Unit Plan
Climate Change
Junior Science - year 9

https://commons.wikimedia.org/wiki/File:Greenland_Ice_Sheet_(3970865344).jpg

List science strands covered: Nature of Science Living World Physical World Material World Planet Earth & Beyond	BIG IDEA: Climate change is the result of many interacting systems on Earth, and it is accelerating due to anthropogenic (human-caused) activities.	LEVEL: New Zealand Curriculum Level 3-5 YEAR: Mixed ability Year 9, with extension work

NZC (Science) STRANDS: List AOs covered in this unit (including additional opportunities and linked into Unit Plan)		
Level 3	Level 4	Level 5
Nature of science. *Students will:* 3.1. Understanding about science 3.1.a. Appreciate that science is a way of explaining the world and that science knowledge changes over time. 3.1.b. Identify ways in which scientists work together and provide evidence to support their ideas. 3.2. Investigating in science 3.2.a. Build on prior experiences, working together to share and examine their own and others' knowledge. 3.2.b. Ask questions, find evidence, explore simple models, and carry out appropriate investigations to develop simple explanations. 3.3. Communicating in science 3.3.a. Begin to use a range of scientific symbols, conventions, and vocabulary. 3.3.b. Engage with a range of science texts and begin to question the purposes for which these texts are constructed. 3.4. Participating and contributing 3.4.a. Use their growing science knowledge when considering issues of concern to them. 3.4.b. Explore various aspects of an issue and make decisions about possible actions.	Nature of science. *Students will:* 4.1. Understanding about science 4.1.a. Appreciate that science is a way of explaining the world and that science knowledge changes over time. 4.1.b. Identify ways in which scientists work together and provide evidence to support their ideas. 4.2. Investigating in science 4.2.a. Build on prior experiences, working together to share and examine their own and others' knowledge. 4.2.b. Ask questions, find evidence, explore simple models, and carry out appropriate investigations to develop simple explanations. 4.3. Communicating in science 4.3.a. Begin to use a range of scientific symbols, conventions, and vocabulary. 4.3.b. Engage with a range of science texts and begin to question the purposes for which these texts are constructed. 4.4. Participating and contributing 4.4.a. Use their growing science knowledge when considering issues of concern to them. 4.4.b. Explore various aspects of an issue and make decisions about possible actions	Nature of science. *Students will:* 5.1. Understanding about science 5.1.a. Understand that scientists' investigations are informed by current scientific theories and aim to collect evidence that will be interpreted through processes of logical argument. 5.2. Investigating in science 5.2.a. Develop and carry out more complex investigations, including using models. 5.2.b. Show an increasing awareness of the complexity of working scientifically, including recognition of multiple variables. 5.2.c. Begin to evaluate the suitability of the investigative methods chosen. 5.3. Communicating in science 5.3.a. Use a wider range of science vocabulary, symbols, and conventions. 5.3.b. Apply their understandings of science to evaluate both popular and scientific texts (including visual and numerical literacy). 5.4. Participating and contributing 5.4.a. Develop an understanding of socio-scientific issues by gathering relevant scientific information in order to draw evidence-based conclusions and to take action where appropriate.
Living world *Students will*: 3.1. Life processes 3.1.a. Recognise that there are life processes common to all living things and that these occur in different ways. 3.2. Ecology 3.2.a. Explain how living things are suited to their particular habitat and how they respond to environmental changes, both natural and human-induced. 3.3. Evolution 3.3.a. Begin to group plants, animals, and other living things into science-based classifications. 3.3.b. Explore how the groups of living things we have in the world have changed over long periods of time and appreciate that some living things in New Zealand are quite different from living things in other areas of the world	Living world *Students will:* 4.1. Life processes 4.1.a. Recognise that there are life processes common to all living things and that these occur in different ways. 4.2. Ecology 4.2.a. Explain how living things are suited to their particular habitat and how they respond to environmental changes, both natural and human-induced. 4.3. Evolution 4.3.a. Begin to group plants, animals, and other living things into science-based classifications. 4.3.b. Explore how the groups of living things we have in the world have changed over long periods of time and appreciate that some living things in New Zealand are quite different from living things in other areas of the world.	Living world *Students will:* 5.1. Life processes 5.1.a. Identify the key structural features and functions involved in the life processes of plants and animals. 5.2. Ecology 5.2.a. Investigate the interdependence of living things (including humans) in an ecosystem.
Physical world *Students will:* 3.1. Physical inquiry and physics concepts 3.1.a. Explore, describe, and represent patterns and trends for everyday examples of physical phenomena, such as movement, forces, electricity and magnetism, light, sound, waves, and heat. For example, identify and describe the effect of forces (contact and non-contact) on the motion of objects; identify and describe everyday examples of sources of energy, forms of energy, and energy transformations.	Physical world *Students will:* 4.1. Physical inquiry and physics concepts 4.1.a. Explore, describe, and represent patterns and trends for everyday examples of physical phenomena, such as movement, forces, electricity and magnetism, light, sound, waves, and heat. For example, identify and describe the effect of forces (contact and non-contact) on the motion of objects; identify and describe everyday examples of sources of energy, forms of energy, and energy transformations.	Physical world *Students will:* 5.1 Physical inquiry and physics concepts 5.1.a. Identify and describe the patterns associated with physical phenomena found in simple everyday situations involving movement, forces, electricity and magnetism, light, sound, waves, and heat. For example, identify and describe energy changes and conservation of energy, simple electrical circuits, and the effect of contact and non-contact on the motion of objects. 5.2. Using physics 5.2.a. Explore a technological or biological application of physics
Material world *Students will:* 3.1. Properties and changes of matter 3.1.a. Group materials in different ways, based on the observations and measurements of the	Material world *Students will:* 4.1. Properties and changes of matter 4.1.a. Group materials in different ways, based on the observations and measurements of the	Material world *Students will:* 5.1. Properties and changes of matter 5.1.a. Investigate the chemical and physical properties of different groups of substances,

characteristic chemical and physical properties of a range of different materials. 3.1.b. Compare chemical and physical changes. 3.2. Chemistry and society 3.2.a. Relate the observed, characteristic chemical and physical properties of a range of different materials to technological uses and natural processes.	characteristic chemical and physical properties of a range of different materials. 4.1.b. Compare chemical and physical changes. 4.2. The structure of matter 4.2.a. Begin to develop an understanding of the particle nature of matter and use this to explain observed changes. 4.3. Chemistry and society 4.3.a. Relate the observed, characteristic chemical and physical properties of a range of different materials to technological uses and natural processes.	for example, acids and bases, fuels, and metals. 5.2. The structure of matter 5.2.a. Describe the structure of the atoms of different elements. 5.2.c. Distinguish between an element and a compound, a pure substance and a mixture at particle level. 5.3. Chemistry and society 5.3.a. Link the properties of different groups of substances to the way they are used in society or occur in nature.
Planet Earth and beyond *Students will:* 3.1. Earth systems 3.1.a. Appreciate that water, air, rocks and soil, and life forms make up our planet and recognise that these are also Earth's resources. 3.2. Interacting systems 3.2.a. Investigate the water cycle and its effect on climate, landforms, and life. 3.3. Astronomical systems 3.3.a. Investigate the components of the solar system, developing an appreciation of the distances between them.	Planet Earth and beyond *Students will:* 4.1. Earth systems 4.1.a. Develop an understanding that water, air, rocks and soil, and life forms make up our planet and recognise that these are also Earth's resources. 4.2. Interacting systems 4.2.a. Investigate the water cycle and its effect on climate, landforms, and life. 4.3. Astronomical systems 4.3.a. Investigate the components of the solar system, developing an appreciation of the distances between them.	Planet Earth and beyond *Students will:* 5.1. Earth systems 5.1.a. Investigate the composition, structure, and features of the geosphere, hydrosphere, and atmosphere. 5.2. Interacting systems 5.2.a. Investigate how heat from the Sun, the Earth, and human activities is distributed around Earth by the geosphere, hydrosphere, and atmosphere.

