Geography 11–12

Human-environment interactions learning sequence

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This resource has been developed to assist teachers in NSW Department of Education schools to create learning that is contextualised to their classroom. It can be used as a basis for the teacher’s own program, assessment, or scope and sequence, or be used as an example of how the new curriculum could be implemented. The resource has suggested timeframes that may need to be adjusted by the teacher to meet the needs of their students.

# Content focus

Students investigate evidence of human diversity across the Earth’s surface. They examine the spatial patterns and extent of the human footprint and the human transformations shaping those patterns. Students investigate the unique character of places and how various human processes are shaping them.

**Duration**: this sequence of learning is designed to be completed in 40 indicative hours.

# Outcomes

A student:

* **GE-11-01** examines places, environments and natural and human phenomena, for their characteristics, spatial patterns, interactions and changes over time
* **GE-11-03** explains geographical opportunities and challenges, and varying perspectives and responses
* **GE-11-04** assesses responses and management strategies, at a range of scales, for sustainability
* **GE-11-05** analyses and synthesises relevant geographical information from a variety of sources
* **GE-11-06** identifies geographical methods used in geographical inquiry and their relevance in the contemporary world
* **GE-11-07** applies geographical inquiry skills and tools, including spatial technologies, fieldwork, and ethical practices, to investigate places and environments
* **GE-11-08** applies mathematical ideas and techniques to analyse geographical data
* **GE-11-09** communicates and applies geographical understanding, using geographical knowledge, concepts, terms and tools, in appropriate forms

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# Learning sequence 1 – Overview of change to Earth’s natural systems over time

**Teacher note**: examples included in the syllabus are provided to support delivery of course content. These examples are not mandatory and teachers may choose to use the examples provided or select appropriate alternatives.

Overview of change to Earth’s natural systems over time acts as an introduction to the topic Human-environment interactions and should take no longer than 3 hours of course time to complete.

## Syllabus content

* Natural change compared to human-induced change
* Evidence of climate change in the contemporary world
* Evidence for the causes of climate change over time
* Land cover change at a global scale, including deforestation, desertification, melting glaciers and retreating ice sheets

### Learning intentions and success criteria

**Teacher note**: these learning intentions and success criteria are general and should be contextualised to suit your school and students’ needs.

#### Learning intentions

Students:

* understand the different causes of environmental changes, distinguishing between natural changes (such as erosion and natural disasters) and human-induced changes (such as urbanisation and pollution)
* explore the natural processes and human activities contributing to climate change, including understanding of the greenhouse effect and its significance in climate change
* investigate climate change trends over time by using various types of graphs and statistics to compare temperature data, ice cap sizes and sea levels
* understand the historical and contemporary factors influencing climate change through various sources and data analysis
* apply acquired knowledge and analytical skills to engage in meaningful discussions and debates, and present their findings through multimedia presentations and written responses
* understand of the environmental and global impacts of deforestation, desertification and changes in ice cover, through research, discussion and analysis of provided resources.

#### Success criteria

Students can:

* successfully complete a brainstorming session, listing the various causes of natural and human-induced changes to environments and visually represent the relationship between natural changes and human-induced changes
* prepare a well-thought-out response, summarising their findings from the Geographic Information System (GIS) software analysis, reflecting on the implications of environmental changes in their chosen region
* accurately summarise the information from the specified webpage and create a coherent fishbone diagram showing evidence of climate change
* accurately analyse and interpret climate data using various types of graphs and make informed inferences about climate change and its impact on different regions
* effectively compare data from different regions, and collaboratively reflect on the evidence to understand the implications of climate change for humans
* accurately summarise the key points regarding how climate has changed over time and the human activities contributing to climate change using evidence
* critically analyse historical and contemporary data to identify trends and impacts, and effectively communicate their findings through debates, multimedia presentations and written responses, reflecting a sound understanding of the topic
* create annotated maps illustrating land cover changes on a global scale and engage in a meaningful discussion on the global implications of these changes, showcasing their ability to synthesise information and propose viable solutions.

## Natural change compared to human-induced change

Complete a [brainstorm](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/542) about the causes of natural change and human-induced change to environments. Create an interactive multi-circle Venn or Eular diagram, comparing natural change to human-induced change. [Visme](https://www.visme.co/venn-diagram-maker/), [Meta-Chart and](https://www.meta-chart.com/venn) [Creately](https://creately.com/lp/venn-diagram-maker/) might be useful resources.

**Teacher note**: this activity is designed to be completed in 2 groups. One group will research natural changes (for example, erosion, natural disasters) and the other will research human-induced changes (for example, urbanisation, pollution). The following webpages provide a starting point for research – [Australian Bureau of Meteorology](http://www.bom.gov.au), [Australian Government Department of Agriculture, Fisheries and Forestry](http://www.awe.gov.au/), [U.S. Geological Survey (USGS)](http://usgs.gov/).

Use the [Australian Bureau of Meteorology](http://www.bom.gov.au), [Australian Government Department of Agriculture, Fisheries](http://www.awe.gov.au/) and Forestry and [US Geological Survey](http://USGS.gov) webpages to conduct research and complete Table 1.

Table **– change and examples**

|  |  |  |
| --- | --- | --- |
| Natural and/or human change | Example | Natural or human-induced change? Or both? |
| Erosion: research how natural processes like wind, water and ice wear away soil and rock, changing the landscape over time. | The Grand Canyon's formation due to erosion by the Colorado River over millions of years. |  |
| Floods: understand the reasons behind flooding and its effects on both the natural environment and human settlements. | The 2010 Pakistan floods which changed river courses and landforms. |  |
| Earthquakes: explore the causes and effects of earthquakes, and how they change the natural landscape. | The 2010 Haiti Earthquake and its impact on the landscape and communities. |  |
| Water management: explore human-induced changes in water systems, including dam construction and water extraction. | The construction of the Snowy Mountains Scheme and its impact on river ecosystems. |  |
| Drought: research the causes and impacts of prolonged dry periods in Australia. | The Millennium Drought (1997–2009) and its effects on agriculture and water resources. |  |
| Urbanisation: research the growth of cities and towns, and how urbanisation alters the natural environment. | Urban sprawl in Los Angeles and its impact on local ecosystems. |  |
| Bushfires: explore the occurrence and consequences of bushfires in Australia. | The 2019–2020 Australian bushfire season and its impact on wildlife, communities and the environment. |  |
| Coral bleaching: investigate the natural and human-induced factors contributing to coral bleaching in the Great Barrier Reef. | Mass coral bleaching occurred in 2019–2020 in the Great Barrier Reef. |  |
| Pollution: investigate different types of pollution (air, water, soil) and how they are caused by human activities. | The Great Pacific Garbage Patch as a result of ocean pollution. |  |
| Deforestation: examine the causes and impacts of deforestation, focusing on regions in Australia where logging is prevalent. | Deforestation in Queensland and its impact on local ecosystems and species such as the koala. |  |
| Invasive species: research how the introduction of non-native species by humans has altered natural ecosystems in Australia. | The introduction of rabbits and their effect on vegetation and soil erosion. |  |

Access GIS software such as [ArcGIS](https://www.arcgis.com/index.html) or [Google Earth](https://earth.google.com/). Select a region that has undergone significant natural and human-induced changes (for example, the Amazon Rainforest). Access historical satellite imagery and other relevant spatial data for the chosen region.

Analyse the imagery and data to identify signs of natural and human-induced changes, noting the timeframe and scale of these changes.

Prepare a short response summarising the findings and reflecting on the implications of these changes.

Reflect on the use of GIS tools in this activity. How do they enhance understanding of geographical changes in the region?

Complete a class discussion using the following prompts:

* What are the challenges in distinguishing between natural and human-induced changes? What made this task difficult or uncertain?
* How might natural and human-induced changes affect this region in the future? What could be done to mitigate negative impacts?
* Can you think of other regions in the world where a similar analysis might be beneficial? Why?

Access [What is climate change?](https://www.science.org.au/learning/general-audience/science-climate-change/1-what-is-climate-change) and use the 4 main headings to briefly summarise the information from the webpage.

Using the summary and the article [How do we know climate change is real?](https://climate.nasa.gov/evidence/#:~:text=Global%20Temperature%20Is%20Rising,atmosphere%20and%20other%20human%20activities.), create a [fishbone diagram](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/599) that shows evidence for climate change in the contemporary world.

Use [NOAA Climate.gov](http://www.climate.gov/), [USGS – Earth Explorer](https://earthexplorer.usgs.gov/), [Google Earth](https://earth.google.com/) and [Climate Data Snapshots](https://www.climate.gov/maps-data/data-snapshots) to investigate Climate Change trends. Examine the various types of graphs and statistics to compare temperature data, ice cap sizes and sea levels using line graphs, bar charts or scatter plots.

Explore global weather patterns by examining real-time data on the [NOAA View Global Data Explorer](https://www.nnvl.noaa.gov/view/globaldata.html). Analyse data related to temperature, precipitation and storm patterns over a specified time period. Use the data to:

* make inferences about climate change and its impact on different regions
* study geographical features and phenomena such as ocean currents, land use and vegetation
* compare data from different regions to understand the geographical variations and its implications.

Use GIS and remote sensing data to analyse spatial impacts of climate change on different regions. In pairs, highlight how different areas are affected by climate change. Use the following driving questions to conduct a [Think-Pair-Share](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/645).

* Explain how geographical features of an area impact on the weather and climate.
* What are some natural processes that contribute to climate change?
* How do human activities impact on the natural processes identified?
* Explain the concept of the greenhouse effect and its significance in climate change.

