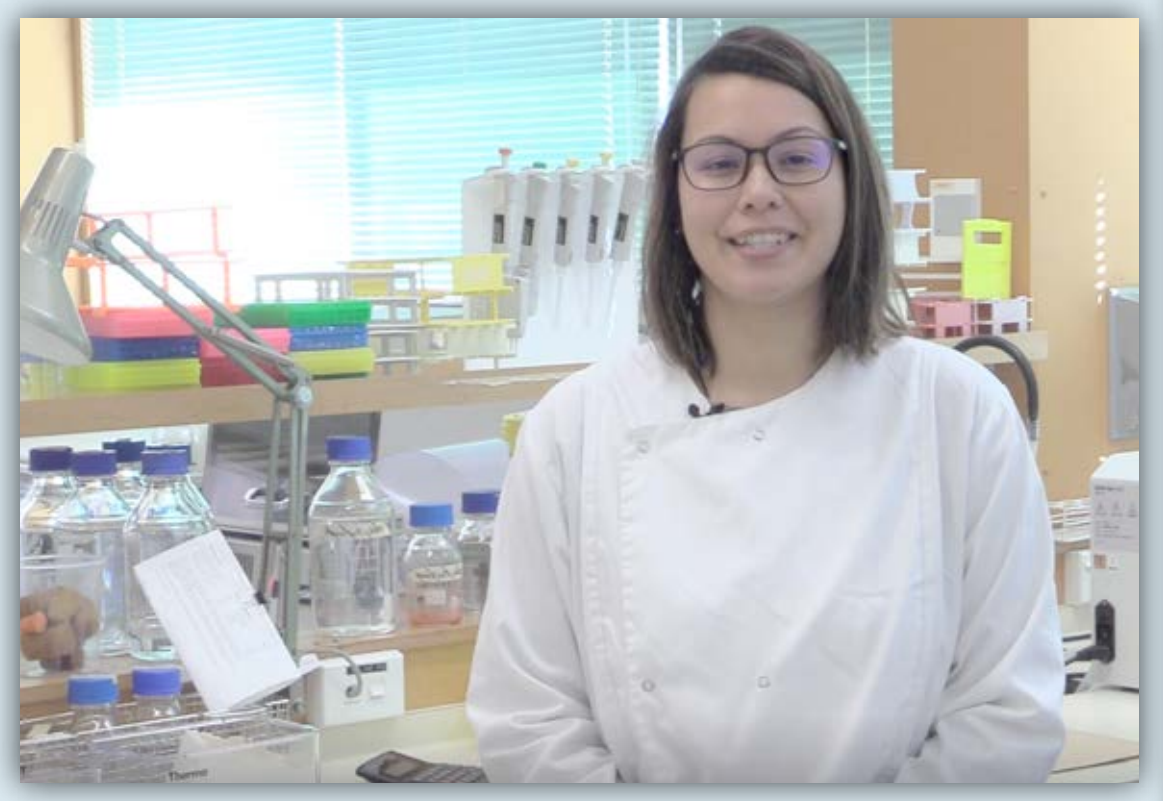
- 2 glasses - one labelled 'freshwater' and the other 'saltwater'.
- 2 large ice cubes, made with fresh (tap) water and a few drops of food colouring.
- Fresh (tap) water at room temperature.
- Salt water at room temperature (approximately 7 teaspoons of salt added to 1 litre of tap water).
- Camera or other recording device.

ACTIVITY 1 Video: A day in the life of a scientist

ANNETTE BOLTON, SENIOR SCIENTIST
Institute of Environmental Science and Research Ltd (ESR)

The 17 minute video will cover:

- The role of science in understanding climate change.
- 'A day in the life of Annette Bolton, Senior Scientist, Institute of Environmental Science and Research Ltd (ESR)'.
- Causes of climate change and how that it is measured, with a specific focus on CO2.
- Where does the heat and CO2 go?
- The importance of the oceans in stabilizing our climate (ocean conveyor, carbon sink, ocean acidification, heat movement, polar ice caps).
- What does it mean? What are the scenarios?
- What can we do? Create your future.
- Experiment: Temperature, salinity and water density (following page).



ACTIVITY 2 Experiment – Temperature, salinity & water density

In this activity, students investigate the impact of temperature and salinity on water density.

Equipment required

- 2 glasses - one labelled 'freshwater' and the other 'saltwater'.
- 2 large ice cubes, made with fresh (tap) water and a few drops of food colouring.
- Fresh (tap) water at room temperature.
- Salt water at room temperature (approximately 7 teaspoons of salt added to 1 litre of tap water).
- Camera or other recording device.

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

- describe how temperature affects water density.
- describe how salinity affects water density.
- offer simple explanations of how climate change may impact the oceans' chemical and physical properties.

Method

1. Label one glass 'freshwater' and the other 'saltwater' and add equal amounts of water to the appropriate glasses.
2. Place an ice cube in each glass.
3. Observe, photograph and discuss what is happening in each glass at regular intervals.

Extension questions on next page...

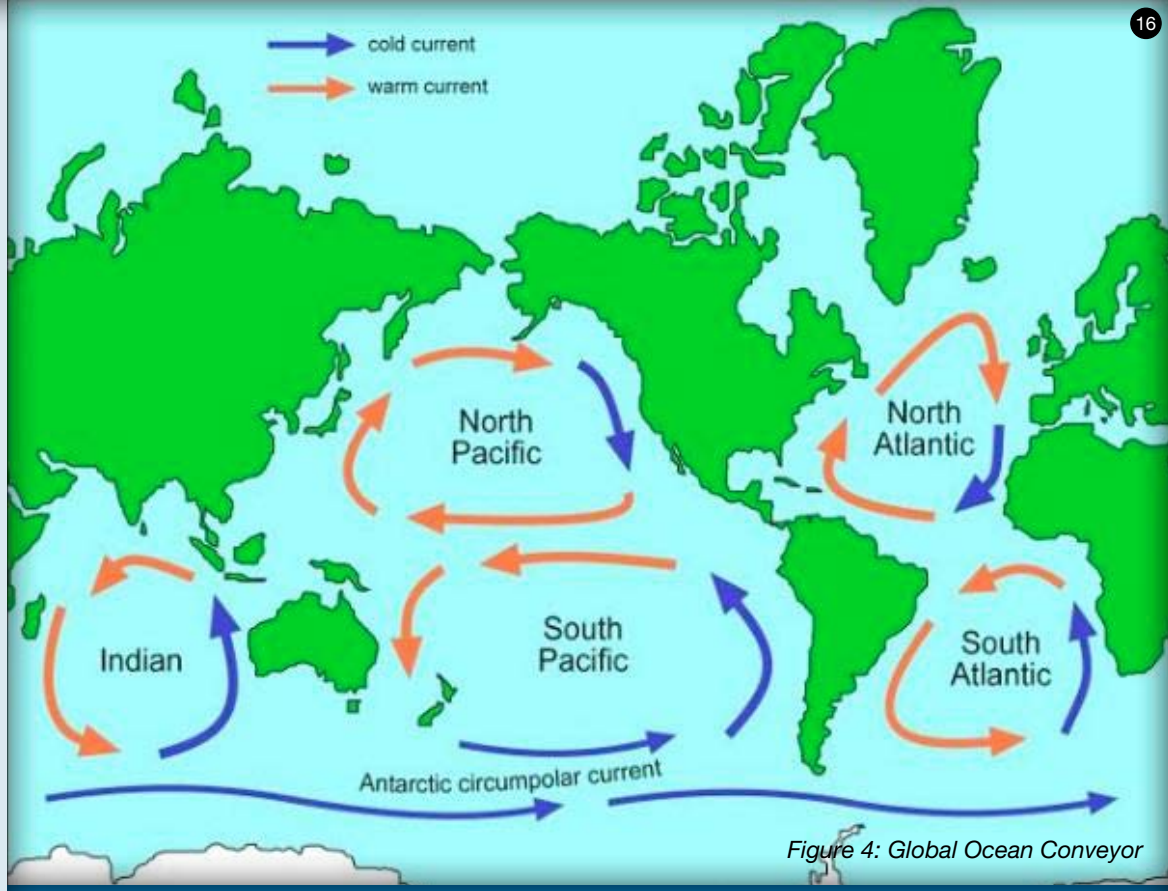


Figure 4: Global Ocean Conveyor

BACKGROUND INFORMATION FOR TEACHERS

This activity explores the impact of temperature and salinity on water density.

Cold water is denser than warm water, so it tends to sink. This is because water expands when it warms up - heat energy makes its molecules move around more and take up more space. When water cools, it contracts, becomes denser and sinks.

Firstly, ask the children: "What is different about water in the ocean and water from your tap?"

- Seawater is denser than freshwater. This is because seawater has additional chemicals like sodium chloride (NaCl – salt) dissolved in it. Salinity, temperature and depth all affect the density of seawater.

The ocean has a complex circulation system called the Global Ocean Conveyor. It moves water, heat, salt and nutrients around the world. Surface currents in the top 400 metres are driven mainly by wind. Deeper currents are driven by changes in water density. Both types of currents work with the atmosphere to help shape the Earth's climate.

Melting land ice and increased rainfall - as consequences of climate change - have the potential to disrupt the oceans' chemical and physical properties, which will impact this complex circulation system.

EXTRA, EXTRA! Extension questions for your students

1 As we set up the activity, what parts are set up the same?
The glasses, ice cubes and the amount and temperature of the water.

2 What part of the activity setup is different?
One glass has freshwater, the other has saltwater.

3 Why do you think we have changed this one thing (a variable)?
To demonstrate the impact of temperature and salinity on water density.

4 We are using the equipment to model the impacts of temperature and salinity on water density. What do the different parts of the model represent?
The glasses = a body of water. The ice = glacier, iceberg or another source of freshwater. Tap water = freshwater body/lake. Saltwater = seawater body/ocean.

5 What do you think will happen in each model?
Answers will vary.

6 Were the predictions correct?
Answers will vary.

7 What differences did you observe in each glass?
Freshwater model: as the ice melted, the cold water sank to the bottom of the glass. Saltwater model: as the ice melted, the freshwater floated on top of the saltwater. Also, the water level in the glass will increase a little, which is what happens when grounded ice (ice on land) melts.

8 Why did the cold water sink to the bottom of the freshwater glass?
Cold water is denser than warm water.

9 How could you tell the cold water was sinking?
Darker currents of coloured water moved down through the water.

10 Why did the freshwater float on top of the saltwater although the freshwater was colder?
Freshwater is less dense than saltwater.

11 What difference does freshwater make to the chemistry of the oceans?
It dilutes the seawater, making it less dense.

12 What difference may this make to the Global Ocean Conveyor?
Dense water sinking below less dense water drives the Global Ocean Conveyor. The flow of warm freshwater onto the ocean surface warms the oceans, melts sea ice and disrupts the sinking of the cold, salty water. This may slow and/or alter the Global Ocean Conveyor.

13 Why is climate change a factor in these changes?
Warmer temperatures lead to melting land ice & changes in rainfall, which add freshwater to the oceans. Sea ice reflects heat back into the atmosphere. Melting sea ice allows the darker ocean water to absorb the heat, warming the seawater. These changes in temperature & salinity affect density, which then affects the Global Ocean Conveyer.

ACTIVITY 3 Feelings Thermometer
Can we measure our feelings?

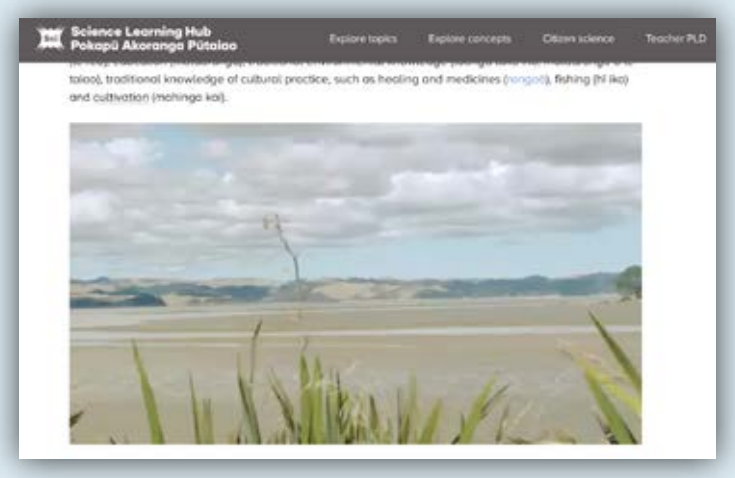
There is a lot of investigation and measurement in understanding the science of climate change, which gives information about changes and suggests ways to respond. The same approaches and tools can help us understand and keep a track of feelings, so that effective coping actions can be taken when needed.

- Draw a large “Feelings Thermometer” on a poster or project image on Smart Board.
- Discuss how feelings can range in strength or intensity. Use the example of anger and explore how different feeling words relate to different strengths of emotion (irritated, annoyed, angry, furious, livid).
- Explain that it can be helpful to track our ‘emotional temperature’ to understand the range of feelings, how they change, come and go.
- Discuss how students may respond to, and cope with, feelings of different strengths.
- Discuss: if we track strong feelings, and they happen often, these could be the feelings we might need some support with or use extra coping skills for.

Tracking Emotions

ACTIVITY 4 Video

Weno Iti and Apanui Skipper describe their views on mātauranga Māori.



What could Climate Change look & feel like?