INTENDED LEARNING OUTCOMES: List what learning outcomes could be achieved under the following headings:

Conceptual LOs	Nature of Science LOs	Technical/skills LOs
O 1.2.1. Students can define, and state the key differences between weather and climate O 1.3.2. Students can describe some changes that occur within the five components of climate, which lead to climate change O 1.3.3. Students can describe some examples of interactions between climate components that influence climate, and they can identify some examples. O 1.3.4. Students can explain how human activity can influence the components of climate (extension) O 2.1.3. Students can describe where some of different forms of carbon compounds are found on Earth, and explain some of the processes that created them. O 2.2.3. Students can identify which processes in the carbon cycle are influenced by human activity, especially those that add CO_2 to the atmosphere. O 2.2.4. Students can compare pre-industrial to present day movement of carbon around the carbon reserviours. O 3.1.1. Students can explain that shortwave energy, in the form of light, radiates from the Sun, and is absorbed by Earth's surface. O 3.1.1. Students can explain that the cooler Earth surface radiates long wavelength energy in the form of heat.	O 1.1.1. Students explore their prior knowledge about climate change. O 1.1.2. Common misconceptions about climate change are discussed, and alternative ideas are presented for students to consider. O 2.1.1. / 2.1.2. Students can draw, and construct models, name and give the symbol for carbon and some of the simple compounds it forms on Earth O 3.1.5. Students can conclude that darker surfaces absorb more energy from the Sun, and reflect less light, leading to an increase in the Earth's energy budget. O *3.2.4. Students explore the relationships between ocean surface temperature and levels of atmospheric carbon dioxide and water vapour. (extension)* O 4.1.1. Students can observe that scientists use a range of methods to collect atmospheric CO_2 data, both from prehistoric and contemporary times. O 4.2.1. Students are able to make evidence supported claims from observed and predicted data and models. O 4.2.2. Students can conclude that only the melting of land ice, including the ice shelves in Antarctica, Greenland, and glaciers, contribute to sea level rise, NOT sea ice, such as that in the Arctic circle. O 5.2.1. Students can describe some New Zealand species affected by climate	O 1.2.2. Students are able to use a thermometer and rain gauge to correctly observe, and record, daily weather readings. O 1.3.1. Students can label the five components of climate as the atmosphere, the hydrosphere, the cryosphere, the land surface and the biosphere. O 2.1.1. / 2.1.2. Students can draw, and construct models, name and give the symbol for carbon and some of the simple compounds it forms on Earth O 2.2.1. / 2.2.2. Students are able to define, and label, carbon sources, sinks, and reserviours in a carbon cycle. O 3.1.4. Students can complete an Energy Earth budget, and calculate NET energy gain, linking it to an increase of temperature O 4.1.2. Students are able to correctly graph provided data on atmospheric carbon dioxide concentration O 7.2.1. Students are able to clearly present their mitigation projects, explaining their goal and outcome, and how the project has contributed towards climate change mitigation.

O 3.1.4. Students can link the temperature of the Earth's surface to the balance between incoming shortwave radiation (light) and outgoing long wavelength radiation (heat) O 3.2.1. Students can explain the importance of the greenhouse effect in keeping the Earth at a temperature suitable for life, and that some gases, called greenhouse gases, in the atmosphere can affect that energy balance, by absorbing heat (and some light) O 3.2.2. Students can understand why some gases in the atmosphere, such as CO_2, CH_4 and H_2O, act as greenhouse gases, while others, such as N_2 and O_2, do not. O 3.2.3. Students can link the presence of more CO_2 in the atmosphere, to more energy being retained around Earth, and hence an overall increase in average temperature. O 4.1.3. Students can link human activity to the most recent rapid increase in CO_2 in the atmosphere. O 4.2.1. Students can identify some of the consequences of climate change, including increasing temperature, changing precipitation patterns, sea level rise, and increasing frequency of extreme weather events. O 5.1.1. Students can identify some effects to ecological systems, and the species within them, caused by climate change, both in the present, and most likely in the future. O 5.1.1. Students describe a number of adaptation strategies, which can be used, or developed, to assist species to adjust to the present, and future, climate change challenges.	change, and identify possible adaptation strategies that can be planned and/or implemented to help them better cope with changes to their environments. O 5.2.2. Students can describe some New Zealand human communities affected by climate change, and identify possible adaptation strategies that can be planned and/or implemented to help them better cope with changes to their environments. O 6.1.1. / 6.1.2. Students investigate, and contribute to, some mitigations actions that are being undertaken, both globally and locally, which reduce the factors contributing to climate change. O 6.1.3. Students work in groups to decide on appropriate mitigation strategies (at governmental level), and justify their decisions O 6.1.4. Students explore how solar radiation, Earth's surface and oceans, and greenhouse gases interact to cause global warming. Students change variables to determine how much greenhouse gas emissions might need to fall to mitigate the temperature increase. O 6.2.1. / 6.2.2. Students describe some daily actions, which create their carbon footprint, and identify small changes that can be made to reduce it. O 7.1.1. Students can co-construct a feedback and assessment rubric O 7.1.1. Students can select, adapt, create or plan a feasible mitigation project O 7.1.2. Students are able to action a feasible small mitigation project. O 7.2.2. Students can reflect on their learning and engagement in this climate change unit.	

MANAGEMENT/MATERIALS:	
Resources O Climate Resources booklet (GZ) containing self-developed worksheets and activities O Connected devices with Microsoft O365 / OneNote (or Google classrooms) O Prepared OneNote workbooks for students with notes and literacy activities, and prepared collaborative literacy/multi-media tasks, and glossary O Teacher prepared class presentation/slides ppt O Progress sheet (paper or digital on OneNote)	Artefacts O Investigation equipment from school lab (listed in unit) O Found activities from NEED www.need.org O Thin ice documentary https://thiniceclimate.org/ and ice core collections videos O Found activities from Arkive www.arkive.org O Save the climate game printed (link in unit) O Requested resources for individual projects

O Field trip RAMS forms and planning preparation (Zoo, community mitigation group, etc.)	