Examine and reflect on the evidence to create a [Y chart](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/599), showing what the evidence means for humans. Share the findings with the class.

Review [How has climate changed?](https://www.science.org.au/learning/general-audience/science-climate-change/2-how-has-climate-changed) and [Are human activities causing climate change?](https://www.science.org.au/learning/general-audience/science-climate-change/3-are-human-activities-causing-climate-change). Complete a [dictogloss](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/661) for each source.

Use evidence and information collected in the fishbone to respond to the statement ‘Climate change is a contemporary geographical issue’.

Explore the evidence for the causes of climate change over time using the NOAAView [USGS Global Data Explorer](https://www.nnvl.noaa.gov/view/globaldata.html).

Using [Nearmap](https://www.nearmap.com/au/en?utm_source=google&utm_medium=organic), conduct a comparative analysis of aerial photographs. View the vertical aerial photographs from different periods to identify climate change impacts on landforms and land use.

In groups, create an Interactive Climate Change Timelines showcasing significant climate change events and impacts using multimedia tools, for example, [Tiki-Toki](https://www.tiki-toki.com/) or [Timegraphics](https://time.graphics/).

Complete Table 2 below about the evidence of climate change contemporary and over time.

Table – climate change in the contemporary world and over time

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Climate change in the contemporary world | Climate change over time | Evidence | Source | Natural and/or human induced? |
| ****Temperature data****: global temperature data is crucial in understanding the extent of climate change. |  |  |  |  |
| ****Ice cap sizes****: the size of ice caps and glaciers is a direct indicator of the global climate’s state. |  |  |  |  |
| ****Sea levels****: rising sea levels are a result of thermal expansion (as water warms, it expands) and the melting of ice caps and glaciers.  Coastal regions and small island nations are particularly vulnerable to rising sea levels, which lead to erosion, increased flooding and other coastal hazards. |  |  |  |  |
| ****Historical climate data****: records from physical, chemical and biological materials preserved within the geologic record. These materials offer clues to the climate conditions of the past. |  |  |  |  |
| ****Indirect measurements****: data from natural sources like tree rings, ice cores, corals and sediments from oceans and lakes. These materials hold information about climate conditions over varying time scales. |  |  |  |  |

Undertake a historical climate change analysis by analysing historical photographs, maps and data to understand past climate change events and their impacts. Analysis should include resources from local, state or national archives such as [NOAA – Paleoclimatology](https://www.ncei.noaa.gov/products/paleoclimatology).

Complete a short response explaining the historical data and analysis of trends over time. The response should include how the temperature or sea level has changed over the years.

Complete [The One-Minute Paper](https://www.rochester.edu/college/teaching/teaching-guidance/one-minute-paper.html#:~:text=A%20one%2Dminute%20paper%20is,of%20that%20day's%20class%20session.) for each of the following:

* deforestation
* desertification
* melting glaciers
* retreating ice sheets.

Write a response to each of the following questions about land cover change at a global scale, including deforestation, desertification, melting glaciers and retreating ice sheets.

Deforestation dynamics and drivers:

* How has deforestation impacted biodiversity in the Amazon Rainforest over the past decade?
* What are the primary human activities contributing to desertification in Sub-Saharan Africa?
* Using GIS and remote sensing data, how can you compare the extent of deforestation in the Brazilian Amazon between 2000 and 2020?

Glacier melting and ice sheet retreat:

* How is glacier melting in the Himalayas affecting the availability of freshwater in surrounding regions?
* What are the consequences of the Greenland Ice Sheet retreat on global sea-level rise?

Climate change connection:

* How do global land cover changes contribute to the broader issue of climate change?
* How can local communities be engaged in efforts to prevent or reverse land cover changes such as deforestation?

Technological solutions and future projections:

* How can spatial technologies like GIS and remote sensing aid in monitoring and addressing land cover changes at a global scale?
* Based on current trends, what are the projected impacts of melting glaciers on global freshwater resources by 2050?

Use [Deforestation and Forest Loss](https://ourworldindata.org/deforestation) to compare and contrast deforestation rates across different countries using the interactive map provided. Complete the questions below:

* What is the net change in forest cover and how is it calculated?
* Which countries are experiencing positive changes in forest cover and which ones are facing negative changes?
* How has the global forest cover changed over the past 10 000 years?
* What factors have contributed to deforestation historically?

Use [Mapping the Shocking Extent of Desertification](https://earth.org/data_visualization/how-desertification-has-affected-these-9-countries-since-1984/) to discuss the global implications of desertification and [brainstorm](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/542) potential solutions to address this issue.

In pairs, complete the following questions:

* How is desertification defined and what are its primary causes?
* What are some of the consequences of desertification in China, Yemen, Kenya and Mali?
* What strategies have been employed to combat desertification and have they been successful?

Use the [Global Ice Viewer](https://climate.nasa.gov/interactives/global-ice-viewer/#/) to investigate the rate of ice melt in the Arctic and Antarctic over the past decade, including melting glaciers and retreating ice sheets. [Discuss](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/547) the global implications of ice melt and [brainstorm](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/542) solutions to mitigate its effects. Use the following questions to drive the discussion:

* What are the main factors contributing to global ice melt?
* How does the changing polar ice caps affect global sea levels?
* What are some observable effects of changes to ice cover on local ecosystems?
* What measures are being taken globally to mitigate the ice loss?
* How does data from satellites contribute to our understanding of global ice trends?

Complete an annotated [map or maps of the world](https://www.outline-world-map.com/), illustrating land cover change at a global scale for deforestation, desertification, and melting glaciers and retreating ice sheets.

Using [Not passive victims: Indigenous Australians respond to climate change](https://www.foreground.com.au/culture/not-passive-victims-indigenous-australians-respond-to-climate-change/), complete a [Strengths, Weaknesses, Opportunities and Threat (SWOT)](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/660) analysis of First Nations people’s responses to climate change. Conduct further research and discuss the effects of climate change on a specific community of Indigenous Australians. Complete the following:

* How is climate change affecting the socio-economic and environmental systems of Indigenous populations in Australia?
* What are some examples of the impacts of climate change on traditional sites and practices of Indigenous Australians?
* How are Indigenous Australians adapting to the challenges posed by climate change?
* What are some new initiatives and alliances mentioned in the article that aim to strengthen cultural practices amid climate change?

# Learning sequence 2 – Land use and land cover change

**Teacher note**: examples included in the syllabus are provided to support delivery of course content. These examples are not mandatory and teachers may choose to use the examples provided or select appropriate alternatives.

## Syllabus content

* The extent and rate of change in ONE form of land cover

**Including:**

* how changes in land use can interrupt natural systems and contribute to the land cover change
* the impacts of the land cover change at a range of scales, including climate change

### Learning intentions and success criteria

**Teacher note**: these learning intentions and success criteria are general and should be contextualised to suit your school and students’ needs.

#### Learning intentions

Students:

* know about changes to land cover and understand how land use can impact natural systems and land cover
* describe the key physical and ecological characteristics of the tundra biome and analyse the impact of human activities on this biome
* develop skills in creating informative visual representations (concept maps and cause-and-effect diagrams) that effectively communicate the complex relationships and changes within the tundra biome
* develop skills to analyse and interpret changes in land cover across various regions in Australia over the past decade
* investigate the characteristics of alpine and tundra environments, focusing on climate, vegetation, wildlife and the impact of climate change.

#### Success criteria

Students can:

* clearly identify and describe specific aspects of the tundra biome present in the video, including climate, vegetation, animal life and geographical features
* accurately identify and explain the main threats to the tundra biome originating from human activities, showing a clear understanding of the cause-and-effect relationship
* create a detailed concept map and a cause-and-effect diagram that visually represent the relationships within the tundra biome, including threats and their impacts
* write a comprehensive extended response that includes a clear introduction to the tundra biome, a focused thesis on a specific type of land cover, detailed information about the chosen land cover, its role in the ecosystem, and relevant data or statistics showing changes over time
* demonstrate a thorough analysis of assigned Australian regions, comparing and contrasting land cover, and effectively considering factors like climate, human activity and topography
* make reasoned predictions about the impacts of global warming on tundra land cover and subsequently evaluate these predictions based on recent data, expert opinions and findings from authoritative sources.

## How changes in land use can interrupt natural systems

**Teacher note**: the format and strategies can be adapted for other forms of land cover to meet individual school contexts.

[360 video, Journey to Elbrus Mountain, Russia 8K. aerial video (2:46)](https://youtu.be/iU9AaGzXblM) can be viewed on desktop or for an immersive experience, viewed through 360 goggles.

Access [360 video Journey to Elbrus Mountain, Russia 8K aerial video (2:46)](https://youtu.be/iU9AaGzXblM), [Tundra](https://earthobservatory.nasa.gov/biome/biotundra.php) and [Alpine Tundra](https://thewildclassroom.com/biomes/alpine-tundra/) to research the land cover, the tundra biome.

Describe the key physical features that are observed and are characteristic of the tundra biome. Complete the following questions:

* What specific aspects of the tundra biome are visible in the video? How do these aspects differ from other biomes?
* What are the main threats and/or interruptions to the tundra biome? How do these threats and/or interruptions originate from human activities?
* What measures could be taken to mitigate the threats to the tundra biome?