BACKGROUND INFORMATION FOR TEACHERS

Climate Change: The time is now

Although we sometimes hear about the planning for and the impact of climate change on our weather, ecosystems, and even on people living in low lying islands, it can sometimes feel like an 'over there but not here' problem. Or, as something we should think about in future, but certainly not now!

But no matter how you look at it, climate change is the biggest environmental challenge of our time. It is already affecting our climate, agriculture, native ecosystems, infrastructure, health and biosecurity.

So, although an inconvenient truth, it is time to acknowledge that climate change is happening. And because every action has a reaction when it comes to Earth's climate system, we are all in this together.

We cannot afford to ignore what is happening in New Zealand and globally. It requires a highly coordinated and committed global, national and local response. This will enable us to be adequately prepared to adapt to the short, medium, and long-term impacts of climate change.

A global response

The **United Nations Framework Convention on Climate Change** (UNFCCC) came into force in 1994. The UNFCCC enables countries to collectively consider how to mitigate climate change and cope with its impacts. It has near-universal membership with 197 Parties (countries) to the Convention, including New Zealand.

However, the international community recognised that more urgent action, with more powerful and legally binding measures than those required under the UNFCCC, was needed. Negotiations on a second agreement under the UNFCCC, known as the **Kyoto Protocol**, began in 1995 and came into force in 2005. 55 countries backed it including those responsible for 55% of global emissions.

The Kyoto Protocol committed developed countries to greenhouse gas emissions reduction targets for the first commitment period of the Kyoto Protocol (2008-2012). Only countries that ratified the Protocol are bound to it.

RIGHT HERE, RIGHT NOW...

New Zealand is already experiencing higher land and sea temperatures. The sea rose 14 to 22 centimetres in the last century, the oceans are acidifying, there is more sunshine, and the country's glaciers have lost a quarter of their ice in the past 40 years.

Some regions have drier soils, altered rainfall patterns, fewer frost days and more warm days. Extreme wind has also increased in some places.

Studies suggest flood and drought events have worsened, and there is a higher likelihood of these happening.

Many of these impacts, like erosion from extreme rainfall, cannot be reversed.

These effects are expected to intensify in the coming decades and all aspects of life in New Zealand will be affected.

SOURCE: ENVIRONMENT AOTEAROA 2019 (MINISTRY FOR THE ENVIRONMENT AND STATS NZ)

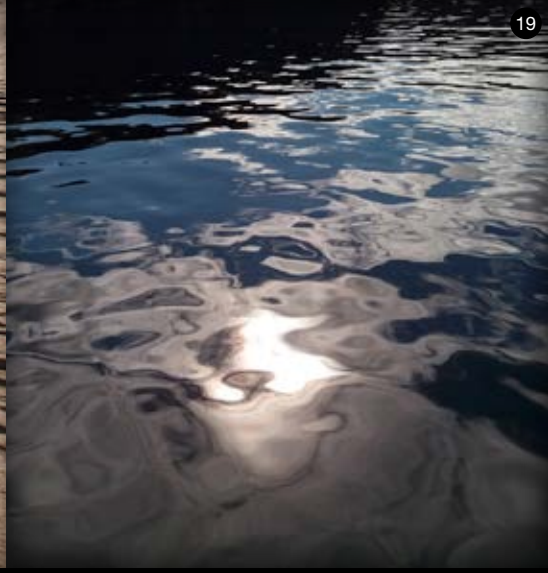
New Zealand's obligations under the Kyoto Protocol

New Zealand ratified the Kyoto Protocol in December 2002. New Zealand's obligations under the Kyoto Protocol include:

- A responsibility towards an emissions reduction target for the first commitment period (2008-2009) to reduce greenhouse gas emissions to their 1990 levels.
- Submitting an **annual inventory of greenhouse gas emissions** to the UNFCCC.

During November 2015, New Zealand accepted the **Doha Amendment to the Kyoto Protocol**. This means we support a second commitment period under the Kyoto Protocol running from 2013 until 2020. However, the amendment will only come into force when 144 parties under the United Nations have accepted it. As of May 2018, 112 parties have accepted the Doha Amendment.

The **Paris Agreement** is the new global agreement on climate change. It was adopted by Parties under the UNFCCC in December 2015. It commits all countries to take action on climate change and will take effect from 2020.



THE PURPOSE OF THE PARIS AGREEMENT IS TO:

Keep the global average temperature well below 2°C above pre-industrial levels, while pursuing efforts to limit the temperature increase to 1.5°C.

Strengthen the ability of countries to deal with the impacts of climate change.

Support development of low-carbon and climate-resilient economies.

The agreement provides a framework for the global response to climate change.

New Zealand ratified the Paris Agreement on Climate Change in October 2016 and then submitted its Nationally Determined Contribution to the UNFCCC. This contribution was to reduce emissions to 30% below 2005 levels by 2030.

How will Climate Change affect New Zealand?

The Earth has had many tropical climates and ice ages over the billions of years it has been in existence, so why is now so different? Well, as you now know, this is because for the last 150 years, human activity has meant we're releasing enhanced amounts of greenhouse gases into the Earth's atmosphere.

The table (on the following page) from the Ministry for the Environment provides an overview of the most likely short, medium and long-term impacts of climate change on New Zealand. Some are positive and some not so positive. A lot of these impacts will be like those experienced around the world.

Impacts of Climate Change

Higher temperatures	There is likely to be an increase in demand for air-conditioning systems and therefore electricity in summer. People are likely to enjoy the benefits of warmer winters with fewer frosts, but hotter summers will bring increased risks of heat stress and subtropical diseases. There may be a reduction in demand for winter heating meaning lower costs and reduced stress on those who cannot afford electricity.
Flooding	More frequent intense winter rainfalls are expected to increase the likelihood of rivers flooding and flash flooding when urban drainage systems become overwhelmed.
Water resources	Water demand will be heightened during hot, dry summers. Longer summers with higher temperatures and lower rainfall will reduce soil moisture and groundwater supplies. Drought intensity will likely increase over time. Drier conditions in some areas are likely to be coupled with more frequent droughts. River flows are likely to be lower in summer and higher in winter. Lower river flows in summer will raise water temperatures and aggravate water quality problems (e.g. through increased algae growth).
Sea-level rise	Rising sea levels will increase the risk of erosion, inundation and saltwater intrusion, increasing the need for coastal protection where it is possible.
Health	Higher levels of human loss of life related to summer heat are expected. Higher winter temperatures may lead to a reduction in winter related human mortality and illnesses such as colds and flu.
Built environment	Increased temperatures may reduce comfort of occupants in domestic, commercial and public buildings and could lead to disruptions to business.
Transport	Hotter summers may damage elements of transport infrastructure causing buckled railway lines and damaged roads, with associated disruption and repair costs.
Agriculture	Agricultural productivity is expected to increase in some areas but there are risks of drought and spreading of pests and diseases. There are likely to be costs associated with changing land-use activities to suit a new climate.
Business & Finance	Households may find it more difficult to access adequate insurance cover in the face of increased flood risk. Fruit and vegetable growers may find it more expensive to insure against weather related damage (e.g., from hail). The risk management of potential climate change impacts may provide significant opportunities for businesses.

How will it affect wildlife?

Climate change is already affecting wildlife all over the world, but certain species are suffering more than others. Polar animals, whose icy natural habitat is melting in the warmer temperatures, are particularly at risk. In fact, experts believe that the Arctic sea ice is melting at a shocking rate - 9% per decade! Polar bears need sea ice to be able to hunt, raise their young and as places to rest after long periods of swimming. Certain seal species, like ringed seals make caves in the snow and ice to raise their pups, feed and mate.

It's not just polar animals that are in trouble. Apes like orangutans, which live in the rainforests of Indonesia, are under threat as their habitat is cut down, and more droughts cause more bushfires.

In New Zealand all of our native species and ecosystems will eventually be affected by climate change, either directly or indirectly, but some will be more vulnerable, including:

- **Alpine ecosystems** are refuges for many of our bird, lizard and invertebrate species, and contain a great diversity of plant species. However, as temperatures rise, increased animal pest pressure (e.g. hedgehogs, rats, wasps) is expected as their range expands to higher grounds. In the long-term, alpine zones will also experience increased woody growth as tree lines and scrub moves upslope, reducing the alpine habitat.
- **Freshwater ecosystems** will also be particularly vulnerable because they are already subject to high levels of land use pressure (e.g. dams and increased water takes for irrigation). Native freshwater plants and animals will be impacted by climate change directly (e.g. increased flood frequency, lower water levels from drought), and indirectly (e.g. increased water takes/ irrigation and pests and weeds which grow in warmer water).
- **Coastal ecosystems** (includes estuaries, coastlines, and offshore island habitats) where rising sea levels will 'squeeze' our coastal native ecosystems against developed land. Storm surge and increased sedimentation as a result of increasing flood frequency will also affect these ecosystems.
- **Vulnerable native species** lack the ability to adapt to the impacts of climate changing at the rate expected and may need us to specifically intervene.
- **Wildfire and its impact:** Not only are habitats such as trees and shrubland burnt, what is left is bare land that, if left, can cause huge issues for erosion, land slumps and sediment, polluting waterways.

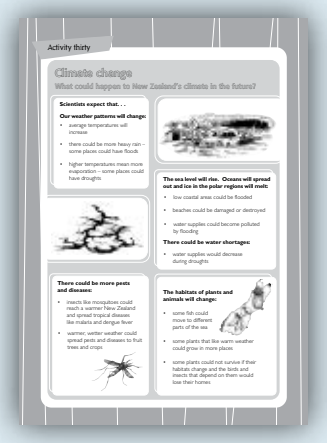
SOURCE: DEPARTMENT OF CONSERVATION

AND HOW WILL IT AFFECT HUMAN MENTAL WELLBEING?

Climate change will have direct and indirect impacts on psychological wellbeing. After climate related extreme weather events such as storms and fires, common human reactions include stress, anxiety, grief, social tension, feelings of displacement, relationship conflicts, cognitive decline, problems with alcohol and drugs and greater rates of mental health disorders such as post-traumatic stress disorder and depression. Learning and understanding about climate change also affects people even without exposure to a direct event, and may create anxiety, depression, despair, aggression and a host of other emotional upheavals.

What you will need

- Access to Wi-Fi, Smart TV (including good sound) or lap-top and projector.
- Topic book to record thoughts and information.
- Printed copies per student of the activity 'What could happen to New Zealand's climate in the future?' worksheet.


Activity thirty

Climate change

What could happen to New Zealand's climate in the future?

Scientists expect that. . .

Our weather patterns will change:

- average temperatures will increase
- there could be more heavy rain – some places could have floods
- higher temperatures mean more evaporation – some places could have droughts

The sea level will rise. Oceans will spread out and ice in the polar regions will melt:

- low coastal areas could be flooded
- beaches could be damaged or destroyed
- water supplies could become polluted by flooding

There could be water shortages:

- water supplies would decrease during droughts

There could be more pests and diseases:

- insects like mosquitoes could reach a warmer New Zealand and spread tropical diseases like malaria and dengue fever
- warmer, wetter weather could spread pests and diseases to fruit trees and crops

The habitats of plants and animals will change:

- some fish could move to different parts of the sea
- some plants that like warm weather could grow in more places
- some plants could not survive if their habitats change and the birds and insects that depend on them would lose their homes


Activity thirty

Track 7

		Read	Heard
1	There will be more severe storms and cyclones in Pacific countries.	○	○
2	Sea levels will rise as a result of climate change.	○	○
3	Ice in polar regions will melt.	○	○
4	There may be more droughts and water shortages.	○	○
5	Warm winters will reduce the demand for electricity.	○	○
6	There will be more pest and disease problems like dengue fever that is carried by mosquitoes.	○	○
7	New technologies that use solar power, wind energy and wave energy produce no greenhouse gases.	○	○
8	Some plants and animals that have adapted to current conditions may not survive if their habitats change.	○	○
9	Using a bike, skateboard or walking to get around are all ways we can help reduce greenhouse gas emissions.	○	○
10	Hotter summers mean we will use more electricity for air conditioning.	○	○
11	The Kyoto Protocol is an agreement between countries which want to reduce greenhouse gas emissions.	○	○
12	Reducing the amount of electricity we use in our homes can help reduce the amount of greenhouse gas emissions.	○	○

ACTIVITY 1 What could happen to New Zealand's climate in the future?

The following activity is from ***TKI ESOL Online programme.***

The activity is based around an audio interview with a climate change scientist who discusses the positive and negative impacts of climate change in the Pacific, including New Zealand.

Click here and follow the instructions for 6.30 'What could happen to New Zealand's climate in the future'

NB: *You will need to print off a worksheet per student before the lesson.*

Brief overview of the lesson:

- Look at the first page of the student worksheet and explain to students that they will read a text about climate change, then listen to an interview.
- Before they read or listen, have students look at the statements on the second page of the student worksheet. Explain that they will be asked to tick the circle to say whether they read or heard the information, or both.
- Read the text together and talk about it, then play track 6.30 (Track 7 for this topic) and listen to the interview.
- Have students talk about their answers in pairs or small groups.
- Students may want to listen again before they can agree on the correct answers.

DECLARING A 'CLIMATE EMERGENCY'

Canterbury is now in a state of "climate emergency".

On May 16th, 2019 Environment Canterbury (regional council) became the first council to declare a climate emergency. Councillors voted to declare the emergency in front of a packed council chamber. It will allow the council to highlight the importance of climate change in everything it does.

This was quickly followed by the Marlborough District & Christchurch City councils.