ASSESSMENT/EVALUATION: Activities/tasks:

Formative

O 1.1.1. Climate change "Cartoon Concepts" scenario
O 1.2.1. Weather or Climate? sorter activity
O 1.2.1. Weather and Climate Venn diagram activity
O 1.2.2. OneNote digital weather diary (to be graphed later in the unit)
O 1.3.2. Climate features
O 1.3.3. Concept mapping
O 1.3.4. Climate features, and human influence activity
O 2.1.3. Carbon on Earth activity
O 2.2.2. Carbon cycle model
O 2.2.4. NEED "Carbon Cycle Simulation" card game
O 3.1.4. Earth's energy budget calculations
O 3.1.5. Albedo Effect investigation
O 3.2.3. NEED Greenhouse in a bottle investigation
O 4.1.2. "How much CO_2?" carbon dioxide concentration data graphing activity
O 4.2.1. Impacts on physical systems data activity
O 4.2.2. Land and Sea Ice investigation
O 5.1.1. Our homes are changing activity – ecosystems
O 5.1.1. Arkive "climate change activity"
O 5.2.1. NZ adaptation strategies card activity
O 6.1.3. Pangea 'middle school' mitigation activity
O 6.2.1. 'Save the climate' game
O Online assessment throughout unit with Education Perfect and OneNote literacy, cognitive/thinking tools and collaborative activities (self-paced)

Summative assessment

O 7. Students, with support, will design their own small group, or individual, climate change mitigation project, research, or initiative, which they will action and/or present to an audience. (Rubric co-constructed)

Macro Task: 1. Unpacking Climate Change misconceptions held by students, and understanding what drives Earth's climate.					
Meso	Micro	Organisational Frame	Focal Artefacts	Planned Interactions	Key Outcomes What do I Expect
O 1.1. Students identify their prior knowledge, and consider some of the main misconceptions about climate change. (NoS 3.1.a., 4.1.a., 3.2.a., 4.2.a, 3.3.b., 4.3.b.)	O 1.1.1. Students participate in a "Cartoon Concepts" activity to share their prior knowledge about climate change O 1.1.2. Students contribute to a class discussion, which help to identify any misconceptions about Climate Change	O 1.1.1. Students work in small groups to discuss and record ideas O 1.1.2. Groups chosen by teacher in turn to present to whole class	O 1.1.1. Climate change "Cartoon Concepts" scenario card sets (GZ - adapted) O 1.1.2. "Scientist Says" class slide set (GZ)	1./ Handout sets of 1.1.1. climate change cards (laminated) to small groups (2-3) 2./ Students, in groups, read each card scenario, and discuss which idea they agree with the most 3./ Students record their thinking and explanation for each card. 4./ Groups, in turn, present one scenario card, with their explanation to the whole class. Other students encouraged to ask each group questions. 5./ Teacher encourages a classroom discussion after each scenario, with 1.1.2. Scientist Says slides.	O 1.1.1. Students explore their prior knowledge about climate change. O 1.1.2. Common misconceptions about climate change are discussed, and alternative ideas are presented for students to consider.
O 1.2. Students will be able to differentiate between weather and climate (PE&B 3.2.a., 4.2.a., 5.2.a.) *[Optional: opportunity to cover water cycle (PE&B 3.2.a., 4.2.a.)]* *[Optional: opportunity to cover states of matter and particle theory (MW 4.2.a., 5.3.a.)]*	O 1.2.1. Students use a Venn diagram, to differentiate between the terms weather and climate O 1.2.2. Students collect weather data using a diary and compare to local climate averages	O 1.2.1. Working in pairs, then larger groups O 1.2.1. Working in collaborative groups online O 1.2.1. Whole class discussion O 1.2.2. class demo O 1.2.2. Working individually to collect and record data	O 1.2.1. Weather or Climate sorter activity - paper and digital (GZ-adapted) O 1.2.1. Venn diagram page (on OneNote collaboration page) O 1.2.1. readwritethink compare and contrast map tool https://bit.ly/R9IecS O 1.2.2. MeteoEarth https://bit.ly/1Dn46JB O 1.2.2. OneNote digital weather diary (adapted) O 1.2.2. Climate data from NIWA https://bit.ly/2y67x8v	1./ Handout 1.2.1. weather or climate sorter activity to pairs, once finished they can combine with another group to discuss and compare. Combined answers in 2 columns (weather/climate) 2./ Students use 1.2.1. Venn diagram (weather/climate), as a collaboration activity (could use OneNote) using information from the previous activity to start developing ideas on the differences and similarities between the two. 3./ Paragraphs can be constructed using the 1.2.1. readwritethink compare and contrast map tool. (teacher supported) https://bit.ly/R9IecS 4./ Demonstrate how a (outside) thermometer and rain gauge are used to make weather observations. 5./ Use 1.2.2. Meteo Earth model to show current weather patterns http://www.meteoearth.com 6./ Students begin a 3 week 1.2.2. weather diary (On paper or OneNote) of their local weather, from class 'weather station' (at the same time each day), or from programs such as windy.com. This will be compared to average climate data from weather and climate from NIWA https://bit.ly/2y67x8v 7./ At the end of the 3 week period, a lesson can be set aside to graph both collected (and averaged) class weather data, and average climate data. Students may wish to add to their Venn diagram (1.2.1.).	O 1.2.1. Students can define, and state the key differences between weather and climate O 1.2.2. Students are able to use a thermometer and rain gauge to correctly observe, and record, daily weather readings.

Meso	Micro	Organisational Frame	Focal Artefacts	Planned Interactions	Key Outcomes What do I Expect
O 1.3. Students will be able to understand how the five components of climate interact, (and how human activity can influence these components – Extension) (PE&B 3.2.b., 4.2.b., 5.2.a, NoS 3.3.b., 4.3.b.) *[Optional: opportunity to introduce seasons, as a source of climate variation and/or sun spots (PE&B 3.3.a., 4.3.a., 5.2.a.)]* *[Optional: opportunity to cover Earth's major biomes (LW 3.2.a., 4.2.a.]*	O 1.3.1. Students identify components in a climate system model O 1.3.2. Students identify some changes occurring <u>within</u> the components in a climate system model O 1.3.3. Students identify some examples of interactions <u>between</u> components in the climate system. *O 1.3.4. Students describe how human activity can influence climate components interactions (extension)*	O 1.3.1. Group / class discussion O 1.3.2. Working individually on paper, or digitally O 1.3.3. Whole Class activity O 1.3.3. Individual digital activity O 1.3.3. individual or small group activity *O 1.3.4. Working individually on paper, or digitally*	O 1.3.1. Climate model diagram O 1.3.2. / 1.3.3. Climate features diagram (GZ - adapted from IPCC) O 1.3.3. StudyJams Weather and climate https://bit.ly/16gvWI3 O 1.3.3. large paper for concept mapping or digitally https://bubbl.us *O 1.3.4. Climate features, and human influence chart (GZ - adapted from IPCC)*	1./ printed 1.3.1. Climate model diagram (and/or on ppt slides) given to small groups. Students identify main areas (components) that they consider could influence climate. Following on students discuss what type of changes could occur <u>within</u> each of those components. 2./ Students Label 1.3.2. climate features diagram to show components 3./ 1.3.3. Class role-play. 5 students can represent the five components and stand round in a spaced out circle. They can hold a ball of string/wool each. Students from the class suggest a component starter, and a component finisher, with the named interaction. Suggestions are on 1.3.2. The students connects the two with string/wool. This can be continued for a number of rounds so the class can see the numerous interactions involved in climate components. Students complete interactions on 1.3.2. 4./ Online 1.3.3. weather and climate StudyJams, animated interactive (OneNote linked) https://bit.ly/16gvWI3 5./ Begin a glossary of climate change in their OneNote After class discussion, list words on board that have been covered in past lessons, and including components of climate. This will be added to throughout the unit. 6./ 1.3.3. Concept mapping can be used at this stage to support the student understanding of climate and weather. Provide key words (and from glossary), and students have their previous work to draw on. Students can work on A3 paper in pairs, and digital mapping programs are also an option, such as https://bubbl.us *7./ (Extension) activity 1.3.4. for students to suggest how human activity may influence the interactions between the components*	O 1.3.1. Students can label the five components of climate as the atmosphere, the hydrosphere, the cryosphere, the land surface and the biosphere. O 1.3.2. Students can describe some changes that occur <u>within</u> the five components of climate, which lead to climate change O 1.3.3. Students can describe some examples of interactions <u>between</u> climate components that influence climate, and they can identify some examples. *O 1.3.4. Students can explain how human activity can influence the components of climate (extension)*

