



Ever-Changing Environments – Year Eleven + Twelve Program Overview & Schedule

Program Duration: 45 minutes

Minimum Participants: 10 students

Maximum Participants: 35 students

Location: Polar Bear Shores

Relevant Subjects: Earth & Environmental Science, Geography

Program Overview:

This program allows students to consolidate their understanding of climate change with a focus on how it is affecting the survival of wild Polar bears. *Ever-Changing Environments* aligns with the Queensland Syllabi and Australian Curriculum for Earth & Environmental Science and Geography. To understand the current state of our global climate, students will first be introduced to the science behind the naturally occurring greenhouse effect, a necessity to life on Earth, by creating a diagram showing the involvement of solar energy, Earth's atmosphere and the Earth's various land surfaces. Students will review how the Earth has naturally gone through periods of warming and cooling in the past and how scientists have detected these changes by methods including the collection of ice cores and coral cores. Students will postulate how humans are creating an enhanced greenhouse effect and an unprecedented period of warming (climate crisis) through a variety of activities such as deforestation, farming and the burning of fossil fuels. The contribution of natural and artificial greenhouse gases to climate change will be considered, as well as identifying the human activities responsible for increasing quantities of these gases in the atmosphere. Students will hypothesise the consequences of climate change on ocean temperatures, ocean currents and global weather patterns, permafrost and sea ice and will relate these changes to the survival of Polar bears. Discussions will finalise with examples of management strategies, including local initiatives, that aim to lessen human induced climate change and students will consider the social, economic and environmental benefits and costs of these options. Lastly, students will be asked to pledge actions they can personally take to reduce their ecological footprint.

Program Schedule:

Time

9:15am Arrival

The school will arrive promptly at 9:15am and will be met by a Marine Education Officer on the lawn next to the flagpoles out the front of Sea World.

9:20am Park Entry

The Marine Education Officer will lead the school group through the admissions gate to Polar Bear Shores for the education program.

9:30am Education Program

This program is approximately 45 minutes and will finish by 10:30am at the latest. Please note: selection of this program will prevent the school group from seeing the morning *Seal Guardians Presentation*.

10:30am Program Conclusion

At the conclusion of this session, students will be free to enjoy the park for the rest of the day, at the discretion of school staff.

Alignment with Queensland Senior Syllabi:

EARTH & ENVIRONMENTAL SCIENCE (2019)

Science as a Human Endeavour

Science is a global enterprise that relies on clear communication, international conventions, peer review and reproducibility

Development of complex models and/or theories often requires a wide range of evidence from multiple individuals and across disciplines.

Advances in science understanding in one field can influence other areas of science, technology and engineering.

The use and acceptance of scientific knowledge is influenced by social, economic, cultural and ethical contexts.

The use of scientific knowledge may have beneficial and/or harmful and/or unintended consequences.

Scientific knowledge can enable scientists to offer valid explanations and make reliable predictions.

Scientific knowledge can be used to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability.

ICT and other technologies have dramatically increased the size, accuracy and geographic and temporal scope of datasets with which scientists work.

Models and theories are contested and refined or replaced when new evidence challenges them, or when a new model or theory has greater explanatory power.

Scientific knowledge can be used to inform the monitoring, assessment and evaluation of risk.

Science can be limited in its ability to provide definitive answers to public debate; there may be insufficient reliable data available, or interpretation of the data may be open to question.

International collaboration is often required when investing in large-scale science projects or addressing issues for the Asia–Pacific region.

Unit 2: Earth processes – energy transfers and transformations

Unit objectives	1. Describe and explain energy for Earth, atmospheric, hydrologic and biogeochemical processes
	2. Apply understanding of energy for Earth, atmospheric, hydrologic and biogeochemical processes
	7. Communicate understandings, findings, arguments and conclusions about energy for Earth, atmospheric, hydrologic and biogeochemical processes.

Topic 2: Energy for atmospheric and hydrologic processes

Solar energy	<p>Analyse how the transfer of solar energy to the Earth's surface is influenced by:</p> <ul style="list-style-type: none"> Impeded transfer of ultraviolet radiation due to its interaction with atmospheric ozone Physical characteristics of the Earth's surface Albedo Non-anthropogenic particulate matter Atmospheric reflection.
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Program Mapping