ACTIVITY 2 Regional snapshot Calling for action in Thames – Coromandel

As of April 2019, approximately 60 mayors and councils around the country had signed up to the ***Local Government Leaders' Declaration on Climate Change 2017***. The declaration states councils will commit to plans to reduce greenhouse gases, promote walking, public transport, increase resource efficiency, and commit to renewable energy and electric vehicles. However, a handful of Councils are holding out, with Thames-Coromandel District Council being one of them.

At a packed April 2019 Council meeting, concerned residents young and old - including Thames students Lillian Balfour and Helena Mayer - told the Thames-Coromandel District councillors that signing the Local Government Leaders' Climate Change Declaration was a step towards a sustainable, collaborative Coromandel.

The following videos and article provide an overview of both positions and highlight the importance of young and old working together and not giving up, regardless of setbacks.

Video: ***Calling for action in Thames – Coromandel*** SOURCE: STUFF.CO.NZ

Article: ***Thames Coromandel District Council and the Local Government Leaders' Declaration on Climate Change*** SOURCE: NEWSHUB.CO.NZ

EXTRA: As the enhanced greenhouse effect is caused by human activity, we can also be the solution and there are **so many solutions to global warming**. This great website from ***Drawdown*** offers just that - ***100 solutions to reverse global warming.***

ACTIVITY 3 What is happening around the world?

Watch one or all of the following videos about how climate change is impacting on the environment, the way people live around the world, and on how communities are successfully managing the effects.

Video: *Tuvalu, Building resilience to climate change in the Pacific: Tuvalu Coastal Adaptation Project (2mins)*
SOURCE: UNDP IN ASIA AND THE PACIFIC (YOUTUBE)

Video: *Climate change: United Nations 'Climate action summit 2019' (2mins 40secs)* SOURCE: UNITED NATIONS

ACTIVITY 4 Understanding our feelings about Climate Change

Our reactions to information and events are connected to how we think about situations, what we do in response and what environment or situation we are in.

In groups, the students to choose one climate change feeling response (their own or imaginary) and consider:

- What might be the thinking about climate change?
- What might be happening in the person's body?
- What could be happening in the environment that could be contributing to the feeling?

Ask each group to share their observations with the class. During this discussion, reinforce key messages about feelings and highlight how our feelings are linked to thinking, physical responses, action and the environment.

Remember

Feelings are made up of different parts.
Feelings show up in our body.
We can listen to our body for signals of how we are feeling.
Everyone has thoughts about the things that happen.
How people think influences how they feel and behave.
Feelings are connected to our motivations and actions.

More about Climate Change reactions

Extension Ideas

Try this activity to extend children's awareness of the role the body plays in emotion.

Sparklers Body Scan SOURCE: SPARKLERS

- Write down thoughts, feelings and actions on some cards and play a sorting game where the students sort them into a thought pile, feeling pile and action pile.
- Read the students a book and get them to stop you when they identify the character demonstrating a thought, feeling or action.

Read through several scenarios you think might be relevant to the students in your classroom. Ask them to imagine what the person might be thinking or feeling, and suggest some actions they might take as a result. For example:

- You forgot to bring your assignment to school.
- Your friend tells you s/he is moving to another school.
- You see piles of rubbish in your neighbourhood park.
- You have to speak at an open day for your school to a group of new parents.

Video: *Why Do We Lose Control of Our Emotions? (2mins)*
SOURCE: KIDS WANT TO KNOW (YOUTUBE)

How will Climate Change affect you?

BACKGROUND INFORMATION FOR TEACHERS

New Zealand case study: Auckland & Climate Change

Learn about climate change projections for your region - visit ***'How could climate change affect my region?'*** MINISTRY FOR THE ENVIRONMENT

Auckland is situated in a sub-tropical climate zone, with warm humid summers and mild winters. Winter usually has more rain and is the most unsettled time of year. In summer and autumn, storms of tropical origin may bring high winds and heavy rainfall.

So what, if any, impacts from climate change will the Auckland region experience? Our climate is changing and will continue to change in the future. While the extent and rate of change is dependent on the extent that greenhouse gas emissions are reduced globally, some change to our climate is already in motion and inevitable. The following projected changes from the Ministry for the Environment are calculated for 2031–2050 (referred to as 2040 approx. 20 years away) and 2081–2100 (about 70 years away - 2090) compared to the climate of 1986–2005 (1995).

Temperature

Compared to 1995, temperatures are likely to be 0.7˚C to 0.9˚C warmer by 2040 and 0.7˚C to 3.1˚C warmer by 2090. By 2090, Auckland is projected to have from 11 to 70 extra days per year where maximum temperatures exceed 25˚C, and frosts are likely to become rare.

Sea-level rise

New Zealand tide records show an average rise in relative mean sea level of 1.7 mm per year over the 20th century. Globally, the rate of rise has increased, and further rise is expected in the future. Increased coastal inundation causing flooding will occur with as little as 0.3m sea level rise (the minimum likely to occur in the next 50 years).

Wind

The frequency of extremely windy days in Auckland by 2090 could decrease by up to 5%. There may be an increase in westerly wind flow during winter, and northeasterly wind flow during summer.

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 21st century; however, the ex-tropical cyclones will likely be stronger and cause more damage as a result of heavy rain and strong winds.

Rainfall

Rainfall will vary locally within the region. The largest changes will be for particular seasons rather than annually. Spring rainfall in Warkworth is projected to decrease by 1% to 13% by 2090. In Mangere, spring rainfall is projected to decrease by up to 10% by 2090. There is large natural variability in extreme rainfall frequency in the Auckland region from year to year and decade to decade. According to latest projections, Auckland is not expected to experience a significant change in the frequency of extreme rainy days as a result of climate change.

IMPACTS BY SEASON

*WHAT THE AUCKLAND REGION COULD EXPECT BY 2090**

Spring	• 0.6°C to 2.8°C temperature rise • 1% to 13% less rainfall in Warkworth • No change to 10% less rainfall in Mangere
Summer	• 0.7°C to 3.3°C temperature rise • 2% to 5% more rainfall in Warkworth and Mangere
Autumn	• 0.7°C to 3.2°C temperature rise • 1% less to 3% more rainfall in Warkworth • 2% less to 3% more rainfall in Mangere
Winter	• 0.7°C to 3.0°C temperature rise • 1% less to 2% more rainfall in Warkworth • 1% to 5% more rainfall in Mangere

** Projected changes are relative to 1995 levels. The values provided capture the range across all scenarios. They are based on scenario estimates and should not be taken as definitive. For more information, see the full report on climate projections.*

What could this mean for Auckland?

HEAVY RAIN: The capacity of storm water systems may be exceeded more frequently due to heavy rainfall events, which could lead to surface flooding. River flooding and hill country erosion events may also become more frequent.

COASTAL HAZARDS: Coastal roads and infrastructure may face increased risk from coastal erosion and inundation, increased storminess and sea-level rise.

DROUGHT: By 2090, the time spent in drought ranges from minimal change through to more than double, depending on the climate model and emissions scenario considered. More frequent droughts are likely to lead to water shortages, increased demand for irrigation and increased risk of wild fires. The frequency and intensity of El Niño events, which are associated with periods of drought in Auckland, may increase. Increased drought frequency coupled with windier conditions may lead to an increase in the occurrence of fires.

AGRICULTURE: Warmer temperatures, a longer growing season and frosts becoming rare could provide opportunities to grow new, sub-tropical crops and farmers might benefit from faster growth of pasture and better crop-growing conditions. However, these benefits may be limited by negative effects of climate change such as water supply issues, prolonged drought, increased flood risk, or greater frequency and intensity of storms.

BIOSECURITY: Climate change could result in an increased incidence of invasive pests, affecting both pasture and horticultural crops. Several existing pest species could become more serious pests with even a slight increase in temperature.

DISEASE: There may be an increase in the occurrence of summer water-borne and food-borne diseases such as Salmonella. There could also be an increased risk from some vector-borne diseases such as Dengue Fever and Ross River Virus.

DID YOU KNOW...

In Auckland, the highest storm-tide level on record for the 20th century (from 1925) occurred late morning on 26 March 1936. A cyclonic low-pressure storm generated a storm surge, coinciding with a 'king' tide. Some coastal flooding occurred, and waves severely damaged the Browns Bay Wharf. History repeated late morning on 23 January 2011, with a similar type of low-pressure storm on the back of a spring tide, leading to damaging coastal inundation of low-lying areas of Auckland. Both storms had a similar annual exceedance probability (1 - 2%), relative to the mean sea level at the time of the events. The 2011 event, however, was 0.13 metres higher than the 1936 event causing deeper coastal flooding - including to houses - and causing road closures. Most of the difference in peak water level for these similar storms is attributable to the 0.12 metre rise in sea level in Auckland over the intervening 75 year period.

EXTRACT SOURCE: TIDE GAUGE DATA (PORTS OF AUCKLAND LTD, AUCKLAND COUNCIL); BARNETT (1938).

In our neighbourhood: A coastal snapshot

Approximately 65% of New Zealanders live within five kms of the coast. New Zealand is an island country situated in the South Western Pacific Ocean. It consists of two main land masses (North and South Islands) and numerous smaller islands, all surrounded by sea. In fact, there is no location in New Zealand that is more than 130km from the sea. We take it for granted because, well, that is just the way we are.

So being a predominantly coastal population, what does that mean for where you live?

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

Coastal inundation and erosion

Coastal processes can create hazards onshore either by flooding (coastal inundation) or wearing away or removing sediment from the coastline (coastal erosion).

- **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 piling water up along the shoreline. The effect of air pressure and strong winds raising sea levels temporarily during storms is called “storm surge”.
- **Coastal erosion:** Long-term increases in sea level will worsen both long-term and short-term erosion. This is because with a rise in sea level, all the normal coastal storm processes such as storm surge and wave run-up can reach higher up the beach. This means each storm can cause more erosion than would have been the case if the sea level had not risen.

DID YOU KNOW?

Liquefaction is the process where, during earthquake shaking, sand and silt grains in wet soil are rearranged and the water in the spaces between the grains is squeezed.

Sea-level rise

New Zealand tide records show an average rise in relative mean sea level of 1.7 mm per year over the 20th century. Globally, the rate of rise has increased, and further rise is expected in the future. It also creates potential for liquefaction. For example, increased groundwater levels near the coast due to increased sea levels, and higher groundwater levels, means wetter soils are more susceptible to becoming liquefied during earthquake ground shaking.

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 groundwater 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 21st century. However, they are likely to be stronger and cause more damage as a result of heavy rain and strong winds.

Flooding

Flooding is a common natural hazard in New Zealand. River flooding will be exacerbated by climate change and in the lower reaches of rivers; sea level rise will also increase flood risk.

Tsunamis

Tsunamis are waves created when the ocean floor is displaced by earthquakes, landslides or volcanoes. 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 in the sea level that the tsunami is superimposed on could mean the impacts of tsunami are greater in the future.

What you will need

- Access to Wi-Fi, Smart TV or lap-top and projector.
- ***Link to video: A day in the life of a scientist - Justin Cope.***
- A2 pieces of paper, enough for each group (activity 2).

And for the experiments...

1. Atmospheric Pressure: Flip water glass trick

- A playing card.
- A glass – small enough to fit on top of the playing card.
- Water.

2. Sea level rise effects on coastal hazards – the 'coast in a paint tray' activity

- A paint roller tray.
- Play dough, modelling clay or plasticine.
- At least 3-4 litres of water (coloured with food colouring is good but not essential).
- Optional: some small model houses or something to act as buildings e.g. Lego blocks.

ACTIVITY 1 Video: A day in the life of a scientist

JUSTIN COPE, SCIENTIST & PROGRAMME MANAGER COASTAL & RIVER SYSTEMS
Environment Canterbury

The video will cover:

- The role of science in understanding climate change.
- Sea level changes - tides and weather.
- Sea level rise.
- Experiment 1.

1. Atmospheric Pressure: Flip water glass trick

By the end of this activity, students understand that the air around us - even though we can't feel it - exerts a pressure on us from all directions.

BACKGROUND INFORMATION FOR TEACHERS

The following activity explores air pressure. Air pressure drives weather. During hazardous coastal storms it is the wind and low air pressure (along with waves) that increases the sea level at the coast. Wind blows onshore and increases water levels and low pressure causes the sea level to rise temporarily (called the inverse barometer effect). Conversely, during finer weather when the air pressure is higher, the higher pressure pushes down on the ocean surface and depresses sea levels. This activity demonstrates that even though we can't feel it, air pressure pushes in all directions and can even hold back the forces of gravity (to a small degree).

Method

- Take the glass and add a small amount of water.
- Put the playing card or piece of cardboard over the glass so it's completely covered.
- Slowly flip the glass over, while holding the playing card in place.
- Gently let go of the playing card.

What happens? Amazingly, the playing card will hold the water in the glass.

Why? ***A basic/simple answer:*** Even though it doesn't feel like it, the atmosphere around us pushes in all directions. The air pushing up from underneath the card is strong enough to stop the weight of water pushing the card down.

A more accurate (but more involved) answer: Before the glass is flipped over, the air pressure inside the glass is equal to the air pressure outside the glass. When you flip the glass over, gravity moves the water to the bottom of the space and causes a tiny bit of water to leak out. This increases the volume (or space) that the air above the water occupies. The amount of air is the same, but it now occupies a larger space. This decreases the air pressure. The pressure of the air outside the glass is now greater than the air pressure inside and the greater air pressure pushes the card to keep it in place.