Macro Task: 2. Explore and explain how carbon cycles throughout the Earth's systems, and how human activity affects the rate of transfer of carbon from one carbon reserviour (store) to another.					
Meso	Micro	Organisational Frame	Focal Artefacts	Planned Interactions	Key Outcomes What do I Expect
O 2.1 Understand the structure of carbon, and identify some common carbon compounds on found on Earth, and the processes to create them. (MW 3.1.a, 4.1.a, 3.2.b, 4.2.b. NoS 3.2.b., 4.2.b.) *[Optional: opportunity to cover carbon chemistry and fuels, coal and oil formation (MW 5.1.a, 4.3.a., 5.3.a), and rock cycle (PE&B 3.1.a, 4.1.a)]*	O 2.1.1. Students locate carbon on the periodic table, and write the chemical symbol O 2.1.2. Students use molymods to construct models of CO_2 and CH_4, and write their formula and name. O 2.1.3. Students identify where different forms of carbon might be found on Earth, and by what processes they were formed	O 2.1.1. Students work in small groups with periodic tables and molymods O 2.1.3. Students work individually on their carbon on Earth sheets	O 2.1.1. Periodic table (class set) O 2.1.2. Large plastic molymod sets (class set) O 2.1.2. Samples of different carbon and carbon compounds O 2.1.3. Carbon on Earth worksheet (GZ)	1./ Think-pair-share, then class discussion about where, and in what forms we would find carbon on Earth. Write the main points on the board. Conceptual diagrams can be constructed by students. 2./ Provide small groups with 2.1.1. periodic table. Students are to locate C (and O, H), and with 2.1.2. plastic molymods, make CO_2, and CH_4 (formula written on board) 3./ Show samples 2.1.2. of carbon (coal, graphite) and carbon compounds, if you have some available. 4./ Use the information from the board, research on their devices, and their models, to complete 2.1.3 Carbon on Earth *5./ (Extension) – research of uses of carbon, and carbon compounds, to humans*	O 2.1.1. / 2.1.2. Students can draw, and construct models, name and give the symbol for carbon and some of the simple compounds it forms on Earth O 2.1.3. Students can describe where some of different forms of carbon compounds are found on Earth, and explain some of the processes that created them.

Meso	Micro	Organisational Frame	Focal Artefacts	Planned Interactions	Key Outcomes What do I Expect
O 2.2. Students describe how carbon cycles throughout the Earth's systems, comparing pre-industrial and present day movement of carbon. (PE&B 3.1.a., 4.1.a, 5.1.a, NoS 3.2.b., 4.2.b.) *[Optional: opportunity to cover combustion engines and coal powered electrical generators (PW 5.2.a)]* *[Optional: opportunity to cover photosynthesis and respiration. (LW 3.1.a, 4.1.a, 5.1.a)]* *[Optional: opportunity to cover decomposers and food webs. (LW 3.2.a, 4.2.a, 5.2.a)]*	O 2.2.1. Students define "carbon sources', 'carbon sinks' and carbon reserviours (stores). O 2.2.2. Students use a carbon cycle model to label each carbon reserviour (store), and identify whether it acts as a carbon sink or a carbon source. O 2.2.3. Students identify carbon sources created by human activity. O 2.2.4. Students compare the rate of transfer of carbon between reserviours in the pre-industrial revolution period, and present day	O 2.2.1. Students work in pairs for think-pair-share O 2.2.2. Students work in pairs, or individually, on the carbon cycle diagram O 2.2.2. Whole class activity O 2.2.3. Individual digital activity O 2.2.4. Individual completion of carbon cycle diagram *O 2.2.4. Individual online writing prompter activity*	O 2.2.2. / 2.2.3. Carbon cycle model (GZ) O 2.2.3. The Habitable Planet Carbon cycle simulator https://bit.ly/1qirgul O 2.2.4. NEED "Carbon Cycle Simulation" card game (found game) https://bit.ly/2y7Vk3b O 2.2.4. two or more packs of playing cards *O 2.2.4. readwritethink compare and contrast map tool https://bit.ly/R9IecS*	1./ 2.2.1.Think pair share on each of the terms : sources, sinks, reserviour (store) 2./ Discuss, and co-create a definition for each that can be added to their digital glossary. 3./ Project carbon cycle (simple) onto board (ppt), and with student input, add labels. 4./ Students use the 2.2.2. carbon cycle model to complete (either digital or paper) 2 levels for students 5./ 2.2.3. Carbon cycle simulator - adjust the amount of CO_2 emissions and relate that to changes in the carbon cycle https://bit.ly/1qirgul 6./ Discuss which processes may be influenced by human activity – students add to their diagrams. *7./ (Extension) Using the "carbon on Earth" worksheet competed previously, students can add the forms of carbon (formula) found in each reserviour.* 8./ Teacher provides explanation of the 2.2.4. NEED carbon cycle simulation game, handing out instructions, cards, posters and worksheets. https://bit.ly/2y7Vk3b This is a role playing game, where the students are 'carbon atoms' – they are originally assigned into 1 of 6 reserviours. At each reserviour each student draws a card. Rules at each reserviour tell the students where to go next. Students record movement. This is repeated for 10 rounds. 9./ Present day activity can be left for the second day. Repeat as above. 10./ When completed, students can work in small groups to summarize data, followed by whole class discussion. 11./ Students can then add extra detail (in 2 different colours) to their carbon cycle diagram. *12./ (Extension) An additional activity on www.readwritethink.org is to use the compare and contrast format, to compare between pre-industrial and post-industrial sources of carbon.*	O 2.2.1. / 2.2.2. Students are able to define, and label, carbon sources, sinks, and reserviours in a carbon cycle. O 2.2.3. Students can identify which processes in the carbon cycle are influenced by human activity, especially those that add CO_2 to the atmosphere. O 2.2.4. Students can compare pre-industrial to present day movement of carbon around the carbon reserviours.