Create a [concept map](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/577), highlighting the key features of tundra biomes. Consider the following questions:

* What are the primary characteristics of the tundra biome that need to be included in a concept map? Consider factors like climate, vegetation, animal life and geographical features.
* How can the relationships between different elements of the tundra biome be visually represented on a concept map?
* How will the structure of the concept map clearly show the cause-and-effect relationship between these threats and their impacts on the tundra biome?

Create a cause-and-effect diagram using [Tundra Threats Explained](https://education.nationalgeographic.org/resource/tundra-threats-explained/) and [Effects of human activities and climate change](https://www.britannica.com/science/tundra/Effects-of-human-activities-and-climate-change). The effect side of the diagram should identify which part of the tundra’s natural system or biophysical environment will be effected.

Write an extended response that explains the size and changes over time of one type of land cover in a tundra biome. The response must:

* Briefly introduce the tundra biome.
* State the specific type of land cover being discussed (for example, permafrost, mosses, lichens).
* Present a thesis statement that outlines the main points regarding the extent and rate of change of this land cover.
* Provide detailed information about the chosen land cover in the tundra.
* Show the importance and role in the tundra ecosystem.

Use the current extent of the land cover in the tundra, including any relevant data or statistics. Historical data on the land cover should show how it has changed over time.

## The impacts of the land cover change at a range of scales

Access the [Digital Earth Australia (DEA) Land Cover](https://www.dea.ga.gov.au/products/dea-land-cover) webpage and [Digital Earth Australia map](https://maps.dea.ga.gov.au/story/DEALandCover). In groups, analyse changes in land cover over a set period of time. This can include changes in vegetation, urbanisation or water bodies.

Complete a class discussion on the different types of land cover identified, including the natural and human factors influencing these changes.

**Teacher note**: complete a [jigsaw](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/546) activity with students working individually or in pairs. Identify regions in Australia where significant land cover change has occurred over the past decade. Each student or pair is assigned a different region to research. Students compare and contrast the land cover in these regions, considering factors like climate, human activity and topography.

Complete a jigsaw activity to compare and contrast different regions of Australia. Use the following guiding questions to conduct research on the assigned region:

* What types of changes have taken place?
* What are the potential environmental impacts of these changes in land cover? Consider aspects such as biodiversity, soil health and water resources.
* Compare the land cover of a coastal region and an inland region in Australia. What are the key differences and why do they exist?
* How does the variation in land cover between these regions affect their respective ecosystems, human activities and climate change?
* What are the main differences and similarities between alpine and tundra environments in terms of climate, vegetation and wildlife? What role do elevation and latitude play in defining the characteristics of these 2 environments?
* What are the typical climatic conditions found in alpine and tundra environments?
* How have plants and animals adapted to survive the harsh conditions of these environments? Provide specific examples.

Access [Climate change impacts on our alpine areas](https://www.climatechange.environment.nsw.gov.au/alpine). Create a poster or infographic using [Canva for Education](https://t4l.schools.nsw.gov.au/resources/professional-learning-resources/canva-for-education.html?clearCache=684df347-3951-68d3-1eba-b4a19702c07bto%20) to show the impacts of climate change on the land cover of alpine tundra in the New South Wales and Australian Capital Territory alpine region.

Observe the images showing [Projected changes of the alpine tundra domain (ATD) in the Alps under warming levels with respect to the reference period (1981–2010)](https://www.researchgate.net/figure/Projected-changes-of-the-alpine-tundra-domain-ATD-in-the-Alps-under-scenario-RCP45-and_fig3_342589788) and [Climate change may make the Arctic tundra a drier landscape](https://phys.org/news/2019-05-climate-arctic-tundra-drier-landscape.html).

Complete a [Predict, Observe, Explain thinking routine](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/662) of the impacts of continued global warming. Predictions should consider aspects like permafrost thawing, vegetation changes, animal migration patterns, and increased human activities like mining and drilling.

Research and compile recent data based on a specific case study, including expert opinions on the current state of tundra ecosystems. Focus on observed changes in land cover including biodiversity, and environmental conditions linked to climate change and human activities.

Access the [Intergovernmental Panel on Climate Change](https://www.ipcc.ch/reports/) (IPCC – Reports) and the [World Wildlife Fund – Effects of Climate Change Effects](https://www.worldwildlife.org/threats/effects-of-climate-change). Make predictions on the specific impacts of global warming on tundra land cover. Predictions should consider aspects like permafrost thawing, vegetation changes, animal migration patterns, and increased human activities like mining and drilling.

Using the [National Snow and Ice Data Center](https://nsidc.org/home) (NSIDC), explain the reasons behind the changes in tundra land cover in a short response format. Correlate the findings with the initial predictions, discussing the accuracy or inaccuracy of their hypotheses and the reasons behind this.

# Learning sequence 3 – Human-environment interactions study

**Teacher note**: examples included in the syllabus are provided to support delivery of course content. These examples are not mandatory and teachers may choose to use the examples provided or select appropriate alternatives.

## Syllabus content

### Study 3: Climate change

* Spatial and temporal characteristics of climate change at a global scale
* Environmental and human impacts of climate change at a range of scales

**Including:**

* impacts on natural processes, systems and/or environments
* impacts on people and communities
* Challenges, opportunities and responses

**Including:**

* varying perspectives
* mitigation in relation to the rate and magnitude of change
* minimising risk through adaptation, resilience and innovation
* local, national and global action
* The effectiveness of people and organisations in managing ONE climate change challenge at a selected place

### Learning intentions and success criteria

**Teacher note**: these learning intentions and success criteria are general and should be contextualised to suit your school and students’ needs.

#### Learning intentions

Students:

* know the spatial and temporal characteristics of global climate change
* understand the impacts of climate change on humans and natural systems
* identify challenges, opportunities and responses to climate change from varying perspectives and scales
* understand the main environmental challenges, opportunities and responses Pacific Island nations like Kiribati face due to climate change
* explore and analyse various strategies for mitigating climate change effects in the Pacific Islands, using geographical tools and concepts
* understand how climate change affects coral reefs, with a particular focus on the Great Barrier Reef. This includes exploring the causes and impacts of phenomena like coral bleaching and ocean acidification
* discuss the effectiveness of managing the climate change challenge of global warming at the Great Barrier Reef.

#### Success criteria

Students can:

* correctly define and identify spatial and temporal characters of global climate change
* use visual representations to show causes and impacts of climate change on natural processes, systems and/or environments, and people and communities over a range of scales
* engage with a range of resources to examine challenges, opportunities and responses to climate change
* identify and analyse the main environmental and socio-economic challenges faced by Kiribati and other Pacific Island nations
* articulate well-reasoned insights into the long-term geographical changes, potential solutions and strategies for resilience of climate change, both locally and globally
* demonstrate the basic principles of coral reef ecosystems, the process of coral bleaching and how climate change causes issues in the context of the Great Barrier Reef
* analyse and interpret data related to coral reef health and climate change indicators, such as carbon dioxide (CO2) levels, temperature changes and biodiversity
* develop and present a plan incorporating local, national and global scales examining past, present and future management of global warming on the Great Barrier Reef.

## Study 3: Climate change

**Teacher note**: teachers choose one of 3 options to develop an understanding of natural and human elements, how they interact, and the implications of the interactions for people and the environment. The study selected must not significantly overlap or duplicate studies selected for Year 12. Study 3: Climate change has been chosen for this teaching and learning program.

Content in Study 3: Climate change – while syllabus content itself is not controversial, examples selected to support student learning should be appropriate and meet the requirements of the [Controversial Issues in Schools](https://education.nsw.gov.au/policy-library/policies/pd-2002-0045) policy.

## Spatial and temporal characteristics of climate change at a global scale

Access [What is Climate Change?](https://www.un.org/en/climatechange/what-is-climate-change) and [Climate projections for Australia](https://www.csiro.au/en/research/environmental-impacts/climate-change/climate-change-information) to refresh knowledge. In small groups, engage in a game of [Hot seat](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/569) where the person in the middle is asked one of the questions from the [Climate change questions and answers](https://www.csiro.au/en/research/environmental-impacts/climate-change/Climate-change-QA) article. Provided below are further guiding questions for further discussion based on the previous articles:

* What defines climate change and how is it different from global warming?
* What are the long-term trends or shifts that define climate change?
* How and why is the world warming, and what is the ‘enhanced’ greenhouse effect?
* What are the projected future changes in climate, and what factors will influence these changes?

Read the spatial and temporal characteristics and examples in Table 3 and Table 4. Conduct further research to complete the tables.