2. Sea level rise effects on coastal hazards – the 'coast in a paint tray' activity

By the end of this activity: *Students should understand the influence sea level rise would have on normal coastal processes such as storms. High water levels and wave run-up during storms reach higher up the beach. With sea level rise, they will reach higher still. Students will also get an appreciation of how natural features such as dunes can absorb and block storm activity, even with sea level rise.*

BACKGROUND INFORMATION FOR TEACHERS

Coastal storms are natural processes. With sea level rise the effects of coastal storms will be able to reach further and higher up a shoreline. This will cause increased coastal inundation (flooding) and erosion of the shoreline which may have never experienced erosion before. Natural features such as dunes help absorb/block the effects of coastal storms. They will help mitigate the effect of sea level rise and protect land and development behind the dunes.

Method

- Using the play dough or modelling clay, cover the shallow end of the paint tray to make a "beach". Taper the thickness so the "beach" is thicker at the shallow end and tapers away towards the deeper end to match the slope of the tray.
- Fill the tray with water about half full to the "seaward" edge of your model "beach". Explain that this represents a calm day at the beach with a high tide and no wind. Use something (a pin or blob of clay) to mark this water level.
- Have one of the students blow over the water surface from the deep end of the tray towards the shallow end to mimic an onshore wind and again mark the extent of the water. Explain that this represents a storm surge with wind piling water up against the shore and waves running up the beach.
- Now add more water. Explain that this represents future sea level rise on a calm day at high tide. Mark this water level.
- Again, have a student simulate a storm with the higher sea level. Mark the level the storm reaches.
- Play around and experiment with the "beach". Sculpt some sand dunes or a seawall. Make one half of the beach protected by a dune, but the other half flat. Scour out a "river", put a gap in, or lower the dune in places. Put some buildings in various places to represent subdivisions or developments. Observe what happens to these features when there is the same storm intensity with current sea levels vs higher sea levels.

ACTIVITY 2 Living here & Climate Change

- **REVISIT:** climate change, greenhouse gases and the likely impacts on New Zealand; the typical weather and climate for your **climate zone**, and what influences that, i.e. proximity to mountains, the sea, equator and south pole and shelter from unsettled weather.
- Thinking about what we know about climate change, your climate zone and what influences that, how do you think climate change could affect your town/city?
- Break into groups and **visually** brainstorm on a piece of A2 paper for 10mins. The challenge is, no words allowed!
- Return as a main group and share ideas.

Find your climate zone: New Zealand's climate zones

ACTIVITY 3 Adaptation & mitigation

What does it mean & what does it look like?

Both adaptation and mitigation are equally important when preparing for the possible impacts of climate change. One is about **reducing** the impacts by reducing greenhouse gases and the other is about **adjusting** to the actual or expected impacts.

- Using their ideas from activity 2, ask the following question: 'Looking at the possible impacts, what do you think are some of the things we could do now to **adjust to** and **reduce** those impacts?'
- In the same groups as activity two, explain to the children that on the other side of their piece of paper, they have 10 minutes to draw their '**adaptation**' and '**mitigation**' ideas. Once complete, each group to discuss their ideas with the class.
- *Appendix 5* provides a simple '***Adaptation and mitigation***' infographic the children can refer to.
- Return as one main group and share their ideas.

ADAPTATION

Adaptation is the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment.

MITIGATION

Climate change mitigation consists of actions to limit the magnitude or rate of long-term climate change. Climate change mitigation generally involves reductions in human emissions of greenhouse gases.

The world is always changing and requires us to adjust our thinking, feeling and coping strategies to adapt. Our response to uncertainty, new situations, or challenges, is called psychological adaption. Climate change is a major challenge and new skills and responses are required to help navigate the feelings and stresses involved. When we adapt effectively, we are more likely to get involved with and enjoy life, feel better about ourselves and discover our own meaning and purpose.

Psychological adaptation to climate change involves three stages:

1. Understanding and knowledge leads to acknowledgement and acceptance of the issue.
2. Coping strategies to manage the feelings and thoughts.
3. Active engagement and action where we change and adjust behaviours in order to reduce climate change impacts.

ACTIVITY 4: Introducing 'Psychological adaptation'

Wellbeing Action – What Can I do?

The lessons up until now have been addressing the first point. The lessons subsequent lessons will address the second two areas and focus on learning and naming feelings and taking actions to support wellbeing.

Provide students with Wellbeing Action tip sheet

Ask students to take a few minutes to reflect and jot notes on how they currently cope with hard times and upsetting feelings, either in general, or related to climate change.

Introduce students briefly to the four areas of coping.

1. **self-talk (thinking)**
2. **feelings**
3. **action**
4. **environment**

Ask students to review the Wellbeing Action tip sheet and consider a new way they might cope between now and the next session in response to any feelings that might come up about the learning material. Remind students that these Wellbeing Actions can also be used for any upsetting or hard times they experience.

Wellbeing action: Wallet Cards - Give each student four blank wallet size cards.

Ask them to write one wellbeing action from each area of coping in the **Wellbeing Action tip sheet** and commit to using them during the next month.

EXTRA! Below are some helpful short videos to build on the students understanding and assist them when it comes to their action-based inquiry.

300 years of fossil fuels in 300 seconds *(5m 30secs)*

SOURCE: POST CARBON INSTITUTE (YOUTUBE)

From Samuel Newcomen's coal burning steam engine to the modern challenges of climate change, this video by the Post Carbon Institute is a slick explainer of how fossil fuels were developed, and why they now need to be left behind. It gives a great recap of the role of the industrial revolution and fossil fuels, before moving on to what needs to be done now.

Smart climate change adaptation in practice *(2min 30secs)*

SOURCE: OECD (YOUTUBE)

Using engaging graphics, this short video provides great practical adaptation examples from around the world.

After watching the video(s), talk briefly about next lesson's focus: 'What can I do?'

Section B: Investigation

Living with Climate Change

SPECIFIC LEARNING INTENTIONS

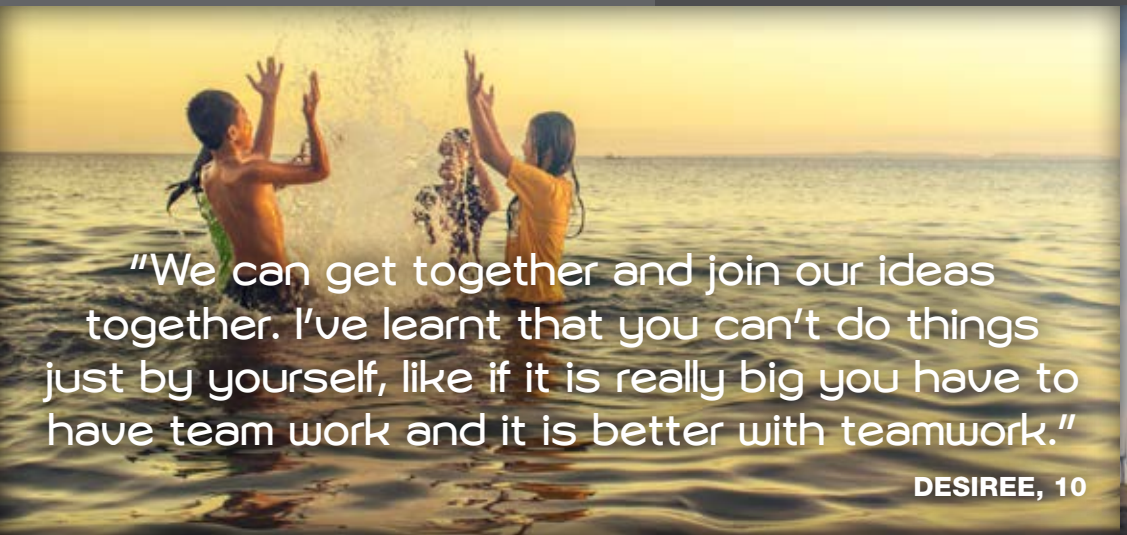
To apply previous knowledge and understanding of climate change and analyse suggested recommended actions to reduce the impacts of climate change.

Research and formulate ideas for reducing the possible impacts of climate change, globally and locally.

SUCCESS CRITERIA

I can:

- Relate knowledge and understanding about climate change and connect it to actions I can take as an individual, and as part of a group.
- Begin to imagine my own decisions and ideas to reduce the possible impacts of climate change, globally and locally.
- Predict possible effects on an individual and groups who may have different values than me and include that in my ideas.
- Understand that there are those that are sceptical about climate change and its causes and consider how to discuss climate change with them in a constructive and respectful way.



"We can get together and join our ideas together. I've learnt that you can't do things just by yourself, like if it is really big you have to have team work and it is better with teamwork."

DESIREE, 10

SESSION 6

Living with Climate Change: What can I do?

BACKGROUND INFORMATION FOR TEACHERS

Climate change and its impacts - global, national and local - is a lot to take in. You will not be alone in thinking it's all a bit scary, or in asking yourself what, if anything, can be done.

As with a lot of situations that can feel overwhelming or out of control, knowledge is power. Understanding the causes and the impact of potential scenarios of climate change will help us adapt to the effects.

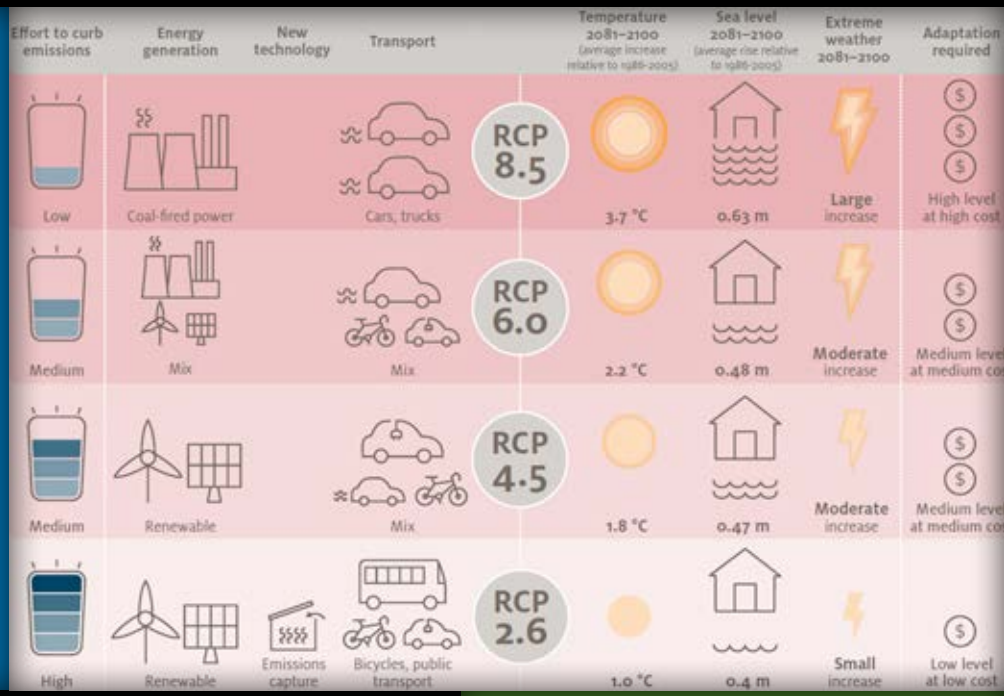
Therefore, it is important that one of the first things we do is understand and measure the potential effects of climate change. In New Zealand, this is influenced by national guidance from the Ministry for the Environment.

Representative Concentration Pathways *(RCPs)*

To understand how our climate may change in future, we need to predict how we will behave. For example, will we continue to burn fossil fuels at an ever-increasing rate, or will we shift towards renewable energy? The RCPs try to capture these future trends. They make predictions of how concentrations of greenhouse gases in the atmosphere will change in future as a result of human activities. The four RCPs range from very high (RCP8.5) through to very low (RCP2.6) future concentrations. The numerical values of the RCPs (2.6, 4.5, 6.0 and 8.5) refer to the concentrations in 2100.

While not all people agree with climate change projections, the RCP 2.6 scenario is now globally accepted as inevitable, and the RCP8.5 scenario reflects current emissions and what could happen if we don't reduce our current emission levels. In other words, even if we were to reduce emissions substantially, there will be some sea level rise and some effects that will need to be managed.

The key uncertainty in climate change projections is not if, but when, changes will reach a certain threshold, and what the extent of the changes will be.



Time to act!

We now have a better idea about what climate change is, its causes, how we know it is happening and what it may look and feel like across the world and locally. We also know that globally and at a government level, initiatives are afoot to manage the effects of climate change.

What is also becoming clear is that every action - big or small, positive or negative - influences the likely impact of climate change. Because of that, every choice each of us makes - today and tomorrow - will contribute to what we and future generations will experience and must adapt to.

We know there is still time to choose actions that will lessen the impacts of climate change. What part will you play as an individual, as a family, and as a community? This includes influencing the Government, business and decision makers.

A warming of 1.5 degrees is recognised as the threshold at which climate changes has an impact on our lives.

Mitigation: Things we can all do to reduce greenhouse gas emissions

The Representative Concentration Pathways infographic demonstrated four climate change scenarios. Each 'pathway' makes a prediction of how concentrations of greenhouse gases in the atmosphere will change in future as a result of human activity.

The outcome or 'adaptation required' depends on the amount of greenhouse gases produced. And the amount of greenhouse gases produced is highly influenced by what we – as individuals, communities, and whole populations - do globally, nationally and locally.