Macro Task: 3. Understand the inputs and outputs that contribute to the Earth's energy budget, and the role of the Greenhouse Gases in creating the Greenhouse Effect					
Meso	Micro	Organisational Frame	Focal Artefacts	Planned Interactions	Key Outcomes What do I Expect
O 3.1. Students understand how energy moves into, and out of Earth, to produce an Energy budget (PE & B 5.2.a, PW 4.1.a., 5.1.a, NoS 3.2.b., 4.2.b., 5.2.a.) *[Optional: opportunity to cover other aspects of light properties. (PW 3.1.a., 4.1.a, 5.1.a.)]*	O 3.1.1. Students use Slinkys to demonstrate that energy travels in waves, linking short wavelengths (Light) to containing more energy than long wavelengths (Heat) O 3.1.2. Students identify the sources, and types of energy, that move around the Earth. O 3.1.3. Students define the following terms: energy transformation, absorption, emitting, short wave radiation, long wave radiation O 3.1.4. Students observe an energy balance demo, and then use data to create an input/output model of energy budget for the Earth.	O 3.1.1. Whole class activities. O 3.1.2. Individual digital activity O 3.1.3. Individual work O 3.1.4. Class demonstration O 3.1.4. Individually calculating energy budget	O 3.1.1. Slinky O 3.1.1. Electro-magnetic spectrum chart. O 3.1.2. Energy on Earth interactive https://bit.ly/1z6404s and teacher demo https://bit.ly/2DhDeeD (hide the math) O 3.1.4. plastic bucket (+ water tap/sink) for demonstration or simulation https://bit.ly/2o2hzUu O 3.1.4. Earth's energy budget sheet (GZ)	1./ Use the slinky, with students holding either end, to demonstrate how waves (transverse) travel along it. Move the slinky quicker (up and down) to create shorter wavelengths (frequency) to show the students the more energy you put in to make the slinky move faster, the shorter the wave length. Repeat at slower speed to produce longer wavelengths. 2./ Display the 3.1.1. EMS chart (ppt) to students, discuss that most energy released from the Sun, travels to earth as SW light, and most travels straight through to Earth's surface. (go outside – see light coming from Sun), is absorbed by earth, and most is re-radiated back from earth as LW energy (heat). 3./ Students identify types and sources of energy on earth using 3.1.2. energy on earth interactive https://bit.ly/1z6404s 4./ Discuss definitions: energy transformation, absorption, emitting, short wave radiation, long wave radiation: that students add to their OneNote glossary. 5./ 3.1.4. Demonstration of energy equilibrium: Place a small plastic bucket with small holes over tap with string. Fill with half way with water. Run water into the bucket at the same rate it runs out – this may take a little time to establish. Explain to students that when the same amount of water (representing light (SW) energy from the sun) equals the amount of water (representing light (SW) and heat (LW) leaving the bucket, then the total amount of eater (energy) remains the same and there is no gain, hence the Earth's overall average temperature remains the same. Cover some of the holes – explain that this represents adding more greenhouse gases (just a brief explanation as this is covered later), or removing ice/snow so less energy is reflected (albedo). Students observe water level increasing – relating to more energy, thus heat on Earth. 6./ Students complete and calculate 3.1.4. Energy budget. Begin with labelling the sheet with energy data provided. Students can then calculate (all energy in- all energy out) and link to a temperature rise. *Advanced sheet only for extension students (math strength)*	O 3.1.1. Students can explain that shortwave energy, in the form of light, radiates from the Sun, and is absorbed by Earth's surface. O 3.1.1. Students can explain that the cooler Earth surface radiates long wavelength energy in the form of heat. O 3.1.4. Students can link the temperature of the Earth's surface to the balance between incoming shortwave radiation (light) and outgoing long wave length radiation (heat) O 3.1.4. Students can complete an Energy Earth budget, and calculate NET energy gain, linking it to an increase of temperature

Meso	Micro	Organisational Frame	Focal Artefacts	Planned Interactions	Key Outcomes What do I Expect
O 3.1. Students understand how energy moves into, and out of Earth, to produce an Energy budget (PE & B 5.2.a, PW 4.1.a, 5.1.a.)	O 3.1.5. Students investigate how the colour of the ground surface can affect the amount of energy absorbed (Albedo Effect)	O 3.1.5. Students work in groups to complete investigation O 3.1.5. Individually working online	O 3.1.5. Albedo Effect investigation (created) equipment: polystyrene cups and digital thermometers O 3.1.5. Feedbacks of ice and clouds. Interactive module. https://bit.ly/2E48FPn	1./ 3.1.5. Albedo Effect investigation: Students work in groups to test the temperature of various coloured surfaces outside. (Full Instructions on sheet). 2./ Follow up questions analyse the temperature difference. 3./ In a class discussion link the results to what might be the consequences of melting polar and ice areas 4./ 3.1.5. Feedbacks of ice and clouds module https://bit.ly/2E48FPn 45 mins. Links on OneNote	O 3.1.5. Students can conclude that darker surfaces absorb more energy from the Sun, and reflect less light, leading to an increase in the Earth's energy budget.
O 3.2. Students identify that some gases, called greenhouse gases, in the atmosphere can affect the energy balance (forcing agents) by absorbing heat, and producing the Greenhouse Effect. (PE & B 5.2.a, PW 4.1.a, 5.1.a, MW 3.2.a, 4.2.a, 5.2.a, 5.2.c. PE & B 3.2.b., 4.2.b., 5.2.a.) *[Optional: opportunity to cover gas tests. (MW 3.1.a., 4.1.a,)]*	O 3.2.1. Students describe the Greenhouse Effect as a natural process, that is necessary to allow life on Earth, and investigate the role that greenhouse gases play in the Earth's energy budget. O 3.2.2. Students identify carbon dioxide, methane, and water vapour as three of the major greenhouse gases. O 3.2.3. Students investigate whether carbon dioxide speeds up the transfer of thermal energy, and therefore acts as a greenhouse gas. O *3.2.4. Students explore the relationships between ocean surface temperature and levels of atmospheric carbon dioxide and water vapour. (extension)*	O 3.2.1. Whole class discussion O 3.2.1. Individually working online O 3.2.2. Whole class demonstration O 3.2.3. Working in small groups for practical investigation	O 3.2.1. Greenhouse gases cards (found) https://go.nasa.gov/2sE14RE O 3.2.1. Greenhouse effect simulation games https://bit.ly/2PgPSkV https://bit.ly/2ei1ljy https://go.nasa.gov/2E5F8EP O 3.2.2. Molymods (small plastic) for demonstration O 3.2.3. NEED Greenhouse in a bottle investigation format sheet - and equipment listed (+ dry ice if available) (found) https://bit.ly/2y7Vk3b *O 3.2.4. Sources, sinks, and feedbacks interactive module https://bit.ly/2PhpF5T*	1./ Discuss greenhouse effect and greenhouse gases as a class. Use 3.2.1. greenhouse gases cards as an expert group 15 min research activity https://go.nasa.gov/2sE14RE 2./ Students use a 3.2.1. greenhouse gas simulation game on their devices – several suitable https://bit.ly/2PgPSkV https://bit.ly/2ei1ljy https://go.nasa.gov/2E5F8EP 3./ 3.2.2. Demonstration, using smaller set of molymods with longer connectors. Have CO_2, CH_4, N_2O, H_2O, O_2 and N_2 made. Show students how the CO_2, CH_4, N_2O, H_2O gases are able to flex around their bonds – link this to their ability to absorb and then release energy (LW). Show the O_2 and N_2, having little flexibility – and hence do not absorb and act as greenhouse gases. 4./ Practical investigation 3.2.3..Greenhouse in a bottle. Students set up two bottles to model Earth's atmospheric system, one with CO_2 added and one without. They will then follow instructions to record temperature at various time intervals, simulating day and night conditions. The question posed to the students is "What affect does adding carbon dioxide to the air have on the air's temperature during the day and during the night?". Students can work in groups to develop a conclusion, and then contribute to whole class discussion. *5./ 3.2.4. Sources, sinks, and feedbacks. https://bit.ly/2PhpF5T 45mins This is part of a module series. Module links will be included in students OneNote, as part of their self-paced learning. that is part of a series (extension)*	O 3.2.1. Students can explain the importance of the greenhouse effect in keeping the Earth at a temperature suitable for life, and that some gases, called greenhouse gases, in the atmosphere can affect that energy balance, by absorbing heat (and some light) O 3.2.2. Students can understand why some gases in the atmosphere, such as CO_2, CH_4 and H_2O, act as greenhouse gases, while others, such as N_2 and O_2, do not. O 3.2.3. Students can link the presence of more CO_2 in the atmosphere, to more energy being retained around Earth, and hence an overall increase in average temperature.