Table – spatial characteristics and examples

|  |  |  |
| --- | --- | --- |
| Spatial characteristics | Examples | Other examples |
| * Involves the geographical distribution and localised impact of climate change. * Vary widely from region to region, including changes in temperature, precipitation patterns, frequency of extreme weather events, sea-level rise, glacial melting, and shifts in ecosystems and biodiversity. | **Polar regions**  The Arctic’s rapid warming, resulting in the shrinking and thinning of sea ice. Impact on polar bears, walruses and other species dependent on sea ice.  Antarctica’s ice shelf disintegration and glacier retreat. The melting of the West Antarctic ice sheet contributes significantly to sea-level rise.  **Oceans**  Sea-level rise caused by the melting of polar ice and thermal expansion of seawater. This leads to inundation of low-lying areas and islands, coastal erosion and habitat loss.  **Ocean acidification**  Increased CO2 absorption lowers pH levels, affecting marine life, particularly organisms with calcium carbonate shells or skeletons.  **Forests and terrestrial ecosystems**  Shifts in vegetation zones, altered rainfall patterns and temperature regimes are causing shifts in plant species distribution, potentially leading to forest dieback in some regions.  Increased wildfires due to warmer and drier conditions in many regions are leading to more frequent and intense wildfires.  **Deserts and arid regions**  Desertification: expansion of desert areas due to reduced rainfall and increased evaporation. This affects soil quality, agriculture and water resources.  **Mountain regions**  Glacial retreat: many mountain glaciers are retreating, affecting freshwater supplies for millions of people downstream.  **Altered ecosystems**  Changes in snow cover and melting patterns affect mountain biodiversity and ecosystems.  **Urban areas**  Heatwaves and urban heat islands in cities often experience higher temperatures than surrounding areas, exacerbating the effects of heatwaves on human health and energy demand. |  |

Table – temporal characteristics and examples

|  |  |  |
| --- | --- | --- |
| Temporal characteristics | Examples | Other examples |
| * Involves the timing and duration of climate change impacts over short-, medium- and long-term periods. * Short-term variations might include year-to-year changes in weather patterns or the frequency of extreme weather events like cyclones or droughts. * Medium-term changes could be observed over decades, such as shifts in average temperature or precipitation patterns, affecting agriculture and water resources. * Long-term trends span centuries and even millennia, involving gradual but significant shifts like the alteration of global temperature averages and sea-level rise. | **Seasonal changes**  Altered growing seasons’ changes in temperature and precipitation patterns are affecting agricultural practices and crop yields.  Shifts in animal migration and breeding cycles: wildlife is adjusting migration patterns and breeding times in response to climate changes.  **Year-to-year variability**  Increased frequency and intensity of extreme weather events with more intense storms, droughts and flooding events are becoming more common.  **Decadal trends**  Gradual changes in climate norms in areas that are experiencing gradual shifts in average temperatures, precipitation patterns and extreme weather event frequencies.  **Long-term changes (centuries to millennia)**  Ice Age cycles are natural long-term cycles and are overlaid by human-induced climate changes, complicating predictions for future climate conditions. |  |

Complete a [quick write](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/548) activity that describes the spatial and temporal characteristics of climate change.

Access the [World Bank Climate Change Knowledge Portal](https://climateknowledgeportal.worldbank.org/country/somalia/climate-data-historical) – [Somalia summary](https://climateknowledgeportal.worldbank.org/country/somalia). Select a second country to explore the historical climate data from 1991 to 2020. Focus on comparing the spatial variation, seasonal cycles and time series analysis.

Use the provided tools on the portal to visualise national and sub-national climate data for the 2 countries. Research various factors influencing the countries’ climate, such as the Inter-Tropical Convergence Zone (ITCZ), monsoonal winds and ocean currents.

Examine different aspects of the countries climate, including temperature trends, rainfall patterns and the impact of the El Niño Southern Oscillation (ENSO). Conduct a detailed study on the rainy seasons in the countries, examining their impact on local agriculture and livelihoods. Use the following questions to guide the research:

* What are the primary climatic characteristics of Somalia and the other country for the period 1991–2020?
* How do geographical factors like monsoonal winds and ocean currents influence Somalia's and the other country’s climate?
* Discuss the seasonal temperature and precipitation patterns in Somalia and the other country. How do they vary between the northern and southern regions?
* What is the role of the El Niño Southern Oscillation or other climate patterns in influencing Somalia's and the other country’s climate variability?
* How does the average annual rainfall vary across different parts of Somalia? Is this similar to the other country? What implications does this have for agriculture and water resources?

**Temperature variation and change**

Access the article and observe the map in [Rising temperatures: A month versus a decade](https://climate.nasa.gov/news/2180/rising-temperatures-a-month-versus-a-decade/). How is temperature across the globe recorded and analysed?

Label and annotate locations on the map that experienced reduced, +2°C and +4°C temperature change from the norm from April to September 2014.

The article states: ‘But in the context of climate change, it does not make sense to try to derive much meaning from a single month—or, for that matter, even a single year’ (Voiland 2014). Research average temperature change over at least a 20-year period in 3 of the locations identified in the annotated map.

Complete a [See-Think-Wonder thinking routine](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/662). ‘Think’ why the observed temperature change has occurred in these locations. ‘Wonder’ what impacts people and natural systems experience in each location and what they could be in the future.

Read and explore the chart in [How Understanding the History of the Earth's Climate Can Offer Hope Amid Crisis](https://time.com/5680432/climate-change-history-carbon).

In pairs or small groups, complete the following steps:

1. Create 5 questions.
2. On a separate sheet of paper, record the answers to the questions.
3. Swap with another pair or small group.
4. Complete the questions and review the responses.
5. Swap with another pair or small group and do the same.

Create a [group brainstorm](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/542) summarising causes of global temperature change overtime. Provided are some guiding questions for the brainstorm:

* What historical events or discoveries led to our understanding of carbon's role in climate change?
* How has the scientific understanding of carbon emissions evolved over time?
* What are the key scientific studies or experiments that have demonstrated the impact of carbon on the climate?
* How did early industrialisation contribute to the increase in carbon emissions?
* What are some of the most significant sources of carbon emissions historically and in the present day?
* How do current carbon emission levels compare with those in the past?

**Precipitation patterns**

Use [How climate change is disrupting rainfall patterns and putting our health at risk](https://climate.ec.europa.eu/news-your-voice/news/how-climate-change-disrupting-rainfall-patterns-and-putting-our-health-risk-2023-08-03_en) and background knowledge to explain how climate change affects precipitation patterns. Use diagrams, flowcharts and other visual representations in the support response.

Read the article and examine the diagram in [Rainfall becomes increasingly variable as climate warms](https://phys.org/news/2021-07-rainfall-increasingly-variable-climate.html). Write a short response based on the article and further research about the spatial impacts of climate change on rainfall. Provided are some guiding questions for the research and the response:

* What do climate models predict about rainfall variability in wet regions globally due to global warming?
* How does increased rainfall variability impact the incidence of floods and droughts?
* How does increased water vapor in the air due to warming climates affect rainfall variability?

**Sea-level change**

Explore the computer model in [A NASA first: Computer model links glaciers, global sea level](https://sealevel.nasa.gov/news/43/a-nasa-first-computer-model-links-glaciers-global-sea-level/). Use the information and data provided to support the statement – ‘Sea-level change differs across the globe’. Read [Sea Level Rise](https://education.nationalgeographic.org/resource/sea-level-rise/), (the response to the statement above).

Complete a [words and images brainstorm](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/542) representing the spatial impacts of rising global sea level.

Access [Vital Signs: Sea Level](https://climate.nasa.gov/vital-signs/sea-level/). Construct a response using explicit data as evidence to explain how the graph supports the ‘key takeaway’ statement indicated at the top of the webpage.

Review the completed tables in Activity 4 in the resource booklet. Add additional examples and evidence to the tables based on the previous webpages and activities from:

* temperature variation and change
* precipitation patterns
* sea-level change.

Recap and reflect on the original short response that described the spatial and temporal characteristics of climate change. Write a reflection on the response based on the main ideas, opinions or conclusions. Engage in a comparison between the original responses and the new information. For example, what has changed? Are there any contradictions or reinforcements between the old and new information? After the discussion, write a revised response, incorporating students’ new understanding and/or insights. Share these revised responses within the group and discuss the evolution of thoughts and understanding.

## Environmental and human impacts of climate change at a range of scales

Access [NASA – Global Climate Change](https://climate.nasa.gov/) and [World Bank – Climate Change Knowledge Portal](https://climateknowledgeportal.worldbank.org/), students create thematic maps showing different aspects of climate change impacts (for example, temperature rise, sea-level change). Using GIS software to map areas most affected by climate change (for example, melting ice caps, areas of deforestation). Analyse the maps to discuss the regional differences in climate change impacts.

Access satellite images, vegetation identification charts and remote sensing data to investigate changes in vegetation over time. Compare current satellite images with historical data, using the following links [Google Earth Engine,](https://earthengine.google.com/) and [Atlas of Living Australia](https://ala.org.au/). In groups, discuss how climate change is affecting plant species distribution and biodiversity.

Access [Climate change and sea-level rise in the Australian region](https://coastadapt.com.au/climate-change-and-sea-level-rise-australian-region) and [Coast Adapt](https://coastadapt.com.au/). In small groups, complete a [Frayer diagram](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/553) showing impacts of climate change on the allocated impacted natural system in Australia. The 4 areas to complete the Frayer diagram are:

* projections
* impacts
* variations across Australia
* data and points of interest.

Use virtual instruments like GIS to measure beach profiles and observe signs of erosion or sea-level rise. Access photographs or Google maps of the area to document current conditions.

In small groups, access [Climate change is the single biggest threat facing the Reef?](https://www.barrierreef.org/the-reef/threats/climate-change#:~:text=Already%20marine%20heatwaves%20have%20triggered,and%20conditions%20return%20to%20normal) and further research to answer the following questions:

* What is the primary cause of the rising temperatures in our oceans and on land? Explore the role of carbon dioxide and greenhouse gases in climate change.
* How does coral bleaching occur, and what are its consequences? Discuss the process of coral bleaching and its impact on the Great Barrier Reef.
* Explain the phenomenon of ocean acidification and its effect on coral reefs.
* What are the impacts of severe weather events on the Great Barrier Reef?
* Examine how climate change increases the frequency and intensity of storms, cyclones and flooding.
* How do habitat changes, due to rising water temperatures, affect marine life in the Great Barrier Reef?