It is that simple!

Remember, one of the big contributors is fossil fuel – the energy sources we use to make 'stuff' and move things around nationally and globally - including people, food and other goods. How can we do that in a way that doesn't use fossil fuels, or at least uses them a lot less? Can we come up with new, smarter technology?

Below is a 'beginners guide' to some of the things you, your families, and communities, can start doing to learn about, prepare for, and take action on, climate change!

Let's get talking!

When and where possible and appropriate, we all need to start talking about climate change - what is happening and why. Most importantly, we need to decide what we can do as a country, as communities and as individuals, to reduce the impact of enhanced greenhouse gases and warming temperatures. Let's get out there!

Actions you can take

Get talking! Get others on board, spread the message. We need lots of people making good choices about climate action. Get involved and talk to others to get them involved. You can be powerful as change agents!

Be aware of your emissions

If you have an indication of where most of your greenhouse gas emissions are coming from, you can choose to take the actions that have the biggest impacts.

Actions you can take

Get an indication of your Ecological Footprint - Global Footprint Network website: ***www.footprintcalculator.org***

Learn more about how to reduce you carbon footprint by playing the ***'My Carbon footprint'*** game from the Kiwi Conservation club.

Or, go home and calculate the emissions from your homes using the ***free enviro-mark calculator***.

Why not take it a 'foot print' further? What is your school's footprint and what can be done to reduce it? Write to your local MP and ask what they're doing to reduce their emissions. Or, take one further step forward - email the Minister for Climate Change and/or the Prime Minister to ask what they're doing to support us to reduce our carbon footprint.

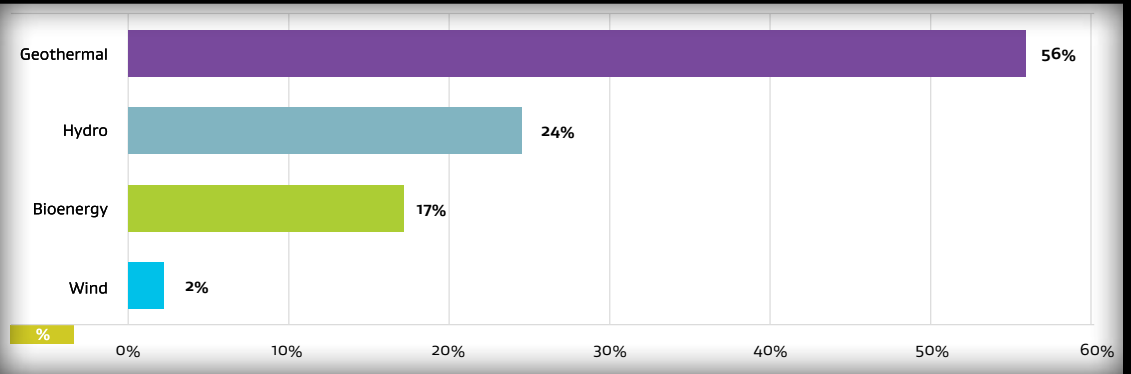
Reduce your electricity use

Greenhouse gas emissions are produced when we use electricity and gas. New Zealand has a high level of renewable electricity production, mostly from hydropower. In 2013, a total of 75% of electricity generation came from renewable sources. But that leaves 25% still supplemented by burning fossil fuels.

Actions you can take

- Switch off lights when not in use.
- Use LED light bulbs.
- Unplug electronics from the wall socket when they're not in use.
- Run the dishwasher and the washing machine only when full.
- Wash clothes in cold water and dry them outdoors when possible.
- Try having shorter showers or shower before going to bed (there is less fossil fueled electricity generation after 9 pm).

Figure 5 Renewable Primary Energy Supply 2014. SOURCE: MBIE



Drive & fly less

The transport sector contributes **19% of New Zealand's total greenhouse gas emissions**.

Actions you can take

- Walk or cycle - it is free, has the least impact on the environment and is good for your health.
- Take the bus.
- Carpool with friends.
- Reduce the number of flights you take, when possible (this has been shown to be one of the most effective climate change actions you can take).
- When you fly, pay to offset your emissions.
- Buy things that have been made or grown locally, so they haven't had to travel far.

Eat less meat & dairy products

Red meat and dairy production results in significantly more greenhouse gas emissions than the production of chicken meat, fruit, vegetables and cereals. It also requires substantially more water. Around 30% of the world's land area is used for livestock production, and it is one of the key reasons for cutting down forests.

Actions you can take

- Cut down on meat. Eat more fruit and vegetables instead - this has many health benefits, such as reducing the risk of heart disease.
- Try having a meatless day each week. The Meatless Monday website has great recipes to get you started.
- Give it a go! Try out these meatless recipes at ***Oh my veggies***!

Shop local & buy second hand when & where possible

When you buy local food or products it means that your food hasn't had to travel so far (in a vehicle which uses fossil fuels). You are also helping our economy.

Buying second hand is often not only cheaper, it diverts goods from the landfill and gives items a much longer life than they would otherwise have. They can also be run by charities, meaning some of the profits go towards that charity.

Actions you can take

- Plant vegetables and fruit trees. Containers are great if you are short of space.
- Buy local and in-season foods that haven't travelled long distances to reach you.
- Shop at local secondhand stores or online marketplaces (e.g. TradeMe) for everything from clothes to furniture, kitchenware & books!

DID YOU KNOW that a typical meal bought from a supermarket uses 4 to 17 times more petroleum for transport than the same meal using local ingredients?

But if I eat less meat, use alternative energy sources or take fewer flights, that's just me – how much of a difference can that really make?

Actually, it's not just you! Social scientists have found that when one person makes a sustainability-oriented decision, other people do too. **Here are three examples:**

- Patrons at a US cafe who were told that 30% of Americans had started eating less meat were twice as likely to order a meatless lunch.
- An online survey showed that of the respondents who know someone who had given up flying because of climate change, half of them said they flew less as a result.
- Community organisers trying to get people to install solar panels were 62% more successful in their efforts if they had panels in their house too.

Social scientists believe this occurs because we constantly evaluate what our peers are doing, and adjust our beliefs and actions accordingly. When people see their neighbours taking environmental action, like conserving energy, they infer that people like them also value sustainability, and feel more compelled to act.

Reduce, reuse, recycle

The best way to reduce waste is to avoid creating it in the first place! All products require energy and materials to be built, packaged, transported and sold. Reducing your consumption in general is good for the environment, and for your wallet.

Actions you can take

- Buy only the food you need and compost your kitchen scraps and garden waste. Around half of the waste that ends up in New Zealand landfills is organic material (food, garden, paper and wood waste). When organic material decomposes, it produces methane, which is a potent greenhouse gas.
- Buy products without any packaging whenever possible and always take your reusable bags to the supermarket. Make the most of what you already have.
- Maintaining and repairing products, such as your clothes, means they don't have to be replaced so often.
- Ask yourself: 'Do I really need this?' Think about what will happen to it after you have finished with it. Will it last long? How quickly will it end up in a landfill?

Plant trees

In New Zealand, forests offset nearly 30% of our greenhouse gas emissions. A regenerating native forest can remove more than 8 tonnes of carbon dioxide per hectare per year from the atmosphere over its first 50 years.

Studies have shown that coastal vegetation can reduce erosion and minimise the impact of waves and floods, and gradual changes such as sea level rise.

Trees provide shade, which has a cooling effect in towns and cities. Placed strategically around buildings, they can cut electricity used for cooling in summer.

Actions you can take

- Plant native trees on your property.
- Get involved in a community forest restoration, dune care or coastal revegetation programme in your area. ***Nature Space*** is a great place to discover restoration groups in your region.
- From local to national: ***The Million Metre Streams project*** allows you to support planting projects via donations and/or volunteering if you haven't got your own area to plan and plant out.

DID YOU KNOW?

Planting native grasses, trees and shrubs along waterways helps filter out pollution and provides habits for species such as inanga/whitebait.

Conserve water

Climate change is likely to have an impact on our water resources. Water supply may be altered due to changes in temperature and rainfall patterns, and water demand is likely to increase during the summer months as temperatures increase.

Be proactive in developing household or farm water conservation measures.

Actions you can take

- Replace lawns with native plants. Did you know that maintaining a grass lawn uses 80% more water than maintaining native plants? Native plants also provide food and shelter for birds and other wildlife.
- Collect rainwater and use it to water the garden and for other household tasks that don't require drinking quality water.
- When buying new household devices, consider how water-efficient they are.
- ***Planning and planting a native garden***, Department of Conservation.
- Save water - Christchurch City Council: ***water saving tips***.

Further ideas for action on Climate Change

These actions have a higher cost, but a big impact:

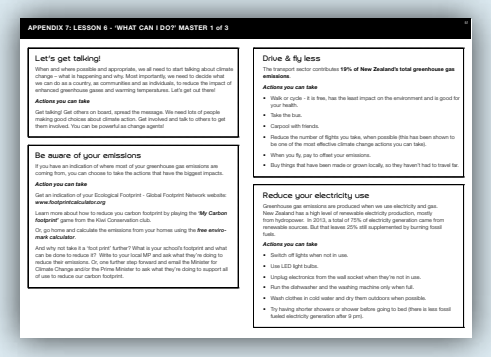
- If you are building a house, include balconies, shading and efficient cooling systems such as natural ventilation.
- Use passive solar design and insulation - this reduces the need for heating in winter and air-conditioning in summer.
- If you replace your car, consider electric - bike or car!
- Building an energy efficient home ***Energywise website***.
- ***Electric vehicles website***.
- ***Electric bikes*** SOURCE: THE SPINOFF

Video: For those children who may be thinking: 'We are just children, what can we do?', watch the following inspirational video: ***Greta Thunberg, climate change and you are never too young.*** *(4mins)* **SOURCE: GOAL CAST INSPIRING SPEECH (YOUTUBE)**

At a young age, Greta Thunberg recognised that there was a huge disconnect between the evidence from climate experts and the actions being taken in society. Frustrated by this lack of action, she decided to take matters into her own hands. Greta is a 15-year-old Stockholm native who lives at home with her parents and sister Beata. She's a 9th grader in Stockholm who enjoys spending her spare time riding Icelandic horses, and spending time with her family's two dogs, Moses and Roxy. She loves animals and has a passion for books and science. At a young age, she became interested in the environment and convinced her family to adopt a sustainable lifestyle. This talk was given at a TEDx event using the TED conference format, but independently organized by a local community.

What you will need

- ***Appendix 6: Lesson 6*** - 'What Can I do?' masters (3 pages).
- Nine groups (a group per action).
- Sheets of paper per group, plus pens to write up their ideas.


APPENDIX 7: LESSON 6 - 'WHAT CAN I DO?' MASTER 1 of 3

Let's get talking!

When and where possible and appropriate, we all need to start talking about climate change – what is happening and why. Most importantly, we need to decide what we can do as a country, as communities and as individuals, to reduce the impact of enhanced greenhouse gases and warming temperatures. Let's get out there!

Actions you can take

Get talking! Get others on board, spread the message. We need lots of people making good choices about climate action. Get involved and talk to others to get them involved. You can be powerful as change agents!

Be aware of your emissions

If you have an indication of where most of your greenhouse gas emissions are coming from, you can choose to take the actions that have the biggest impacts.

Action you can take

Get an indication of your Ecological Footprint - Global Footprint Network website: **www.footprintcalculator.org**

Learn more about how to reduce you carbon footprint by playing the **'My Carbon Footprint'** game from the Kiwi Conservation club.

Or, go home and calculate the emissions from your homes using the **free enviro-mark calculator**.

And why not take it a 'foot print' further? What is your school's footprint and what can be done to reduce it? Write to your local MP and ask what they're doing to reduce their emissions. Or, one further step forward and email the Minister for Climate Change and/or the Prime Minister to ask what they're doing to support all of use to reduce our carbon footprint.

Drive & fly less

The transport sector contributes **19% of New Zealand's total greenhouse gas emissions**.

Actions you can take

- Walk or cycle - it is free, has the least impact on the environment and is good for your health.
- Take the bus.
- Carpool with friends.
- Reduce the number of flights you take, when possible (this has been shown to be one of the most effective climate change actions you can take).
- When you fly, pay to offset your emissions.
- Buy things that have been made or grown locally, so they haven't had to travel far.

Reduce your electricity use

Greenhouse gas emissions are produced when we use electricity and gas. New Zealand has a high level of renewable electricity production, mostly from hydropower. In 2013, a total of 75% of electricity generation came from renewable sources. But that leaves 25% still supplemented by burning fossil fuels.

Actions you can take

- Switch off lights when not in use.
- Use LED light bulbs.
- Unplug electronics from the wall socket when they're not in use.
- Run the dishwasher and the washing machine only when full.
- Wash clothes in cold water and dry them outdoors when possible.
- Try having shorter showers or shower before going to bed (there is less fossil fueled electricity generation after 9 pm).

ACTIVITY 1 Acting up for Climate Change

Place the nine actions **face down** on the floor in front of you.

Ask one student per group to come up and pick a sheet. While staying up the front, ask them to read it silently, without sharing it with anyone.

Once all groups have their 'action' sheet, explain to the students that each group will act out the things they could do to help their selected climate change action become a reality. The rest of the class will watch and must guess their action.

In their groups, and without letting the other groups know their action, they will have approx. 15 mins to practice.

When all groups are ready, each group 'acts out' their action for climate change. At the end of their 'play', the rest of the class guesses their action and discusses what they could also do, as an individual or a collective. Include sharing how their action(s) will help reduce the impacts of climate change.