Macro Task: 4. Link the consequences of the increasing carbon dioxide gas in the atmosphere, to the effect on Earth's physical systems, leading to climate change.					
Meso	Micro	Organisational Frame	Focal Artefacts	Planned Interactions	Key Outcomes What do I Expect
O 4.1 Students understand that carbon dioxide concentration has increased rapidly in the atmosphere, and that carbon dioxide emissions, created from human activity, is the main reason for this increase (MW 3.2.a., 4.3.a, 5.3.a, NoS 3.1.b., 4.1.b., 3.2.a, 4.2.a., 5.1.a, 3.2.b, 4.2.b) *[Optional: opportunity for local scientist visits and/or studies (NoS 3.1.b, 4.1.b)]* ..	O 4.1.1. Students explore how carbon dioxide atmospheric concentration data can be collected, in both prehistoric times and recent times. O 4.1.2. Students graph atmospheric carbon dioxide concentration data from pre-industrial time and recent times. O 4.1.3. Students link the rapid increase of CO_2 concentrations in recent times to human activity, and refer back to possible sources of emissions from the carbon cycle activities.	O 4.1.1. Whole class activity. O 4.1.2. Individual graphing activity O 4.1.3. Individually working online O 4.1.3. Whole class, followed by class discussion.	O 4.1.1. Video clips of ice core collection https://bit.ly/2PiOezo https://bit.ly/2fzd1BQ https://bit.ly/2RwR1WX O 4.1.2. "How much CO_2?" worksheet (GZ) O 2.1.3. Carbon on Earth worksheet (GZ) O 2.2.1. Carbon cycle model (GZ) O 4.1.3. Interactions within the atmosphere digital module https://bit.ly/2BZkNyo O 4.1.3. "Thin Ice: The Inside story of climate Science" documentary	1./ Students watch 4.1.1. clips of scientists collecting ice cores from Antarctica to retrieve prehistoric atmospheric carbon dioxide data. https://bit.ly/2PiOezo and New Zealand Scientists collecting ice-core samples https://bit.ly/2fzd1BQ or https://bit.ly/2RwR1WX 2./ Students compare this to modern day collections of data from Mauna Loa. "the observatory has been collecting and monitoring data relating to atmospheric change since the 1950s. Dr John Barnes, the Station Chief for the observatory, describes the functions of the MLO, which provides valuable long-term and continuous recording of data" https://bit.ly/2C0NxH1 3./ 4.1.2. How much CO_2? .Students provided with data of CO_2 from the past 300+ years, of which they need to graph the past 60 years. Students can use information from previously completed 2.1.3. and 2.2.1 sheets to give explanation for where the excess CO_2 emissions have come from. Students can also research the dates of when combustion engine transportation became common, increase in coal burning power stations etc., and add to their graphs. 4./ Brief class discussion on reasons for fluctuations and rate of change past of CO_2 levels. 5./ 4.1.3. Interactions within the atmosphere digital module (on OneNote) 45mins - https://bit.ly/2BZkNyo 6./ 4.1.3 Thin Ice: The Inside story of climate Science documentary can be introduced at this stage, focussing on the collecting data, monitoring, and investigating climate change. – this will lead into the next segment of making evidence backed statements. https://thiniceclimate.org/ (email thiniceclimate@vuw.ac.nz. For free of charge streaming link.) Followed by cognitive tools activities on OneNote.	O 4.1.1. Students can observe that scientists use a range of methods to collect atmospheric CO_2 data, both from prehistoric and contemporary times. O 4.1.2. Students are able to correctly graph provided data on atmospheric carbon dioxide concentration O 4.1.3. Students can link human activity to the most recent rapid increase in CO_2 in the atmosphere.

Meso	Micro	Organisational Frame	Focal Artefacts	Planned Interactions	Key Outcomes What do I Expect
O 4.2. Students will understand that climate change has impacted on Earth's Physical systems, resulting in global temperature rise, sea level rise, cryosphere melting, and increasing the frequency of extreme weather events (NoS 3.1.a, 4.1.a, 3.2.b., 4.2.b, 5.3.a., 5.3.b., PE & B 5.2.a.) *[Optional: opportunity to cover acid-base neutralisation and equations (MW 3.1.b., 4.1.b., 5.1.a.)]* *[Optional: opportunity to cover heat transfer and heat expansion. (PW 3.1.a., 4.1.a., 5.1.a., 4.3.a.)]*	O 4.2.1. Use collected evidence (data and graphs), and current models, to make evidence supported claims about the impacts of climate change O 4.2.2. Students investigate what effects sea and land ice have on sea level, when melted. *O 4.2.3. (Extension) Students investigate if acidification of water can increase the rate that shells (calcium carbonate) react, and disintegrate in water* *O 4.2.4. (Extension) Students investigate if increasing temperature causes the heat expansion of water.*	O 4.2.1. Small groups followed by class discussion O 4.2.1. Individually working online O 4.2.2. Small groups practical investigation O 4.2.2. Individually working online	O 4.2.1. Impacts on physical systems data activity (GZ - adapted) O 4.2.1. Constructing an argument: climate. Interactive module https://bit.ly/2PiHEsn https://bit.ly/2C0aF8o O 4.2.1. Earths' changing climates. Interactive module O 4.2.2. Land and Sea Ice investigation (GZ) equipment – beakers, ice cubes. O 4.2.2. NASA Future climate change simulation game https://go.nasa.gov/2sZIEqE	1./ In groups, Students will participate in 4.2.1. Physical impacts of climate change activity. They will work in small groups and are provided with 8 data cards, which show either observations or predictions of physical system change attributed to Climate change. Students need to analyse the information on each card, with 2/3 questions to answer. Then they will make an evidence backed statement on each card. 2./ Class discussion – on the requirements to be an evidence backed statement. Then followed by class contributions to each card (projected onto board. Students write down a summary for each card. 3./ This activity can be supported with 4.2.1. Constructing an argument: climate https://bit.ly/2PiHEsn , a 10 min module, and in a later lesson Earths' changing climates https://bit.ly/2C0aF8o, 45min module. Module links will be included in students OneNote, as part of their self-paced learning. 4./ 4.2.2. Set up 2 large beakers, with an inverted smaller beaker in each. Place 2 ice cubes around the bottom of Beaker A, and on Beaker B place the 2 ice cubes on top of the inverted beaker. Fill each with the same volume of water (but not above the inverted beaker – where the ice cubes sit in Beaker B). Place a heat source (lamp) close to each and record volume in each beaker every 2 minutes until all the ice melts. Student groups decide on a conclusion for the practical, and then discuss it as a class. (Only land ice and glaciers contribute to sea level rise, not sea ice – although melting does contribute to loss of habitat for polar animals) 5./ Students can play 4.2.2. Future climate change consequences on Earth simulation https://go.nasa.gov/2sZIEqE *6./ Additional practical investigations on acidification and heat expansion can be designed, by co-construction, and tested in groups. (Extension)*	O 4.2.1. Students are able to make evidence supported claims from observed and predicted data and models. O 4.2.1. Students can identify some of the consequences of climate change, including increasing temperature, changing precipitation patterns, sea level rise, and increasing frequency of extreme weather events. O 4.2.2. Students can conclude that only the melting of land ice, including the ice shelves in Antarctica, Greenland, and glaciers, contribute to sea level rise, NOT sea ice, such as that in the Arctic circle.