Create an [infographic](https://t4l.schools.nsw.gov.au/resources/professional-learning-resources/canva-for-education.html?clearCache=aff041a2-8a6a-a760-6361-9d7ec913f582) showing the Great Barrier Reef’s natural processes and the impacts of climate change. This could include coral polyp growth, symbiotic relationships with algae, nutrient cycles and reef ecosystem interactions. In planning the infographic, outline the key points and develop a rough sketch to plan the layout. Consider dividing the infographic into sections, like ‘Natural Processes of the Reef’ and ‘Impacts of Climate Change’. Use design software or online tools like [Canva](https://www.canva.com/en_au/) or [Adobe Spark](https://express.adobe.com/page/9bPqZ/?tp=1). Include diagrams of coral polyps and their symbiotic relationship with algae. Use before-and-after images or icons to represent the impact of climate change, such as healthy coral versus bleached coral. Create graphs or charts to show data on temperature changes, coral bleaching events or species decline. Cite all sources used for data and images to maintain credibility. Include a small section at the bottom of the infographic for references.

Use [Climate change impacts on our coasts](https://www.climatechange.environment.nsw.gov.au/impacts-climate-change/natural-environment/coasts) and further research to explain:

* the value of the coastal environment and its natural processes
* how the coastal environment is affected by climate
* impacts of specific climate changes on coastal natural systems, environment, plants and animals.

Conduct a brief discussion on climate change, its causes, and general impacts on the people, communities and human health. Pose the following questions:

* What do you already know about climate change and its impact on people and communities?
* How do you think climate change affects our health and the environment?

Access [Climate change and health](https://www.betterhealth.vic.gov.au/health/healthyliving/climate-change-and-health), [How climate change is affecting community groups](https://www.climatechange.environment.nsw.gov.au/community-groups/effects-community-groups#:~:text=General%20impacts%20of%20climate%20change,other%20members%20of%20the%20community.) and explore how climate change affects various groups, such as those with social or economic disadvantages, non-English-speaking communities and rural areas. Use case studies and real-life examples to illustrate these impacts and guiding questions:

* How do extreme weather events like bushfires and floods uniquely impact rural and regional communities?
* What mental health issues can arise in community groups due to climate events, and how can they be addressed?

Access the [Climate change and health (1:36)](https://youtu.be/eZiiIPEqSiM?si=kVI-uhsF0N850kyG) and [Climate change and health – Extreme weather events (1:07)](https://youtu.be/VBoS1FOxoac). Answer the post-viewing questions:

* What are some key points you learned from these videos?
* How do extreme weather events relate to climate change and health?

Complete a [Venn diagram](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/599) on ‘Impacts of climate change’. Label one circle ‘natural systems and environments’ and the other ‘people and communities’. In the overlapping area, note impacts that affect both natural systems and human communities.

Use a [storyboard](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/559) scaffold to develop a presentation titled ‘Impacts of climate change on people and communities’. Assist in planning. The presentation should clearly identify at least 3 effects of climate change on natural systems such as increased temperature, increased flooding or sea-level rise. The impacts of climate change on people and communities should be based on these natural system impacts.

Conduct climate change and communities’ statistical analysis by using graphs and statistics (for example, data tables, climate graphs). In groups, analyse statistical data on how climate change affects different communities, focusing on aspects like health, economy and migration patterns. Use resources such as [Australian Bureau of Statistics](https://www.abs.gov.au/) for demographic and economic data related to climate change.

Access the [State Library of NSW digital collections](https://www.sl.nsw.gov.au/) to locate and compare historic photographs of a local area with current ones to analyse environmental changes. Focus on aspects like vegetation changes, erosion or urban development.

Access [Food and Agriculture Organization of the United Nations: Climate Change](https://www.fao.org/climate-change/en/) and [National Farmers’ Federation Australia](https://nff.org.au/) to explore impact of climate change on agricultural practices and communities.

**Teacher note**: the following fieldwork activity provides an opportunity for a hands-on learning experience. If this is not accessible in your context, a virtual meeting with a farmer might be a suitable alternate activity.

Visit a local farm to conduct soil tests and interview farmers about changes observed and adaptations made. Tools could include soil testing kits, climate graphs and interviews with local farmers. Compile and analyse data, presenting findings on how climate change is impacting local agriculture and food security.

As a class, discuss how climate change exacerbates existing environmental stresses such as habitat loss, invasive species and water scarcity. Focus on how this impacts groups like [Landcare](https://landcareaustralia.org.au/) and their conservation efforts. Conduct research using the following questions:

* How does climate change threaten conservation efforts by environmental groups?
* What new challenges do environmental groups face in terms of species regeneration and habitat preservation?

Create a proposal for an environmental group to tackle new challenges brought by climate change, such as dealing with new weed species or planning conservation efforts under changing climatic conditions.

## Challenges, opportunities and responses

**Teacher note**: ‘Challenges, opportunities and responses to climate change and rising sea levels in Pacific Island countries’ has been selected as the focus to address syllabus content. The format and strategies can be adapted to other case studies to meet individual school contexts.

Access [24 Hours of reality 2017: Weight of the world (Kiribati) (7:58)](https://youtu.be/Swv1lOA5zDc) and [Kiribati: Battling for Survival (Rising Sea Levels) (4:02)](https://youtu.be/hW9EAkqu6aY?si=XEMuLJ1aJXH0OceL). Complete the following questions:

* What are the main environmental challenges faced by Kiribati as presented in the video?
* How does climate change impact the geography and population of Kiribati?
* Discuss the socio-economic effects of environmental changes on the residents of Kiribati.
* What are the potential long-term geographical changes in Kiribati due to climate change?

Complete a [Perspectives Six Thinking Hats thinking routine](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/545). Select a 'hat' representing different perspectives (information, emotions, caution, benefits, creativity and process). Discuss the impacts of climate change in the Southwest Pacific from these various perspectives.

Access:

* [Climate change impacts increase in the South-West Pacific](https://wmo.int/news/media-centre/climate-change-impacts-increase-south-west-pacific#:~:text=Sea%20level%20rise%20threatens%20the,World%20Meteorological%20Organization%20(WMO)) – review the article and discuss the specific threats posed by climate change in the South West Pacific.
* [The Kiribati Climate Action Network](https://kirican.wordpress.com/) – review this blog to understand grassroots efforts and local responses to climate change.
* [Lessons From the Pacific Islands – Adapting to Climate Change by Supporting Social and Ecological Resilience](https://www.frontiersin.org/articles/10.3389/fmars.2019.00289/full) – analyse response and opportunities for adaptation and resilience in the Pacific Islands, think about both social and ecological aspects.
* [Pacific Islands are holding the front line of climate change, but this is a global fight](https://iceds.anu.edu.au/news-events/news/pacific-islands-are-holding-front-line-climate-change-global-fight) – discuss the global implications of climate change in the Pacific and the importance of international cooperation.
* [The IPCC report and the climate crisis in the Pacific](https://www.undp.org/pacific/blog/ipcc-report-and-climate-crisis-pacific) – summarise, focus on and identify the key points from the UNDP article on the IPCC report’s findings related to the Pacific. Discuss how these findings impact policy and public perception.
* [Trouble in paradise: how does climate change affect pacific island nations?](https://www.climaterealityproject.org/blog/trouble-paradise-how-does-climate-change-affect-pacific-island-nations) – focus on a specific Pacific Island nation and how climate change affects their specific nation.
* [Great power competition and climate security in the Pacific](https://www.chathamhouse.org/2022/07/great-power-competition-and-climate-security-pacific) – explore the intersection of geopolitics and climate security in the Pacific through a debate or panel discussion.
* [Mapping Exposure to Sea Level Rise | Tonga, Samoa, Vanuatu and Papua New Guinea](https://unfccc.int/climate-action/momentum-for-change/ict-solutions/mapping-exposure-to-sea-level-rise) – conduct mapping exercises, visualising the impact of sea-level rise on Tonga, Samoa, Vanuatu and Papua New Guinea.
* [Accurate measurement of absolute sea level rise in the Pacific region](https://www.community-safety.ga.gov.au/projects/pacific-sea-level-rise) – analyse data on sea-level rise and incorporate it into the mapping projects to understand the tangible impacts of climate change.

Complete a reflection on the learning from these sources. As a class, discuss the future implications of climate change for the Pacific Islands and the world.

For each article, complete a 3-2-1 summary. Instructions for this summary can be accessed in [instructional strategies playlist](https://lead4ward.com/playlists/) under **evidence of learning playlist**. Select **3-2-1 summary**.

Construct a [Google Jamboard](https://t4l.schools.nsw.gov.au/resources/professional-learning-resources/google-resources/google-jam-board.html?clearCache=6af6c7d-7d69-6906-8644-bf771ef1fcdb) titled ‘Challenges, opportunities and responses to climate change and rising sea levels on Pacific Island countries’. Label [Google Jamboard](https://t4l.schools.nsw.gov.au/resources/professional-learning-resources/google-resources/google-jam-board.html?clearCache=6af6c7d-7d69-6906-8644-bf771ef1fcdb) pages with the title of an article. Add the 3-2-1 summary notes to the page allocated for each article.

Integrate maps of the Pacific Islands into the Jamboard pages to visually represent the areas discussed in the articles. Include graphs or charts that showcase relevant data, such as sea-level rise projections, temperature changes or demographic impacts.

Complete [peer feedback](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/549) and discussion on the key points, questions and opinions presented. Highlight the importance of geographical ideas related to spatial awareness, environmental impact, human-geographical interactions, and local, national and global action.