ACTIVITY 2 Adaptation & mitigation: making a commitment

At the end of the lesson, explain to the students that over the next two weeks or so, they will be planning and implementing their very own action. To kick start the process, do a quick brainstorm of ideas.

The brainstormed ideas will lead the discussion for sessions seven and eight.

SESSION 7

Climate Change scepticism & communication

BACKGROUND INFORMATION FOR TEACHERS

The preceding sessions have discussed: weather and climate; understanding climate change; anthropogenic or human activity as the main cause of an enhanced greenhouse effect; the impact of climate change on the environment and all living things; and, how best to mitigate and adapt to the impacts, both on us and other species.

A lot of what we know and understand about climate change is guided by science and scientists, complemented with other world views such as Mātauranga Maori.

Scientists continue to observe, measure and monitor climate trends and impacts. For most, it is obvious - climate change is happening, and the cause of the enhanced greenhouse effect is **anthropogenic** (human activity).

However, some are yet to be convinced, or flat out deny the very existence of climate change. Alternatively, they deny that the enhanced greenhouse effect is caused by anthropogenic factors.

As the students learn more about climate change, they may also hear, read about, or speak with, those who disagree with the science behind climate change. This could cause confusion and anxiety, especially if it appears that because of that denial or lack of understanding, the urgent action required to mitigate and adapt to climate change is stalled.

On the following page are just some of the 'climate myths' that some people believe. Each 'myth' is 'busted' by what scientists have monitored, observed and measured over many, many years.

"I'm not a believer in man-made global warming. It could be warming, and it's going to start to cool at some point. And you know, in the early, in the 1920s, people talked about global cooling... They thought the Earth was cooling. Now, it's global warming...

But the problem we have, and if you look at our energy costs, and all of the things that we're doing to solve a problem that I don't think in any major fashion exists."

PRESIDENT DONALD TRUMP, 2015

What do New Zealanders believe?

SURVEY REVEALS MOST OF US BELIEVE CLIMATE CHANGE IS MAN-MADE SOURCE: STUFF

Stanley and Victoria University PhD candidate John Kerr found 79.5% of participants agreed climate change was caused by humans.

Of the 9000 people surveyed, about three quarters, or 76.5% of participants, said they were willing to make personal sacrifices for the environment, and 74.5% said they'd made some sacrifices already.

University researchers found about 12.7% of respondents - one in eight of us - don't believe humans are to blame for climate change. 7.9% were unsure.

Political views were one of the clearest factors that correlated with respondents' beliefs that humans are causing climate change, assistant professor at the University of Canberra, Samantha Stanley, said.

"People who are less convinced that climate change is caused by humans are generally less willing to do something about it, so it is disappointing."

The below climate myths are to be used as part of the 'Myth buster role-play', lesson 7, activity 2 (on the following page).

CLIMATE MYTH	VS.	WHAT THE SCIENCE SAYS
"Climate has changed before"		Climate reacts to whatever forces it to change at the time; humans are now the dominant factor.
"It's not bad"		Negative impacts of global warming on agriculture, health & environment far outweigh any positives.
"There is no consensus"		97% of climate experts agree humans are causing global warming.
"It's cooling"		On average, 2000-2009 was the hottest decade on record.
"Animals and plants can adapt"		Global warming will cause mass extinctions of species that cannot adapt on short time scales.
"It hasn't warmed since 1998"		Every part of the Earth's climate system has continued warming since 1998, with 2015 shattering temperature records.
"It's cold!"		A local cold day has nothing to do with the long-term trend of increasing global temperatures.
"Extreme weather isn't caused by global warming"		Extreme weather events are being made more frequent and worse by global warming.
"Climate scientists are in it for the money"		Climate scientists could make far more money in other careers - most notably, working for the oil industry.
"Human CO2 is a tiny % of CO2 emissions"		The natural cycle adds and removes CO2 to keep a balance; humans add extra CO2 without removing any.
"Polar bear numbers are increasing"		Polar bears are in danger of extinction as well as many other species.
"CO2 limits will harm the economy"		The benefits of a price on carbon outweigh the costs several times over.
"It's a natural cycle"		No known natural forcing fits the fingerprints of observed warming except anthropogenic greenhouse gases.
"Scientists can't even predict weather"		Weather and climate are different; climate predictions do not need weather detail.
"CO2 limits will hurt the poor"		Those who contribute the least greenhouse gases will be most impacted by climate change.
"Volcanoes emit more CO2 than humans"		Humans emit 100 times more CO2 than volcanoes.
"Record snowfall disproves global warming"		Warming leads to increased evaporation and precipitation, which falls as increased snow in winter.
"CO2 limits will make little difference"		If every nation agrees to limit CO2 emissions, we can achieve significant cuts on a global scale.
"Renewable energy is too expensive"		When you account for all the costs associated with burning coal and other fossil fuels, like air pollution and health effects, they are significantly more expensive than most renewable energy sources.
"Humans are too insignificant to affect global climate"		Humans are small but powerful, and human CO2 emissions are causing global warming.
"It's too hard"		Scientific studies have determined that current technology is enough to reduce greenhouse gas emissions to avoid dangerous climate change.
"It's not urgent"		A large amount of warming is delayed, and if we don't act now, we could pass tipping points.
"Climate is chaotic and cannot be predicted"		Weather is chaotic but climate is driven by Earth's energy imbalance, which is more predictable.
"Adapting to global warming is cheaper than preventing it"		Preventing global warming is relatively cheap, while a "business as usual" approach will cause accelerating climate damage costs that economists struggle to even estimate.
"Renewable energy investment kills jobs"		Investment in renewable energy creates more jobs than investment in fossil fuel energy.
"It's only a few degrees"		A few degrees of global warming have a huge impact on ice sheets, sea levels and other aspects of climate.
"Removing all CO2 would make little difference"		Removing CO2 would cause most water in the air to rain out and cancel most of the greenhouse effect.
"Heatwaves have happened before"		Global warming is increasing the frequency, duration and intensity of heatwaves.

The students will now have a good understanding of what climate change is, and how best to mitigate and adapt to the impacts, both on humans and other species. As this understanding grows, it's likely there will be an urge to talk about climate change, with each other, and with family and friends.

The climate change conversation can be challenging, invigorating and unifying all at the same time! As conversations grow and develop, so might the need to get actively involved in a way that contributes to change.

To ensure that children are prepared for the possible conversations ahead, it can be helpful to have a few practice runs in the relative safety of the classroom.

USEFUL INFORMATION AND TIPS

Activism: An activist is someone who works to bring about political or social change.

Resist the urge to protect - Children and youth know what is going on and they are upset by it. Appropriate information and action are empowering and helpful for young people.

When learning about activism, the children need to become aware of teamwork, planning, strategy and communication.

ACTIVITY 1 Empathy or Outrage + Action = ACTIVISM

Write the word 'Activism' on a piece of paper/board and ask the children what they think it means, writing their answers around the word.

If the children aren't sure, share the above definition and discuss.

Ask them if they personally know of, or have heard about, any activists, or examples of activism. If so, what did the activism aim to communicate or change?

Then ask them if they know of, or have heard of, any examples of environmental activists or activism? Examples include Schools Strike4Climate, Steve Irwin (Crocodile Hunter), Rachel Carson, David Attenborough, and Greta Thunberg …

An environmental activist is a person who advocates for, or works towards, protecting the natural environment from destruction or pollution.

Ask the children: 'What do you think your role could be? Can children and young people make a real impact? Can you think of any examples? What qualities do young people have that could make their voices especially powerful?'

Ask the children: 'What do you like doing, and think you are good at? Sometimes this can give you a good steer towards the role you could play. For example, "Are you good at writing, explaining, drawing, public speaking, or writing poems etc.?" There is a role for everyone and their talents. People are more effective when they are doing something they enjoy.

EXTRA: For young movers and shakers in the environmental activism world...

5 young activists who inspired us this year

ACTIVITY 2 Communication is key

Talking about climate change can be challenging enough. But talking to someone who is yet to be convinced, or who flat out denies the existence of climate change can add an extra layer of challenge.

The following activity provides some key 'strategies' for the children to be aware of and to practice when talking about and taking action for climate change.

- Discuss with the children how it feels when someone is disrespectful about something they care about, or insists they're wrong about something they believe.
- Ask the children 'How do you speak to someone in a way that makes them more likely to listen?'
- Share the '5 Ways to (Respectfully) Disagree' below with the children:
  1. Don't make it personal.
  2. Avoid putting down the other person's ideas & beliefs.
  3. Use "I" statements to communicate how you feel. what you think, and what you want or need.
  4. Listen to the other point of view.
  5. Stay calm.

EXTRA! EXTRA!
Image activity: *Show the children images of polar bears on melting ice and smoke stack. Ask the children to comment on the effectiveness of these images in communicating about climate change. What are the problems with these images? What would be better alternatives, and why?*

Myth buster role-play

Please note: Emphasise to students that all discussion remains respectful and constructive. It may be tempting to negatively stereotype those who oppose climate science, but that approach only widens the gap between the two sides. For example, the dialogue could include questions that the students could ask the sceptics to help them understand each other's underlying concerns, rather than steamrolling over each other.

- Using a selection of the 'climate myths' from 'Session 7: Climate change scepticism and communication', explain to the children that they're going to pair up to 'role play' a discussion with someone who doesn't agree with climate change, or who doesn't understand the science.
- One student will be the 'activist' for climate change and the other the 'sceptic.'
- This can be done with the whole class or with a selection of students who agree to take part.
- Halfway through, ask the students to swap roles.
- Remind them of the '5 Ways to (Respectfully) Disagree'.
- After the role-play, reflect on communication skills, how to manage feelings, and communication of the science.

Did you know? The Children's Convention...

The Office of the Children's Commissioner has developed a useful resource that introduces children & their teachers to children's rights & the United Nations Convention on the Rights of the Child (the Children's Convention).

The level 3-4 Rights: Now! education resource has a specific focus on a child's right to have their say, participate and be heard on issues that affect them.

Climate change is an issue that affects children now & in the future. The resource provides timely support for children wanting to have a say and take action!

Section C: It's not too late!

Time for CLIMATE action

SPECIFIC LEARNING INTENTIONS

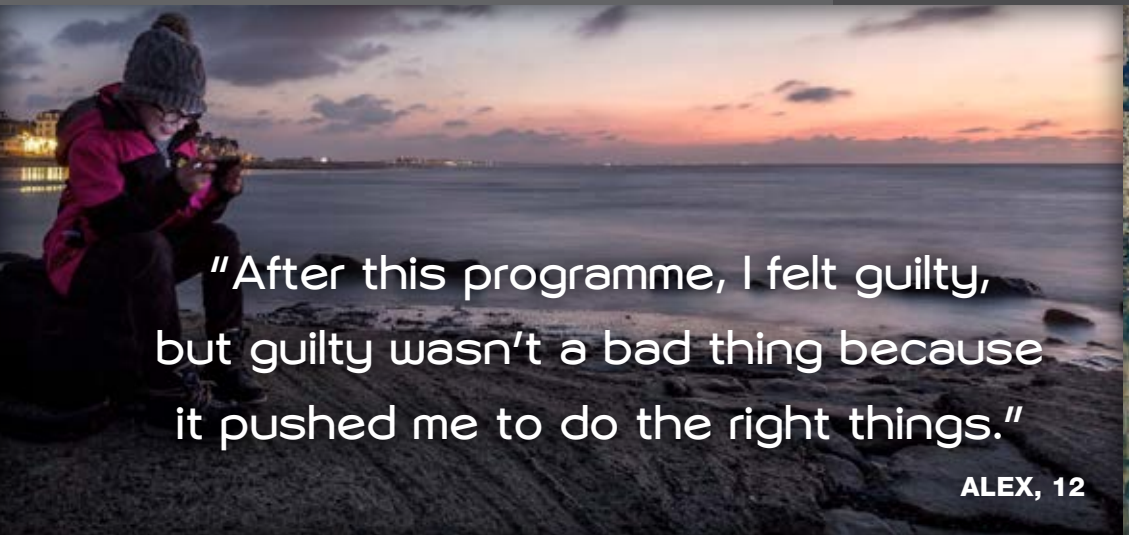
Students will:

- Create rich questions for inquiry, including asking for help, and more information, when and where they need it.
- Build on - and where possible apply - their own ideas and actions, to reduce the possible impacts of climate change, globally and locally.
- Explore values and build their understanding that people's views and values about the environment can vary, in keeping with their own values.
- Practice and develop group and cooperative skills.
- Link their knowledge to the real-life situation (transference).

SUCCESS CRITERIA

I can:

- Establish my own inquiry questions.
- Reflect on my understanding of climate change and its impact globally and locally, and use this understanding to create ideas and actions.
- Reflect on and evaluate my thoughts and ideas, and ask for help and/or clarification, when and where I need it.
- Reflect on my knowledge and understanding to create and apply ideas and actions aimed at reducing the impacts of climate change, both locally and globally.
- Work with others to develop and implement a plan of action.



SESSION 8 & BEYOND:

Adaptation & mitigation

Actions we can take to adapt to & reduce the impact of Climate Change

BACKGROUND INFORMATION FOR TEACHERS

Please note: *Session 8 will be led by the mitigation and adaptation ideas shared by the students. Therefore, in place of prescribed lessons, there are suggestions to inspire and guide you and your students when developing actions aimed at adapting to and mitigating the impacts of climate change.*

Inspiration and hope

The following activities aim to motivate the students' thinking around climate change, including ideas and possible actions that they can plan and implement.