Macro Task: 5. Students investigate the affect that Climate change has on Human and Ecological Systems, and understand how Adaption Strategies can be developed to manage current and future challenges.					
Meso	Micro	Organisational Frame	Focal Artefacts	Planned Interactions	Key Outcomes What do I Expect
O 5.1. Students will investigate how climate change may affect some species and global ecological systems, as well as some possible strategies that could be used to adapt to the changes created. (LW 3.2.a, 4.2.a., 3.3.b., 4.3.b, NoS 3.4.a, 4.4.a., 5.4.a, 3.4.b., 4.4.b.) *[Optional: opportunity to cover classification, MRS C GREN (LW 3.3.a, 4.3.a.,)]*	O 5.1.1. Students identify some species that will be impacted by climate change, and consider what adaption strategies could be used O 5.1.2. Students observe some animals in their 'habitats', and learn about how they might be affected by climate change O 5.1.3. Students play online interactive games showing how climate change may affect various species	O 5.1.1. Individual and paired activity O 5.1.2. Fieldtrip visit to the zoo as a group O 5.1.3. Individually working online	O 5.1.1. Our homes are changing (GZ) O 5.1.1. Arkive "climate change activity" (found) https://bit.ly/2QzAFM5 O 5.1.2. appropriate fieldtrip materials and support, RAMS forms O 5.1.3. Climate change ecosystems scenario interactive games https://go.nasa.gov/2K1RcGa https://bit.ly/2Nnwm4x	1./ Students begin with 5.1.1. Our homes are changing to match some select animal/plants, around the world, with their "stories" about how climate change may affect them. 2./ In groups, the students use sets of 5.1.1. Arkive Climate change activity https://bit.ly/2QzAFM5 "Students will play a game of pairs to match various species images with cards containing information on the main threat climate change poses to each particular species. In addition, students will consider what actions they can take to help reduce the impacts of climate change." Class discussion, and follow up cognitive tools to pair challenges with possible adaptation strategies. 3./ A 5.1.2. Zoo visit could be organised, with an educational facilitator, to observe some of the species, especially New Zealand species, and learn about their habitats, and how they may be affected by climate change – and what climate change adaptation is possible to reduce threats to the species. 4./ 5.1.3. Gamification: opportunity to play a selection of climate change online games, so students can interact with different scenarios Coral-bleaching interactive: https://go.nasa.gov/2K1RcGa Melting ice in Antarctica game: https://bit.ly/2Nnwm4x	O 5.1.1. Students can identify some effects to ecological systems, and the species within them, caused by climate change, both in the present, and most likely in the future. O 5.1.1. Students describe a number of adaptation strategies, which can be used, or developed, to assist species to adjust to the present, and future, climate change challenges.

Meso	Micro	Organisational Frame	Focal Artefacts	Planned Interactions	Key Outcomes What do I Expect
O 5.2. Students will investigate how climate change may affect some New Zealand communities and ecological systems, as well as some possible strategies that could be used to adapt to the changes created. (LW 3.2.a, 4.2.a., 3.3.a, 4.3.a., 3.3.b., 4.3.b, NoS 3.4.a., 4.4.a., 3.4.b., 4.4.b., 5.4.a.) *[Optional: opportunity to cover ecology, and New Zealand habitats and species. (LW 3.2.a., 4.2.a., 3.2.a, 4.2.a., 3.3.a, 4.3.a., 3.3.b., 4.3.b)]*	O 5.2.1. Students research some case studies on vulnerable New Zealand species, and consider what adaptation strategies are being available to minimise the effect of climate change O 5.2.2. Students explore some possible effects of climate change on human communities, and consider what adaptation strategies are being available to minimise the effect of climate change	O 5.2.1. / 5.2.2. Students work in small groups on the adaptations case studies activity	O 5.2.1. NZ adaptation strategies card activity (GZ) O 5.2.1. Question maker dice (or make paper dice) Teacher resources for NZ adaptation https://bit.ly/2C9PZLy https://bit.ly/2Ojcyof https://bit.ly/2IP6NIY	1./ 5.2.1. Case study activity – students, either individually or in pairs, work through scenario cards of New Zealand species, and the problems they might face due to climate change. They are also provided with a range of 'adaptation solution' cards offering different adaptation strategies. The students discuss what solution might help that species, and provide a reason for why they have selected this card. Pairs then join, and in turn each justify to the other, their reasons for each. (Teacher resource to support activity: use DOC: Adapting to a changing climate. A proposed framework for the conservation of terrestrial native biodiversity in New Zealand https://bit.ly/2C9PZLy And DOC: Potential effects of climate change on New Zealand's terrestrial biodiversity and policy recommendations for mitigation, adaptation and research https://bit.ly/2Ojcyof) 2./ Students roll two 5.2.1. question dice (1 dice with what, when, why, where, how *and 1 dice (extension) with if, might, should, could, would*) to construct a question about a climate change scenario for a local ecosystem/species – and offer suggestions for how they might go about solving the problem. I.e. what…if…. Rising sea levels covered mangroves, that were important breeding grounds for some marine species – possible solution – plant more mangroves in areas where there are none. 3./ Students will investigate how climate change may affect human communities, (water scarcity, food production, health etc.) as well as some possible strategies, and technologies, that could be used to adapt to the changes created. Teacher resource: https://bit.ly/2IP6NIY Adapting to climate change in New Zealand: stocktake report. 5.2.2. This activity could involve mind-mapping, expert groups, research posters, role-playing, or videoed drama/skit. Students can be given the option for how they wish to present this LO.	O 5.2.1. Students can describe some New Zealand species affected by climate change, and identify possible adaptation strategies that can be planned and/or implemented to help them better cope with changes to their environments. O 5.2.2. Students can describe some New Zealand human communities affected by climate change, and identify possible adaptation strategies that can be planned and/or implemented to help them better cope with changes to their environments.

Macro Task: 6. Students investigate some Mitigation Strategies used to limit or control the factors contributing to Climate change, and assess how they can contribute, by reducing their own carbon footprint					
Meso	Micro	Organisational Frame	Focal Artefacts	Planned Interactions	Key Outcomes What do I Expect
O 6.1. Students understand how climate change mitigation strategies can be used to limit or control the factors contributing to Climate change (NoS 3.4.a., 4.4.a., 5.4.a., 3.3.b., 4.3.b.) [The political aspect of mitigation could be covered to a greater extent by the social studies curriculum, as a cross-curriculum component. including the goals of the Paris Climate Agreement, and the carbon trading program]	O 6.1.1. Students watch some case studies of climate change mitigation that governments and industries are implementing to help offset, or reduce, their carbon dioxide emissions O 6.1.2. Students visit a local group that is involved in climate change mitigation O 6.1.3. students work in groups to decide on appropriate mitigation strategies (at governmental level), and justify their decisions O 6.1.4. Students explore how solar radiation, Earth's surface and oceans, and greenhouse gases interact to cause global warming. Students change variables to determine how much greenhouse gas emissions might need to fall to mitigate the temperature increase.	O 6.1.1. whole class activity O 6.1.2. Field trip for tree planting or restoration activity with iwi group, or enviro schools organisation O 6.1.3. Group activity O 6.1.4. Individual digital activity	O 6.1.1. Mitigation case study short videos https://bit.ly/2PpMfJG O 6.1.2. appropriate fieldtrip materials and support, RAMS forms O 6.1.3. Pangea 'middle school' mitigation activity https://stanford.io/1yrb7nJ O 6.1.4. Using models to make predictions. Interactive module https://bit.ly/2zW7k8V	1./ The class watches a selection of 6.1.1. Mitigation case study short videos from businesses, industries, and governments, which are investing in carbon-offset programmes, such as forestation, alternative fuels, renewable energy, or landfill and fuel production gas capture. The reason and importance of their projects is discussed. 2./ Case studies (and links) of various projects of various mitigation projects can be analysed for positives and benefits (Thinking tools), as an OneNote collaborative activity. 3./ A 6.1.2. Field visit can be planned to a marae, iwi, or community group, which is involved in tree planting, or another mitigation project. During the visit, the students can hear about how that project contributes to mitigation. (future participation may be the basis for a student/s project work in the next task) 4./ 6.1.3. Mitigation strategy game (found) https://stanford.io/1yrb7nJ "Activity Goal: Students will be able to work in groups to create, analyse, and justify global mitigation plans in response to global warming. Students will learn about technologies currently available that can substantially cut carbon emissions. Students will individually analyse a standardized plan as the final performance assessment." This is a three-lesson task, where students move from different sized groups to whole class activity. 5./ 6.1.4. Using models to make predictions. Interactive module. 45mins. https://bit.ly/2zW7k8V	O 6.1.1. / 6.1.2. Students investigate, and contribute to, some mitigations actions that are being undertaken, both globally and locally, which reduce the factors contributing to climate change.