Use a comparative tool to analyse differences and similarities in climate change impacts among different Pacific Island nations. In small groups, discuss how geographical skills like mapping, data analysis and comparative studies can be used in addressing global challenges and response to climate change.

Drawing on the previous resources, discussions and activities, in small groups, complete a [carousel cooperative learning strategy](https://shelleygrayteaching.com/carousel/) and rotate through all 4 in a carousel manner. Prepare 4 large sheets of paper or whiteboard spaces, to record challenges, opportunities and responses to climate change and rising sea levels on Pacific Island countries. Each titled with one of the brainstorm list topics:

* Varying perspectives
* Mitigation in relation to rate and magnitude of change
* Minimising risk through adaptation, resilience and innovation
* Local, national and global action.

Divide each sheet into 3 columns: Challenges, Opportunities and Responses.

Each group to brainstorm ideas for the starting topic, focusing on identifying challenges, opportunities, and potential responses related to climate change and rising sea levels. Include:

* A set amount of time, groups rotate to the next brainstorm list, adding to the ideas already listed while also considering the perspectives and input of previous groups.
* Think critically and creatively, drawing on previous discussions, activities and resources.
* Use geographical terminology, concepts and statistical data, case studies and real-world examples in the brainstorming.
* Consider the geographical diversity of the Pacific Island countries and how this influences the challenges, opportunities and responses.
* Collaboration and discussion within and between groups to foster a deeper understanding of the interconnected nature of climate change issues.
* Use resources like maps and online geographical tools as a reference during the brainstorming.
* Reflect on how the activity developed understanding of the complexity of climate change issues in the Pacific.

Complete a [SWOT analysis](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/660) of a Pacific island nation’s approach to managing climate change. The SWOT includes:

* Strengths – identify positive aspects or effective strategies related to the Pacific Islands' response to climate change and sea-level rise
* Weaknesses – note challenges or limitations in the current approaches to handling climate change in these regions
* Opportunities – consider potential for innovation, international support, technological advancements or other positive outcomes
* Threats – identify risks or negative impacts that climate change and rising sea levels pose to the Pacific Islands.

Reference maps, data sets and case studies to support the points in the SWOT analysis.

[Take notes](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/661) on the different perspectives, challenges, opportunities and responses observed, focusing on how these can be categorised into the SWOT analysis. The notes should focus on:

* Physical characteristics of the region, socio-economic factors, environmental impacts and policy responses.
* Geographical terms and concepts in their analysis.
* Highlight the importance of spatial thinking and how the location, place, and scale influence the strengths, weaknesses, opportunities and threats.

Share insights and how perceptions might have changed or expanded using the following driving questions:

* Discuss how geographical tools helped them in analysing and understanding the complexities of climate change impacts on the Pacific Islands.
* Explain how their perceptions might have changed or expanded throughout the activity.
* Describe local, national and global action that could be undertaken.

## The effectiveness of people and organisations in managing ONE climate change challenge at a selected place

**Climate change challenge of global warming on the Great Barrier Reef**

Conduct a [KWL – activating prior learning](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/562) task using the driving question ‘What are threats to coral reefs from climate change and how have they impacted the coral reef? KWL includes:

* K (Know) – start with a brainstorming session. Identify facts and information already known about coral reefs, climate change and their interrelation. Discuss geographic concepts like ecosystems, climate patterns and human impact.
* W (Want to know) – list questions about how climate change affects coral reefs. This could include queries about specific impacts, global distribution of coral reefs, the role of human activities and conservation efforts.
* L (Learned) – reflect on what has been learned throughout school about coral reefs. How do these insights align or differ from the initial thoughts? Note: this can be conducted after the following activity.

Explore the infographic titled ‘Threats to coral reefs: climate change’ found in [How does climate change affect coral reefs?](https://oceanservice.noaa.gov/facts/coralreef-climate.html#:~:text=Climate%20change%20dramatically%20affects%20coral%20reef%20ecosystems&text=A%20warming%20ocean%3A%20causes%20thermal,land%2Dbased%20sources%20of%20sediment.) and further research to respond to the following prompts:

* Use maps showing global coral reef distributions, climate change patterns (like rising sea temperatures) and areas most affected by climate change.
* Interpret data related to coral reef health, climate change indicators (like CO2 levels) and biodiversity.
* Analyse and question the data and information they find. How do different sources of information compare? What are the possible biases?

Write a [One Minute Paper](https://www.rochester.edu/college/teaching/teaching-guidance/one-minute-paper.html#:~:text=A%20one%2Dminute%20paper%20is,of%20that%20day's%20class%20session.) response to ‘Threats to coral reefs from climate change and how they impact coral reefs’. The focus of this activity is to summarise information concisely and reflect on their learning process.

View [Coral bleaching 101 – coral bleaching explained (4:14)](https://youtu.be/dcWlVN02kDQ). Complete the following questions:

* What is coral bleaching, and how is it explained in the video?
* Identify the primary causes of coral bleaching. How do these causes relate to broader environmental issues?
* How does coral bleaching affect the Great Barrier Reef specifically?
* Why is coral bleaching a significant issue for marine ecosystems worldwide?
* What conservation efforts or strategies are mentioned in the video to combat coral bleaching?
* Explain the link between climate change and coral bleaching as illustrated in the video.
* Describe the role of human activities in exacerbating coral bleaching, based on the video's content.
* How can the Great Barrier Reef be used as a case study to understand the global implications of coral bleaching?

Using [Cornell notes](https://thinkinsights.net/consulting/cornell-method-great-notes/), develop notes to the following questions, adding diagrams and drawings where appropriate:

* What is coral?
* Define coral as marine invertebrates within the class Anthozoa of phylum Cnidaria.
* Explain the symbiotic relationship between coral and zooxanthellae (algae).
* Encourage the use of diagrams to illustrate the structure of a coral polyp and a coral reef.
* What is coral bleaching?
* Describe coral bleaching as the process of corals losing their colour due to stress factors affecting the algae that live within their tissues.
* Use diagrams to show healthy versus bleached coral.
* Causes of coral bleaching:
* Discuss factors such as water temperature changes, pollution, overexposure to sunlight, and ocean acidification.
* Include charts or graphs showing the correlation between these factors and bleaching events.
* Impact of global temperatures on coral reefs:
* Explain the ecological and economic impacts of coral bleaching.
* Use case studies or real-world data to illustrate the severity and frequency of these events.

**Teacher note:** allocate different actions undertaken by the Authority in managing and protecting the Reef. Provide guidelines on how to research effectively and what to look for on the website.

Visit [Great Barrier Reef Marine Park Authority – Our Work](https://www2.gbrmpa.gov.au/our-work). Select one of the actions of the Great Barrier Reef Marine Park Authority in managing and protecting the Reef.

Complete a [concept map](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/577), explaining the interconnections between the elements and present it to the class. Each concept map should include:

* Initiatives – detail specific conservation or management initiatives.
* Impacts – explain the direct and indirect impacts of these initiatives on the reef ecosystem and surrounding communities.
* Relevant agencies and governing bodies – identify and describe the roles of various organisations involved in reef management.
* Data – incorporate relevant data and statistics to support the information.
* Documents – reference key documents, policies or scientific studies.

Participate in peer feedback and questions to foster a deeper understanding. Use digital tools for creating concept maps and presentations.

In small groups, undertake a [brainstorm](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/542) for each of the following articles:

* [What would happen if there were no coral reefs?](https://reef-world.org/blog/no-coral-reefs#:~:text=For%20these%20creatures%2C%20the%20reef,and%20other%20creatures%20would%20disappear)
* [Coral or Coal: Planning around the Great Barrier Reef](https://www.mining-technology.com/features/coral-or-coal-planning-around-the-great-barrier-reef/?cf-view)
* [Link between fossil fuels and Great Barrier Reef bleaching clear and incontrovertible](https://www.theguardian.com/environment/planet-oz/2016/mar/30/link-between-fossil-fuels-and-great-barrier-reef-bleaching-clear-and-incontrovertible-say-scientists)
* [Why Coal and Climate Change Hurt Our Oceans](https://www.marineconservation.org.au/why-coal-and-climate-change-hurt-our-oceans/)

During the brainstorming session for each article, use collaborative online tools like shared [digital whiteboards](https://app.education.nsw.gov.au/digital-learning-selector/LearningTool/Card/636) for simultaneous contribution of ideas and resources.

**Teacher note**: students may require support and preparation for the Town Hall Circle. Suggested activities prior to this learning activity include:

* Conduct workshops to prepare students for the Town Hall Circle, focusing on public speaking, argumentation and negotiation skills.
* Encourage students to fully immerse themselves in their roles, simulating real-world interactions and discussions.
* Support use of real data, maps, case studies and examples in their arguments. This could include data on coral bleaching, tourism statistics, maps of impacted regions, fishing industry data and so on.

Using the previous activity, identify stakeholders (for example, environmentalists, government officials, local communities, mining companies) who are connected to and reliant on coral reefs.

In pairs, select one of the identified key stakeholders. Using the brainstormed articles and additional research, hold a [Town Hall Circle](https://www.facinghistory.org/resource-library/town-hall-circle) to share the perspectives of the selected stakeholder. Use the following question to drive the discussion: How do we manage use of the Great Barrier Reef for sustainability and security?

After the Town Hall Circle, reflect on what lessons were learned, changed perspectives and the complexities of environmental management.