ACTIVITY 1 A local inspiration

Video: A day in the life of a climate change activist: Lucy Gray, Year 8 student, Beckenham Primary School, Christchurch.

ACTIVITY 2 Refining our ideas

Revisiting their ideas from Lesson 5, Activity 2: Group break out.
Each group to choose their ***top three*** and explore the steps required to make it happen.

Regroup as a class and a select a few students to share their top idea.

Committing to action: Postcards

- Each group receives a postcard and writes the ***top three*** actions that they, as a group, will commit to.
- Explain to the children that they will ***hand in the postcard actions at the end of the lesson*** and that the postcards will be handed out again subsequently, so that each group can check in on their progress.
- The actions can be ***small and may even be something they're already doing***. Their commitment is to begin, or keep up, the action(s) e.g. walking/cycling to school, turning off lights when not in the room, recycling/reducing waste etc.
- ***Or, they can commit to new small and/or larger actions*** that they feel are realistic for them and their situation.

The actions ***can also include planning towards future and larger scale actions***, such as planning a campaign, a website, a group, etc.

ACTIVITY 3: ***Videos: NZ Schools strike for Climate Change***

Next steps: What will you do?

LEARNING INTENT: ***This section involves the students inquiring into at least one action they can take for Climate Change & developing an outcome***

Using the knowledge and understanding gained from the programme, this is the student's first opportunity to take action and make a difference towards the impacts of climate change. By becoming 'experts' in this inquiry process and determining how to share this knowledge with a target audience, students are helping to educate others and raise awareness about the problem, as well as promoting actions that their audience can take now, and into the future.

It's important for students to make the connection between their presentation and the next steps that both they and their target audience can take.

BEING A CLIMATE CHANGE AGENT OR AMBASSADOR

Being a climate change agent or ambassador is an important and empowering role. Raising awareness and sharing stories can make a difference, even if it can't prevent all the negative climate impacts people experience in their communities.

This *video* features Red Cross youth in the Pacific using their voices to raise awareness and call for action. It shows the impacts of climate change and what these youth are doing to adapt to it.

SESSION OUTCOMES

1. Raising awareness

The first part of this section focuses on raising awareness of climate change. Students can work together or on their own to develop a presentation on climate change using local examples, e.g. a video presentation, advertising campaign, play, pamphlet, or storybook. Students choose the information, how it will be presented and who they will present to.

2. Practical action

The second part of this section prompts students to consider how they can work with their audience to make a difference. Students present their audience with a 'take action' challenge, something they can work on together after the initial presentation/performance.

Producing a play, a pamphlet (and delivering it), a story book, a video etc. are all part of the 'taking action' component, as long as students target their audience and deliver their message appropriately.

An example of whole class actions

Explain to students that they're going to use all their knowledge and experience to-date to put together a dramatic performance or presentation about climate change, its impacts, and the short, medium, and long-term actions we can take as individuals and groups.

Students get into groups of 2 or 3. Within each group, students can take on different roles, e.g. script writing, producing, acting, developing technology etc.

Relate to the students that they have a specified time period to work on this, which could include some in-class planning time, some outside class time and three other class periods.

VISION MĀTAURANGA

Contributing innovative, practical and sustainable climate adaptation solutions for Māori and all New Zealanders.

National Science Challenges | THE DEEP SOUTH Te Kōmata o Te Tonga

Ko ngā mahi inaianei hei oranga mo rātou apopo | For those who will benefit from our efforts today.

Eight Māori-led science projects have been or are currently funded through the Vision Mātauranga science programme of the Deep South Challenge. These projects are investigating climate change impacts and opportunities for iwi, hapū, whānau and Māori business. Together they represent the largest ever Māori-led research effort into the implications of changing climate conditions for Māori society.

The projects within the Vision Mātauranga science programme investigate climate change links, pressure points and adaptation strategies for Māori communities and business. They're also considering new products, services and systems derived from mātauranga Māori.

Children's Rights & Climate Change

Climate change poses a severe threat to children's most basic rights, including those related to survival and wellbeing, health, food security and nutrition, water, and access to education. Some of the leading killers of children worldwide are highly sensitive to climate change. Higher temperatures have been linked to increased rates of malnutrition, cholera, diarrhoeal disease and vector-borne diseases like dengue and malaria. Children's underdeveloped immune systems put them at far greater risk of contracting these diseases and succumbing to their complications. Additionally, the loss of a parent or home due to a climate change-induced natural disaster certainly changes a child's world but it also can jeopardise their development. Furthermore, the role of climate change in exacerbating and compounding drivers of insecurity is likely to lead to more children being at risk of violence, exploitation and abuse, in both conflict and non-conflict settings. Climate change is, at its core, an equity issue. Despite being least responsible for climate change, it is today's children and future generations that will bear the heaviest burden of our inaction. SOURCE: UNICEF NZ

Getting Started

You could start this session with a brainstorm about climate change and link back to previous activities. Discuss the following:

- What is climate and weather?
- Why is climate change an issue, and what has caused it?
- Who came to visit us and what kinds of things did we learn from them?
- How has the role of science helped us to understand climate change and how will it continue to do so?
- What kinds of things could we see globally and locally as a result of climate change?
- What human activities threaten the worsening of climate change?
- How can we reduce the impacts of climate change - as individuals and as a group?
- Are there any short, medium, and long-term decisions that you, your family and/or community, could make?

Presentation Ideas

- An advertising campaign or a storybook focussing on one impact of climate change, outlining their recommendations & possible challenges.
- A dramatic play, song, short movie or animated video about climate change in general, or about one particular aspect of it.
- Developing a web page about climate change for community, town and/or region.
- Creating a computer presentation or pamphlet for businesses on how they can reduce their greenhouse gases. Cover their use of transportation, electricity, and waste - including disposal and packaging.

Target audience

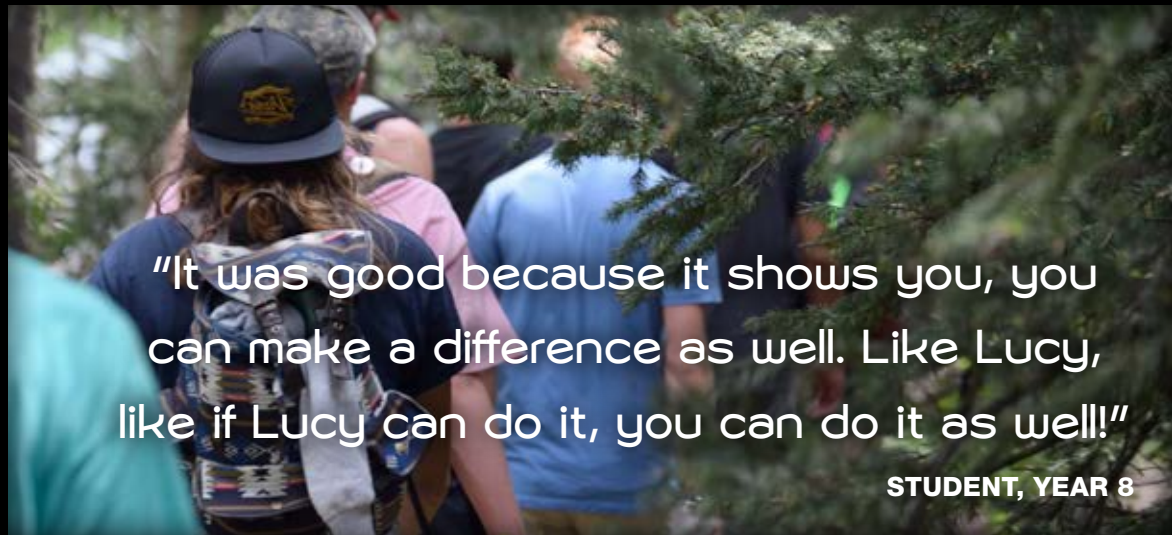
Each group of students presents/performs to a different target audience. They need to decide who they'll invite, and how to invite that audience. Students, together with the classroom teacher, choose each group's target audience. On completion, students could also send their work to outside groups or organisations, such as other schools, local councils and businesses, homeowners, Ministry for the Environment, and Department of Prime Minister and Cabinet!

Possible target audiences

- A class from within their school or a neighbouring primary school.
- Teachers from another class.
- Board of Trustees.
- A local business/business owner.
- Parents/grandparents.
- Local community groups.
- Local and central government.

Reflection

During the times set aside for this presentation/performance, groups could meet with another group to share their learning, or meet with you to ask questions, discuss what they are putting together, and check that they're on the right track.



The New Zealand Curriculum gives strong support to **social inquiry approaches** and to involving students in sustainability issues. The principles and values on which the curriculum is based include **future focus, innovation, inquiry and curiosity**, as well as **ecological sustainability and community participation**.

CURRICULUM LEVEL 4 Focus: Climate Change

BIG IDEAS: Everything is interconnected. Enhanced greenhouse gases are predominantly anthropogenic, and are the dominant cause of climate change. Reducing greenhouse gases will mitigate the impact of climate change in the short, medium, and long term. There are steps that we can take to mitigate and adapt to the impact of climate change – through action, innovation and design, and planning.

MAJOR KEY COMPETENCY FOCUS IN THIS PROGRAMME

Thinking: learners are to explore a range of concepts and related questions about climate and weather, climate change causes and impacts, and short, medium, and long-term actions to reduce those impacts. They are then to use the concepts and knowledge acquired to undertake an inquiry into one aspect of climate change, suggesting ways people can act, design and create to reduce impacts.

Participating and contributing learners have the opportunity to actively engage with their school and wider community about climate change. Through their inquiry they generate their own knowledge and use this to develop suggestions, activities and resources that they share with relevant community groups or businesses.

Using language, symbols and texts: learners explore and have the opportunity to use a variety of methods to communicate information, experiences and ideas. Through their inquiry they select the most appropriate way to present climate change information and ideas - including actions - to their target audience.

EDUCATION FOR SUSTAINAILITY

Learning to think and act in ways that will safeguard the future wellbeing of people and our planet.

Concepts: Central concepts that students can develop understanding of through EfS include:

- **Sustainability:** the ability of individuals, groups and communities to meet their needs and aspirations without compromising the ability of future generations to meet theirs.
- **Equity:** respect for all life, social justice, intergenerational equity, and finite resources.
- **Interdependence:** biodiversity, community, cultural diversity, democracy, globalisation.
- **Responsibility for action:** taking action, informed decision-making, citizenship, consumerism, enterprise, resilience, and regeneration.

The 'Climate change: Prepare today, live well tomorrow' learning programme works effectively as part of an EfS inquiry learning programme. ***Action*** is central to the inquiry learning approach. The ***action-inquiry method*** is the basis of EfS, which seeks to engage students in contemporary environmental issues and to meet the challenges of living sustainably. The programme's aim is for your students to ***create and implement their own planting plan as part of a wider inquiry***. Ensuring there is appropriate emotional and physical support, it is encouraged that the students can implement their actions when and where appropriate. In doing so, they feel empowered and not overwhelmed by the topic and their chosen sustainability inquiry.

LEARNING AREAS

SCIENCE

Nature of Science

Understanding about science

- Appreciate that science is a way of explaining the world & that science knowledge changes over time.
- Identify ways in which scientists work together and provide evidence to support their ideas.

Participating and contributing

- Use their growing science knowledge when considering issues of concern to them.
- Explore various aspects of an issue and make decisions about possible actions.

Living World

Ecology

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

Evolution

- Explore how the groups of living things we have in the world have changed over time and appreciate that some living things in New Zealand are quite different from other living things in other areas of the world.

SOCIAL STUDIES

Students will gain knowledge, skills and experience to:

- Understand how exploration and innovation create opportunities and challenges for people, places and environments
- Understand events have causes and effects;
- Understand how formal and informal groups make decisions that impact on their communities
- Understand how people participate individually and collectively in response to community challenges

ENGLISH

Speaking, writing, and presenting processes and strategies

Integrate sources of information, processes, and strategies with developing confidence, to identify, form and express ideas.

Purposes and audiences

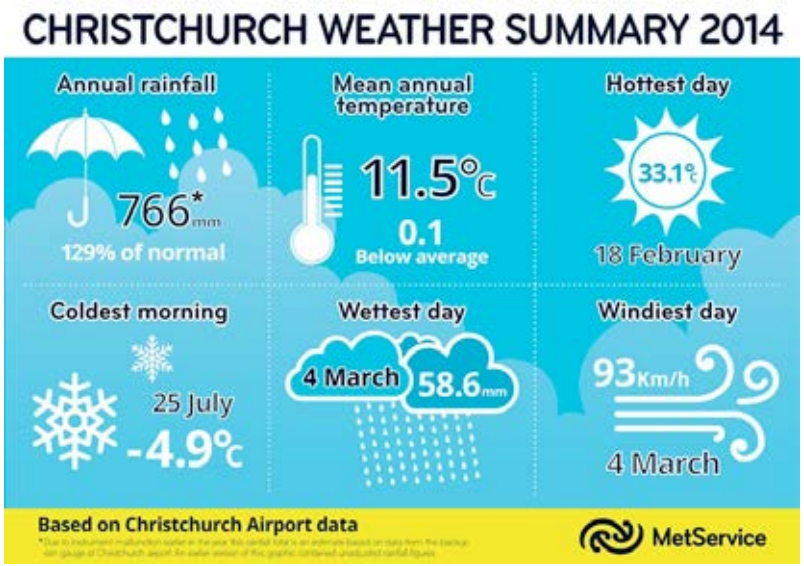
Show an increasing understanding of how to shape texts for different purposes and audiences.