Meso	Micro	Organisational Frame	Focal Artefacts	Planned Interactions	Key Outcomes What do I Expect
O 6.2. Students understand that their own actions can contribute to reducing the factors increasing climate change, and consider mitigation options they might apply to their own carbon footprint. (NoS 3.4.a., 4.4.a., 5.4.a., 3.4.b., 4.4.b.)	O 6.2.1. Students participate in a group game to identify which of their own actions can reduce greenhouse gases (mitigation), and which increase greenhouse gases. O 6.2.2. Students calculate their own personal carbon footprint, and consider ways to reduce it.	O 6.2.1. Board game played in small groups O 6.2.1. class discussion O 6.2.2. individually working online with interactive	O 6.2.1. Save the climate game (found) https://bit.ly/2E5gRPo O 6.2.2. CO_2 reduction simulation https://bit.ly/2y9r7k0 O 6.2.2. Calculating carbon footprint interactive https://go.nasa.gov/2p3kjSl https://bit.ly/2k6yTqe	1./ 6.2.1. Save the climate game. (Materials printed out and played). Played in groups, students take turns to work through scenario cards, assign them to increasing or decreasing greenhouse gases, and then work through solutions and alternatives. All resources can be downloaded from https://bit.ly/2E5gRPo "Description from Game: This board game shows students which actions contribute to climate change and reduce greenhouse gases. In teams, students go through a set of cards and identify which actions they and their families do. If desired, print the cards on either green paper (reducing greenhouse gases) or red (contributing to climate change.) If you print the cards on one colour paper, the teams will have to decide themselves. After they put their actions on the board, they count how many cards increase versus reduce greenhouse gases. They then identify actions to change the behaviours that contribute to climate change to green actions 2./ Discussion Importance of reducing CO2 emissions, and link to 6.2.2. Momentum Simulation demonstration https://bit.ly/2y9r7k0 To show effects of reducing CO2 3./ 6.2.2..Gamification: online carbon offset game https://go.nasa.gov/2p3kjSl 4./ 6.2.2. Calculate your own carbon footprint, and consider options to reduce it. https://bit.ly/2k6yTqe	O 6.2.1. / 6.2.2. Students describe some daily actions, which create their carbon footprint, and identify small changes that can be made to reduce it.

Macro Task: 7. Students, with support, will design their own small group, or individual, climate change mitigation project, research, or initiative, which they will action and/or present to an audience.					
Meso	Micro	Organisational Frame	Focal Artefacts	Planned Interactions	Key Outcomes What do I Expect
O 7.1. Students design and action a small group, or individual, mitigation project (NoS 3.4.a., 4.4.a., 5.4.a., 3.4.b., 4.4.b., 3.3.b., 4.3.b., 5.2.a., 5.2.b., 5.2.c.)	O 7.1.1. Students select, and adapt, a suggested mitigation project, or plan their own with support. O 7.1.2. Students action their mitigation project, either individually, or in small groups	O 7.1.1. Small group, or individual planning O 7.1.2. Small group, or individual (may be outside school hours, which will require parental permission and supervision)	O 7.1.1. / 7.1.2. planning materials as requested by students or groups O 7.1.1. Project feedback rubric (GZ)	1./ This project, (7.1.1.) investigation or initiative will be used as the student's summative assessment for this unit. A rubric, which will be used for planning and feedback, will be co-constructed., during a session that allows students to contribute ideas about what is important for them, in a discursive activity The project is envisioned to take 2-3 weeks of class time to plan, and action. Many students may also decide to collaborate and action outside of class time. 2./ A selection of options are listed which a student, or small group of students, can select from. Alternatively, students may choose to plan, and research their own projects – links to possible sites will be provide. Students set up their collaboration page / OneNote, so they can continue with collaborative planning outside of school, and use as their on-going evidence, and reflection site. 3./ Some ideas that may be suggested to students: > Planning, documenting and reporting about energy use reduction in their own homes >Making a blog about local mitigation efforts, with interviews of the people involved >Making an energy reduction / carbon foot print reduction plan, with justification to present to the school Board of Trustees, and Principal >Join a local community group involved in a mitigation (tree planting etc.) initiative that you can volunteer with, and produce a report. >Suggest, and develop, a mitigation initiative that could be presented to a local businesses 4./ Time will be then given in class, with teacher facilitation, to help with actioning their plan (7.1.2.)	O 7.1.1. Students can co-construct a feedback and assessment rubric O 7.1.1. Students can select, adapt, create or plan a feasible mitigation project O 7.1.2. Students are able to action a feasible small mitigation project.

Meso	Micro	Organisational Frame	Focal Artefacts	Planned Interactions	Key Outcomes What do I Expect
O 7.2. Students present or publish their mitigation project (NoS 3.3.b., 4.3.b.)	O 7.2.1. Students present their projects at a parents evening at school O 7.2.2. Students complete an end of unit survey, reflecting on their learning, engagement and next steps.	O 7.2.1. Evening presentation with parents at school O 7.2.2. Individual online survey	O 7.2.1. presentation equipment, shared supper O 7.2.2. Digital survey created on FORMS.(GZ)	1./ Individual and group presentations (7.2.1.) are made at a Parents night. They may include multi-media, such as videos, slides. Presentation will form part of the assessment grade. 2./ Students can include samples of their work from the unit, and explain why mitigation is important, in the context of climate change. 3./ Students complete a 7.2.2. Digital end of unit survey. This gives them an opportunity to reflect on their learning, discuss which of the activities they found engaging and why, and what next steps they wish to take in their learning. Links to further reading can be provided.	O 7.2.1. Students are able to clearly present their mitigation projects, explaining their goal and outcome, and how the project has contributed towards climate change mitigation. O 7.2.2. Students can reflect on their learning and engagement in this climate change unit.

Notes about Unit

Digital resources/ focal artefacts listed in Unit Plan + Teacher slide presentation + Student Progress Tracker + links, are found:

http://gzscienceclassonline.weebly.com/climate-change.html

Focal artefacts not stated explicitly in the unit include the student's OneNote workbooks, containing the 'Progress Tracker' (appendix 1.), text, additional cognitive tools, literacy activities, and collaboration tasks. Many of the digital worksheets, links to simulation games, interactive modules, and supplemental instructions for group activities, will also be placed into the book. The OneNote book will also be used as a scientific notebook, and data collection site, for investigations.

Education Perfect is a purchased educational programme currently in use by the Science Faculty, but not essential for this unit. Teachers can pre-select 'assessments', that give students directed feedback for further tasks. Students are also able to self-select modules, as they work towards their Success Criteria (LOs). If this programme is available to students, then it will run concurrently with the LOs of the unit.