As a class, develop collaborative solutions or proposals for the sustainable management of the Great Barrier Reef, integrating ideas from the various stakeholders.

Using the information and ideas from the previous activity, develop an [elevator pitch](https://education.nsw.gov.au/schooling/students/student-voices/student-voice-and-leadership/student-resources) on ‘ways to ensure the Great Barrer Reef stays off UNESCO’s “in danger” list’. Access [World Heritage Committee keeps Great Barrier Reef off UNESCO list of sites in danger](https://www.abc.net.au/news/2023-09-14/great-barrier-reef-kept-off-unesco-world-heritage-in-danger-list/102855638), [Adaptive management of the Great Barrier Reef: A globally significant demonstration of the benefits of networks of marine reserves](https://www.pnas.org/doi/10.1073/pnas.0909335107) and [Global Climate Agreements: Successes and Failures](https://www.cfr.org/backgrounder/paris-global-climate-change-agreements). Additional sources, such as academic journals, government reports and international conservation organisation publications can also be used.

The focus of the pitch should be on 4 themes and related questions:

1. Current impact of global warming on the Great Barrier Reef:
2. How has global warming affected the biodiversity and ecological balance of the Great Barrier Reef in recent years?
3. Can you identify specific areas of the reef that have been most impacted by rising sea temperatures and acidification? Provide data or case studies.
4. How do these changes in the Great Barrier Reef reflect broader patterns observed in other coral reef systems around the world?
5. Effectiveness of local, national and global warming management practices and commitments:
6. What specific policies and actions have been implemented at local, national and international levels to mitigate the impact of global warming on the Great Barrier Reef?
7. How successful have these measures been in terms of measurable outcomes such as reduced coral bleaching or improved water quality?
8. Are there any innovative or unique strategies that have been particularly effective, and what lessons can be learned from them?
9. Local, national and global strategies for future management:
10. What new or enhanced strategies should be adopted at different levels (local, national, global) to more effectively manage the impact of global warming on the Great Barrier Reef?
11. How do these strategies integrate with broader efforts to combat climate change, such as carbon emission reductions and sustainable marine practices?
12. What role can local communities, Indigenous Australians and other stakeholders play in these future management strategies?
13. Predicted impact of suggested future management practices:
14. Based on current scientific models and research, what are the predicted outcomes of implementing your suggested management practices on the Great Barrier Reef?
15. How will these practices not only mitigate the effects of global warming but also promote the resilience and recovery of the reef ecosystem?
16. What are the potential challenges or barriers to implementing these practices, and how might they be addressed?

Use the [storyboard](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/559) scaffold to assist in planning. Use of infographics using [Canva for Education](https://t4l.schools.nsw.gov.au/resources/professional-learning-resources/canva-for-education.html?clearCache=684df347-3951-68d3-1eba-b4a19702c07bto%20) is also recommended.

**Climate change debate**

Examine different policies and measures proposed to combat climate change globally and locally.

**Teacher note**: to prepare students for a class debate, the following activities can be undertaken:

* Conduct sessions on research methodologies, critical thinking and effective communication. Focus on how to interpret scientific data related to climate change.
* Provide a list of additional resources beyond the [United Nations Framework Convention on Climate Change](https://unfccc.int/) and [Intergovernmental Panel on Climate Change.](https://www.ipcc.ch/) Include academic journals, government reports and data from climate research organisations.
* Focus on digital tools for data analysis and visualisation tools like GIS, Google Earth or climate modelling software can be valuable for understanding climate change impacts geographically.
* Assign roles that represent various stakeholders in climate policy (for example, government officials, scientists, activists, industry representatives). Encourage students to explore different perspectives.

During the debate:

* Use a formal debate format with opening statements, rebuttals and closing arguments. Each group gets equal time to present the case.
* Include geographic elements into the arguments, such as the impact of climate change on specific regions, adaptation measures in different geographical contexts and so on.
* Represent different viewpoints on climate change policies.

Post-debate activities:

* Write reflective reports, emphasising not just the content of the debate but also the process of understanding and analysing complex policies.
* Conduct a feedback session to discuss what they learned, challenges they faced and how understanding of climate change policies has evolved.
* Students review each other’s reflective reports to foster a community of learning.

Create an online forum or platform where students can continue discussing climate change policies and share relevant news or articles.

# Additional information

The information below can be used to support teachers when using this teaching resource for Geography 11–12 (2022).

## Support and alignment

**Resource evaluation and support**: all curriculum resources are prepared through a rigorous process. Resources are periodically reviewed as part of our ongoing evaluation plan to ensure currency, relevance and effectiveness. For additional support or advice contact the HSIE Curriculum team by emailing [hsie@det.nsw.edu.au](mailto:hsie@det.nsw.edu.au).

**Alignment to system priorities and/or needs**: [School Excellence Policy](https://education.nsw.gov.au/policy-library/policies/pd-2016-0468)

**Alignment to the School Excellence Framework**: this resource supports the [School Excellence Framework](https://education.nsw.gov.au/policy-library/policies/pd-2016-0468) elements of curriculum (curriculum provision) and effective classroom practice (lesson planning, explicit teaching).

**Alignment to Australian Professional Teaching Standards**: this resource supports teachers to address [Australian Professional Teaching Standards](https://educationstandards.nsw.edu.au/wps/portal/nesa/teacher-accreditation/meeting-requirements/the-standards/proficient-teacher) 3.2.2, 3.3.2.

**Consulted with**:Curriculum and Reform, Inclusive Education, Multicultural Education, Aboriginal Outcomes and Partnerships and subject matter experts

**NSW syllabus**: Geography 11–12 Syllabus (2022)

**Syllabus outcomes**: GE-11-01, GE-11-03, GE-11-04, GE-11-05, GE-11-06, GE-11-07, GE-11-08, GE-11-09

**Author**: Curriculum Secondary Learners

**Publisher**: State of NSW, Department of Education

**Resource**: Learning sequence

**Related resources**: further resources to support Geography 11–12 can be found on the [HSIE curriculum page](https://education.nsw.gov.au/teaching-and-learning/curriculum/key-learning-areas/hsie) and the [HSC hub](https://www.hschub.nsw.edu.au/).

**Professional learning**: relevant professional learning is available through the [HSIE Statewide staffroom](https://teams.microsoft.com/l/team/19%3ace47173b5fe14e16918eac8ca5e40913%40thread.skype/conversations?groupId=cc91cc45-b966-4333-b01f-31e78225fac4&tenantId=05a0e69a-418a-47c1-9c25-9387261bf991).

**Universal Design for Learning**: [Curriculum planning for every student](https://education.nsw.gov.au/teaching-and-learning/curriculum/planning-programming-and-assessing-k-12/advice-on-curriculum-planning-for-every-student-k-12). Support the diverse learning needs of students using inclusive teaching and learning strategies.

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# References

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AdaptNSW (n.d.) [*Climate change impacts on our alpine areas*](https://www.climatechange.environment.nsw.gov.au/alpine), NSW Government AdaptNSW website, accessed 12 September 2023.

AirPano VR (13 April 2018) ['360 video, Journey to Elbrus Mountain, Russia 8K aerial video' [video]](https://youtu.be/iU9AaGzXblM), *AirPano VR*, YouTube, accessed 12 September 2023.

Allen M (n.d.) [*DPSIR (Drivers, Pressures, States, Impacts, Responses)*](https://learningforsustainability.net/mwa/dpsir/), Learning for Sustainability website, accessed 12 September 2023.

Australian Academy of Science (n.d.) [*What is climate change?*](https://www.science.org.au/learning/general-audience/science-climate-change/1-what-is-climate-change), Australian Academy of Science website, accessed 12 September 2023.

Australian Government Great Barrier Reef Marine Park Authority (n.d.) [*Our Work*](https://www2.gbrmpa.gov.au/our-work), Great Barrier Reef Marine Park Authority website, accessed 29 February 2023.

Australian Marine Conservation Society (n.d.) [*Why Coal and Climate Change Hurt Our Oceans*](https://www.marineconservation.org.au/why-coal-and-climate-change-hurt-our-oceans/), Marine Conservation website, accessed 21 September 2023.

Barredo J (2020) *Figure 5* [image], ResearchGate website, accessed 12 September 2023.

Brennan P (2016) [*A NASA first: Computer model links glaciers, global sea level*](https://sealevel.nasa.gov/news/43/a-nasa-first-computer-model-links-glaciers-global-sea-level/), Sea Level Change: Observations from Space website, accessed 19 September 2023.

Britannica (n.d.) [*Effects of human activities and climate change*](https://www.britannica.com/science/tundra/Effects-of-human-activities-and-climate-change), Britannica website, accessed 12 September 2023.

Brooke J, Bevis M and Rissing S (2019) [*How Understanding the History of the Earth's Climate Can Offer Hope Amid Crisis*](https://time.com/5680432/climate-change-history-carbon), Time.com, accessed 19 September 2023.

Climate Reality (7 December 2017) ['24 Hours of Reality 2017: Weight of the World (Kiribati)' [video]](https://youtu.be/Swv1lOA5zDc), *Climate Reality*, YouTube, accessed 19 September 2023.

CoastAdapt (2018) [*Climate change and sea-level rise in the Australian region*](https://coastadapt.com.au/climate-change-and-sea-level-rise-australian-region), CoastAdapt website, accessed 19 September 2023.

Dartmouth College (2019) ‘[Climate change may make the Arctic tundra a drier landscape](https://phys.org/news/2019-05-climate-arctic-tundra-drier-landscape.html)’, *Phys.org*, accessed 12 September 2023.