TECHNOLOGY

Technological practice: Planning for practice

Undertake a plan that includes reviewing the effectiveness of past actions and resourcing, exploring implications for future actions and accessing of resources, and consideration of stakeholder feedback to enable development of an outcome.

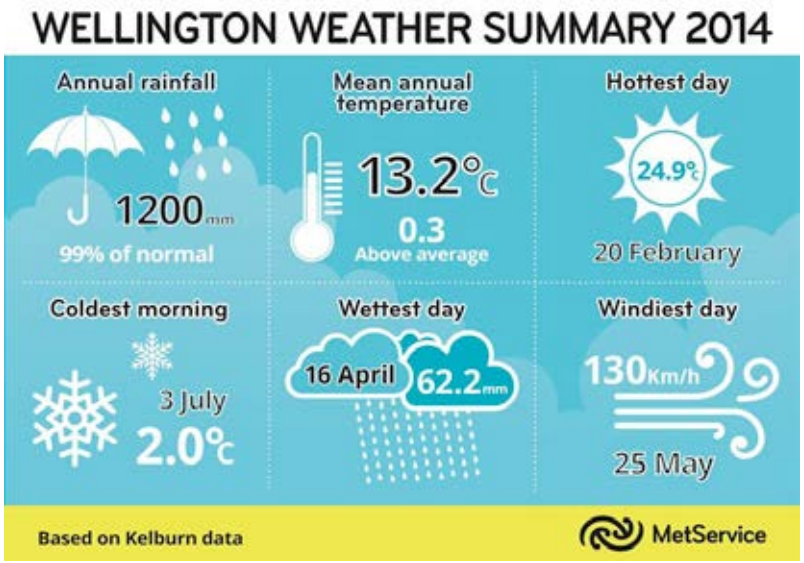
*Examine both Christchurch's and Wellington's **weather** for 2014, and **compare** it to their **climate summary**. In the space provided, describe how the weather for 2014 was similar to the climate summary, and how it was different.*



CHRISTCHURCH CLIMATE SUMMARY

Christchurch is part of the **Eastern South Island zone**, and is greatly dependent on the lie of the **massive Southern Alps**. **Summers are warm**, with highest temperatures occurring when hot dry northwesterlies blow over the Alps and plains. The **average summer daytime temperatures range from 18°C - 26°C**, but may get above 30°C. It is **considered dry with a low annual rainfall** and is prone to long dry spells, especially in summer. **Winters are cold with frequent frost** with typical winter daytime maximum temperatures ranging from **7°C to 14°C**.

*Describe how the weather for 2014 was **like** the climate summary, & how it was **different**.*



WELLINGTON CLIMATE SUMMARY

Wellington is part of the **South-West North Island zone**. Because of its exposure to disturbed weather systems **from the Tasman Sea**, this climate zone is **often quite windy**. The most settled weather occurs during summer and early autumn. Summers are warm. **Typical summer daytime maximum air temperatures range from 19°C to 24°C**, seldom exceeding 30°C. **Winters are relatively cool**. Typical winter daytime maximum air temperatures range from **10°C to 14°C**. Frost occurs inland during clear calm conditions in winter.

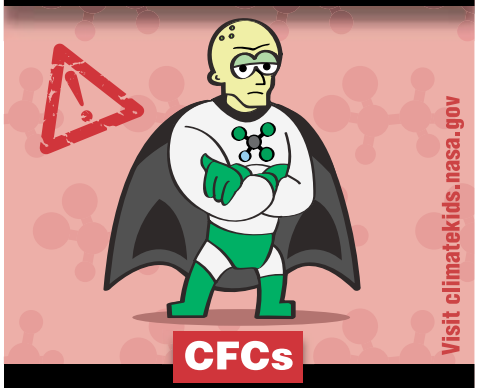
*Describe how the weather for 2014 was **like** the climate summary, & how it was **different**.*

***EXTRA!** After comparing the climate summaries, what are the main differences between Christchurch and Wellington's weather, and the main causes of these differences?*

National Aeronautics and Space Administration

NASA

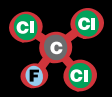
CHLOROFLUOROCARBONS



Visit climatekids.nasa.gov

CFCs

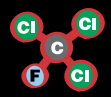
Fluorinated gases are not created in nature. They damage the protective ozone layer and are powerful greenhouse gases.



CHLOROFLUOROCARBONS

CFCs

You probably shouldn't have created me.



National Aeronautics and Space Administration

NASA

NITROUS OXIDE

Visit climatekids.nasa.gov

N2O

Nitrous oxide is a natural part of the nitrogen cycle. Bacteria in soil and the ocean make it.

NITROUS OXIDE

N2O

Nitrous oxide is released by some types of factories, power plants, and plant fertilizer. It damages the protective ozone layer and is a powerful greenhouse gas.

National Aeronautics and Space Administration

NASA

OZONE

Visit climatekids.nasa.gov

O3

Up in the atmosphere where the planes fly, the ozone layer blocks the sun's radiation, which helps protect us from the powerful rays.

OZONE

O3

Close to the ground, ozone acts as a greenhouse gas and can be formed by burning gas in cars and factories.

National Aeronautics and Space Administration

METHANE

Visit climatekids.nasa.gov

CH_4

Methane, made of carbon and hydrogen, is a normal gas released from wetlands, growing rice, raising cattle, using natural gas, and mining coal.

METHANE

CH_4

It traps a lot of heat. Scientists consider it the second most important contributor to human-caused global warming of all the greenhouse gases.

National Aeronautics and Space Administration

CARBON DIOXIDE

Visit climatekids.nasa.gov

CO_2

Made up of carbon and oxygen, CO2 is all around us naturally. It comes from decaying and living organisms, and from volcanoes.

CARBON DIOXIDE

CO_2

CO2 is released when burning fossil fuels like coal and oil. It's the most important contributor to human-caused global warming.

National Aeronautics and Space Administration

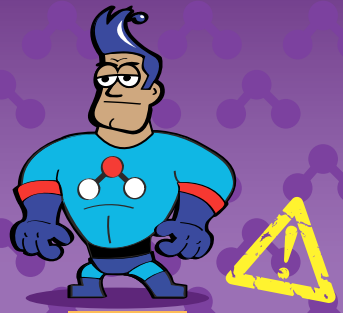
WATER VAPOR

Visit climatekids.nasa.gov

H_2O

This is water in gas form, like steam above a boiling pot or water evaporating off a lake. It forms clouds and rains back on Earth. This can cause a cooling effect.

WATER VAPOR



H_2O

Water vapor blocks heat from escaping, so it gets warmer. That makes even more water evaporate. Once this process happens, it can happen again more easily.

APPENDIX 4: LESSON 2 - FEELINGS SPLASH

13 Return to Lesson

What feelings can you think of that start with the letters below? ***Can you write more than one feeling for some of the letters?***

O J A H

D G U N

V K I F

S P Q W

M T B R

Z C E L

Y

Think about which feelings may be strong or difficult to manage. Highlight which feelings are happening at the moment.

Mitigation and adaptation to climate change

MITIGATION

Actions to reduce and curb greenhouse gas emissions

ADAPTATION

Actions to reduce vulnerability to climate change

Energy efficiency

More secure facility locations and infrastructures

Greater use of renewable energy

Landscape restoration (natural landscape) and reforestation

Electrification of industrial processes

Flexible and diverse cultivation to be prepared for natural catastrophes

Efficient transport
(electric public transport, bicycles, etc.)

Research and development on possible catastrophes, temperature behavior, etc.

Carbon tax and emissions markets

Preventive and precautionary measures
(evacuation plans, health issues, etc.)

Mitigation attends to the causes of climate change and adaptation addresses its impacts

Sustainability for all
www.activesustainability.com

acciona

Let's get talking!

When and where possible and appropriate, we all need to start talking about climate change – what is happening and why. Most importantly, we need to decide what we can do as a country, as communities and as individuals, to reduce the impact of enhanced greenhouse gases and warming temperatures. Let's get out there!

Actions you can take

Get talking! Get others on board, spread the message. We need lots of people making good choices about climate action. Get involved and talk to others to get them involved. You can be powerful as change agents!

Be aware of your emissions

If you have an indication of where most of your greenhouse gas emissions are coming from, you can choose to take the actions that have the biggest impacts.

Action you can take

Get an indication of your Ecological Footprint - Global Footprint Network website: ***www.footprintcalculator.org***

Learn more about how to reduce you carbon footprint by playing the ***'My Carbon footprint'*** game from the Kiwi Conservation club.

Or, go home and calculate the emissions from your homes using the ***free enviro-mark calculator***.

And why not take it a 'foot print' further? What is your school's footprint and what can be done to reduce it? Write to your local MP and ask what they're doing to reduce their emissions. Or, take one further step forward and email the Minister for Climate Change and/or the Prime Minister to ask what they're doing to support all of us to reduce our carbon footprint.

Drive & fly less

The transport sector contributes **19% of New Zealand's total greenhouse gas emissions**.

Actions you can take

- Walk or cycle - it is free, has the least impact on the environment and is good for your health.
- Take the bus.
- Carpool with friends.
- Reduce the number of flights you take, when possible (this has been shown to be one of the most effective climate change actions you can take).
- When you fly, pay to offset your emissions.
- Buy things that have been made or grown locally, so they haven't had to travel far.

Reduce your electricity use

Greenhouse gas emissions are produced when we use electricity and gas. New Zealand has a high level of renewable electricity production, mostly from hydropower. In 2013, a total of 75% of electricity generation came from renewable sources. But that leaves 25% still supplemented by burning fossil fuels.

Actions you can take

- Switch off lights when not in use.
- Use LED light bulbs.
- Unplug electronics from the wall socket when they're not in use.
- Run the dishwasher and the washing machine only when full.
- Wash clothes in cold water and dry them outdoors when possible.
- Try having shorter showers or shower before going to bed (there is less fossil fueled electricity generation after 9pm).

Shop local & buy second hand when & where possible

When you buy local food or products it means that your food hasn't had to travel so far (in a vehicle which uses fossil fuels). You are also helping our economy.

Buying second hand is often not only cheaper, it also diverts goods from the landfill and gives items a much longer life than they would otherwise have. They can also be run by charities, meaning some of the profits go towards that charity.

Actions you can take

- Plant your own vegetables and fruit trees. Containers are great if you are short of space.
- Buy local and in-season foods that haven't travelled long distances to reach you.
- Shop at local secondhand stores or online marketplaces such as TradeMe for everything from clothes to furniture, kitchenware and books!

Conserve water

Climate change is likely to have an impact on our water resources. Water supply may be altered due to changes in temperature and rainfall patterns, and water demand is likely to increase during the summer months as temperatures increase.

Be proactive in developing household or farm water conservation measures.

Actions you can take

- Replace lawns with native plants. Did you know that maintaining a grass lawn uses 80% more water than maintaining native plants? Native plants also provide food and shelter for birds and other wildlife.
- Collect rainwater and use it to water the garden and for other household tasks that don't require drinking quality water.
- When buying new household devices, consider how water-efficient they are.
- ***Planning and planting a native garden***, Department of Conservation.
- Save water - Christchurch City Council: ***water saving tips***.

Reduce, reuse, recycle

The best way to reduce waste is to avoid creating it in the first place!
All products require energy and materials to be built, packaged, transported and sold. Reducing your consumption in general is good for the environment, and for your wallet.

Actions you can take

- Buy only the food you need and compost your kitchen scraps and garden waste. Around half of the waste that ends up in New Zealand landfills is organic material (food, garden, paper and wood waste). When organic material decomposes, it produces methane, which is a potent greenhouse gas.
- Buy products without any packaging whenever possible and always take your reusable bags to the supermarket. Make the most of what you already have.
- Maintaining and repairing products, such as your clothes, means they don't have to be replaced so often.
- Ask yourself: 'Do I really need this?' Think about what will happen to it after you have finished with it. Will it last long? How quickly will it end up in a landfill?

Eat less meat & dairy products

Red meat and dairy production results in significantly more greenhouse gas emissions than the production of chicken meat, fruit, vegetables and cereals. It also requires substantially more water. Around 30% of the world's land area is used for livestock production, and it is one of the key reasons for cutting down forests.

Actions you can take

- Cut down on meat. Eat more fruit and vegetables instead - this has many health benefits, such as reducing the risk of heart disease.
- Try having a meatless day each week. The Meatless Monday website has great recipes to get you started.
- Give it a go! Try out these meatless recipes at ***Oh my veggies***!

Plant trees

In New Zealand, forests offset nearly 30% of our greenhouse gas emissions. A regenerating native forest can remove more than 8 tonnes of carbon dioxide per hectare per year from the atmosphere over its first 50 years.

Studies have shown that coastal vegetation can reduce erosion and minimise the impact of waves and floods, and gradual changes such as sea level rise.

Trees provide shade, which has a cooling effect in towns and cities. Placed strategically around buildings, they can cut electricity used for cooling in summer.

Actions you can take

- Plant native trees on your property.
- Get involved in a community forest restoration, dune care or coastal revegetation programme in your area. ***Nature Space*** is a great place to discover restoration groups in your region.
- From local to national: ***The Million Metre Streams project*** allows you to support planting projects via donations and/or volunteering if you haven't got your own area to plan and plant out.