Facing History and Ourselves (2018) [*Town Hall Circle*](https://www.facinghistory.org/resource-library/town-hall-circle), Facing History & Ourselves website, accessed 21 September 2023.

Geoscience Australia (n.d.) [*Accurate measurement of absolute sea level rise in the Pacific region*](https://www.community-safety.ga.gov.au/projects/pacific-sea-level-rise), Australian Government: Geoscience Australia website, accessed 19 September 2023.

Gray S (2016) [*How to use the cooperative learning 'carousel' strategy*](https://shelleygrayteaching.com/carousel/), Shelley Gray Teaching website, accessed 19 September 2023.

Great Barrier Reef Marine Park Authority (16 April 2020) ['Coral bleaching 101 - coral bleaching explained | Great Barrier Reef Marine Park Authority' [video]](https://youtu.be/dcWlVN02kDQ), *Great Barrier Reef Marine Park Authority*, YouTube, accessed 21 September 2023.

Hesford H (2021) [*What would happen if there were no coral reefs?*](https://reef-world.org/blog/no-coral-reefs#:~:text=For%20these%20creatures%2C%20the%20reef,and%20other%20creatures%20would%20disappear), The Reef-World Foundation website, accessed 21 September 2023.

Howden M and Delaney M (2023) [*Pacific Islands are holding the front line of climate change, but this is a global fight*](https://iceds.anu.edu.au/news-events/news/pacific-islands-are-holding-front-line-climate-change-global-fight), Australian National University: Institute for Climate, Energy and Disaster Solutions website, accessed 19 September 2023.

KiriCAN (n.d.) [*The Kiribati Climate Action Network*](https://kirican.wordpress.com/) [website], accessed 19 September 2023.

Lead4ward (n.d.) [*Instructional Strategies Playlist*](https://lead4ward.com/playlists/) *for teachers*, lead4ward website, accessed 19 September 2023.

Mcleod E, Bruton-Adams M, Förster J, Franco C, Gaines G, Gorong B, James R, Posing-Kulwaum G, Tara M and Terk E (2019) ‘[Lessons From the Pacific Islands – Adapting to Climate Change by Supporting Social and Ecological Resilience](https://www.frontiersin.org/articles/10.3389/fmars.2019.00289/full)’, *Frontiers in Marine Science*, 2019(6), DOI:10.3389/fmars.2019.00289, accessed 19 September 2023.

Miller D and Stillman (2017) [What Are Climate and Climate Change?](https://www.nasa.gov/learning-resources/for-kids-and-students/what-are-climate-and-climate-change-grades-5-8/), NASA.gov, accessed 19 September 2023.

Mulhern O (2021) [*Mapping The Shocking Extent of Desertification*](https://earth.org/data_visualization/how-desertification-has-affected-these-9-countries-since-1984/), Earth website, accessed 12 September 2023.

Nadig S (2023) [*Coral or Coal: Planning around the Great Barrier Reef*](https://www.mining-technology.com/features/coral-or-coal-planning-around-the-great-barrier-reef/?cf-view), Mining Technology website, accessed 21 September 2023.

NASA (National Aeronautics and Space Administration) (n.d.) [*How does climate change affect precipitation?*](https://gpm.nasa.gov/resources/faq/how-does-climate-change-affect-precipitation), Global Precipitation Measurement website, accessed 19 September 2023.

NASA (n.d.) ‘[How do we know climate change is real?](https://climate.nasa.gov/evidence/#:~:text=Scientific%20information%20taken%20from%20natural,of%20a%20warming%20planet%20abounds.)’, Global Climate Change website, accessed 12 September 2023.

NASA (n.d.) *Vital Signs: Sea Level*, Global Climate Change website, accessed 19 September 2023.

National Geographic Society (n.d.) [*Sea Level Rise*](https://education.nationalgeographic.org/resource/sea-level-rise/), National Geographic Education website, accessed 19 September 2023.

NOAA (National Oceanic and Atmospheric Administration) (2023) [*How does climate change affect coral reefs?*](https://oceanservice.noaa.gov/facts/coralreef-climate.html#:~:text=Climate%20change%20dramatically%20affects%20coral%20reef%20ecosystems&text=A%20warming%20ocean%3A%20causes%20thermal,land%2Dbased%20sources%20of%20sediment.), National Ocean Service website, accessed 21 September 2023.

NSW Education Standards Authority (NESA) (2020) [*Nurturing Wonder and Igniting Passion, designs for a new school curriculum: NSW Curriculum Review* (PDF 1.12 MB)](https://www.nsw.gov.au/sites/default/files/2023-04/NSW-Curriculum-Review-Final-Report.pdf), NESA website, accessed 14 February 2023.

Nunez C (2023) [*Tundra Threats Explained*](https://education.nationalgeographic.org/resource/tundra-threats-explained/), National Geographic Education website, accessed 12 September 2023.

Nursey-Bray M (2019) [*Not passive victims: Indigenous Australians respond to climate change*,](https://www.foreground.com.au/culture/not-passive-victims-indigenous-australians-respond-to-climate-change/) Foreground website, accessed 12 September 2023.

Ras M and Fabris G (2021) [*The IPCC report and the climate crisis in the Pacific*](https://www.undp.org/pacific/blog/ipcc-report-and-climate-crisis-pacific), United Nations Development Programme Pacific Office website, accessed 19 September 2023.

Readfearn G (2016) [*Link between fossil fuels and Great Barrier Reef bleaching clear and incontrovertible*](https://www.theguardian.com/environment/planet-oz/2016/mar/30/link-between-fossil-fuels-and-great-barrier-reef-bleaching-clear-and-incontrovertible-say-scientists), The Guardian website, accessed 21 September 2023.

Ritchie H (2021) [*Deforestation and Forest Loss*](https://ourworldindata.org/deforestation), Our World in Data website, accessed 12 September 2023.

Schröder P and Young J (2022) [*Great power competition and climate security in the Pacific*](https://www.chathamhouse.org/2022/07/great-power-competition-and-climate-security-pacific), Chatham House website, accessed 19 September 2023.

Sridharan M (2020) [*Cornell Note*](https://thinkinsights.net/consulting/cornell-method-great-notes/) *Taking Method*, Think Insights website, accessed 21September 2023.

State of New South Wales (Department of Education) (2021) [*Digital Learning Selector*](https://app.education.nsw.gov.au/digital-learning-selector/), NSW Department of Education website,accessed 29 March 2023.

State of New South Wales (Department of Education) (2023) [*Learning activities*](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Browser?clearCache=86a6611-7d6a-ddc6-b1d8-a9563e479e0f), NSW Department of Education: Digital Learning Selector website, 12 September 2023.

State of NSW and Department of Planning, Industry and Environment (n.d.) [*Base maps: Terrain*](https://www.environment.nsw.gov.au/eSpade2Webapp/), environment.nsw.gov.au website, accessed 12 September 2023.

Tenenbaum LF, Jackson R and Shaftel H (n.d.) [*Global Ice Viewer*](https://climate.nasa.gov/interactives/global-ice-viewer/#/), NASA Global Climate Change website, accessed 12 September 2023.

Testa C and Byrne C (2023) [*World Heritage Committee keeps Great Barrier Reef off UNESCO list of sites in danger*](https://www.abc.net.au/news/2023-09-14/great-barrier-reef-kept-off-unesco-world-heritage-in-danger-list/102855638), ABC News, accessed 21 September 2023.

The Climate Reality Project (2019) [Trouble in Paradise: How Does Climate Change Affect Pacific Island Nations?](https://www.climaterealityproject.org/blog/trouble-paradise-how-does-climate-change-affect-pacific-island-nations), *The Climate Reality Project website*, accessed 19 September 2023.

Joseph K (n.d.) *The* [*Alpine Tundra*](https://thewildclassroom.com/biomes/alpine-tundra/), World Biomes: The Wild Classroom website, accessed 12 September 2023.

United Nations (7 November 2020) [‘Kiribati: Battling for Survival (Rising Sea Levels)’ [video]](https://youtu.be/hW9EAkqu6aY?si=XEMuLJ1aJXH0OceL), *United Nations*, YouTube, accessed 19 September 2023.

United Nations Climate Change (n.d.) [*Mapping Exposure to Sea Level Rise | Tonga, Samoa, Vanuatu and Papua New Guinea*](https://unfccc.int/climate-action/momentum-for-change/ict-solutions/mapping-exposure-to-sea-level-rise), United Nations Climate Change website, accessed 19 September 2023.

University of Rochester (n.d.) [*The One-Minute Paper*](https://www.rochester.edu/college/teaching/teaching-guidance/one-minute-paper.html#:~:text=A%20one%2Dminute%20paper%20is,of%20that%20day's%20class%20session.), University of Rochester website, accessed 12 September 2023.

Voiland A (2014) [*Rising temperatures: A month versus a decade*](https://climate.nasa.gov/news/2180/rising-temperatures-a-month-versus-a-decade/), NASA Global Climate Change website, accessed 28 February 2024.

World Meteorological Organization (WMO) (2021) [*Climate change increases threats in South West Pacific*](https://wmo.int/media/news/climate-change-increases-threats-south-west-pacific), WMO website, accessed 19 September 2023.

Yuan L (2021) [*Rainfall becomes increasingly variable as climate warms*](https://phys.org/news/2021-07-rainfall-increasingly-variable-climate.html), Phys.org website, accessed 19 September 2023.

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