Thermal radiation and the greenhouse effect	Explain how thermal radiation is absorbed and emitted from the Earth's surface
	Compare the major greenhouse gases and their sources, including carbon dioxide, methane and water vapour
	Explain how greenhouse gases can reflect or scatter some infrared radiation, leading to the greenhouse effect
Ocean currents	Explain how global oceans act as heat sinks
	Explain that movement of systematic ocean currents, including the global ocean conveyor model, is due to: <ul style="list-style-type: none"> • Equalisation of temperature differences caused by heating and cooling • Earth's rotation, gravity and seasonality.
Unit 4: The changing Earth – the cause and impact of Earth hazards	
Unit objectives	1. Describe and explain the cause and impact of Earth hazards and global climate change
	2. Apply understanding of the cause and impact of Earth hazards and global climate change
	7. Communicate understandings, findings, arguments and conclusions about the cause and impact of Earth hazards and global climate change.
<i>Topic 2: The cause and impact of global climate change</i>	
Contributions to climate changes	Explain how natural processes contribute to global climate changes, including: <ul style="list-style-type: none"> • Oceanic circulation • Orbitally induced solar radiation fluctuations • The plate tectonic super-cycle
	Explain how human activities, including land clearing, fossil fuel consumption and gas production contribute to global climate changes
	Compare the effects of natural processes and human activities on global climate changes at a variety of timescales.
The effect of human activities on atmosphere and climatic conditions	Explain how human activities contribute to changes to the composition of the atmosphere and climatic conditions including: <ul style="list-style-type: none"> • Land clearing • Fossil fuel consumption • Gas production (including carbon dioxide, methane, nitrous oxide and hydrofluorocarbons) • Particulate materials in the atmosphere
	Compare the influence of both human and natural processes on the generation and increase of gases into the atmosphere
	Draw conclusions about the extent to which human and natural processes contribute to the generation and release of gases into the atmosphere.
Effect of climate change on the systems	Explain how climate change affects the biosphere, atmosphere, geosphere and hydrosphere

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Impacts of climate change	Analyse and evaluate the geological, prehistorical and historical records that provide evidence for climate change, including: <ul style="list-style-type: none"> Fossils Pollen grains Ice core data Isotopic ratios
	Analyse the evidence that demonstrates how climate change has affected different regions and species differently over time.

GEOGRAPHY (2019)

Unit 3: Responding to land cover transformations

Unit objectives	1. Explain geographical processes by describing the features, elements and interactions between biophysical and anthropogenic processes that shape the identity of places and result in land cover change of Earth's surface and a changing climate
	2. Comprehend geographic patterns by recognising spatial patterns of land cover change and indications of climate change at global, regional and local scales of study and identifying relationships and implications for people and places

Topic 1: Land cover transformations and climate change

Explain the interconnection between Earth's physical systems and how changes in land use, such as deforestation, land drainage, land reclamation, resource extraction, intensification of agriculture and pastoralism, coastal modification, and soil and water degradation can interrupt these systems and result in land cover transformation at global and regional scales

Explain, using conceptual models, the key processes and relationships associated with global climatic systems, including ocean circulation

Identify, using evidence, how anthropogenic activity (such as changes in land use) may be influencing climate change

Describe the interconnections between land cover change and climate change, including the impact of land cover loss on natural carbon sequestration the impact of land cover loss on surface reflectivity (albedo)

Communicate understanding of the impact of climate change on a particular type of land cover and the challenges for sustainable responses

Alignment with Australian Curriculum:

EARTH & ENVIRONMENTAL SCIENCE

Science as a Human Endeavour

Development of complex models and/or theories often requires a wide range of evidence from multiple individuals and across disciplines (ACSES038)

Advances in science understanding in one field can influence other areas of science, technology and engineering (ACSES039)

The use of scientific knowledge is influenced by social, economic, cultural and ethical considerations (ACSES040)

The use of scientific knowledge may have beneficial and/or harmful and/or unintended consequences (ACSES041)

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Scientific knowledge can enable scientists to offer valid explanations and make reliable predictions (ACSES042)	
ICT and other technologies have dramatically increased the size, accuracy and geographic and temporal scope of data sets with which scientists work (ACSES091)	
Models and theories are contested and refined or replaced when new evidence challenges them, or when a new model or theory has greater explanatory power (ACSES092)	
The acceptance of scientific knowledge can be influenced by the social, economic and cultural context in which it is considered (ACSES093)	
People can use scientific knowledge to inform the monitoring, assessment and evaluation of risk (ACSES094)	
Science can be limited in its ability to provide definitive answers to public debate; there may be insufficient reliable data available, or interpretation of the data may be open to question (ACSES095)	
International collaboration is often required when investing in large scale science projects or addressing issues for the Asia-Pacific region (ACSES096)	
Scientific knowledge can be used to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability (ACSES043; ACSES097)	
Unit 2: Earth processes – energy transfers and transformations	
Energy for atmospheric and hydrologic processes	The global ocean conveyor is important in regulating global climate. Advances in remote sensing with satellites have enabled scientists to develop models of the complex pathways involved and measure their characteristics (ACSES039).
	The global ocean conveyor is partly driven by thermohaline circulation, the movement of water due to density changes resulting from temperature or salinity. The places where these deepwater currents are created are believed to compose less than 1% of the ocean's surface area. Analysis of geological evidence indicates that when these vulnerable areas are disrupted, the global ocean conveyor can be "shut down" and the world's climate can be drastically altered in just a few years. Some scientists predict that melting of the Greenland ice sheet could influence the global ocean conveyor, causing changes in global climate (ACSES043).
	The net transfer of solar energy to Earth's surface is influenced by its passage through the atmosphere, including impeded transfer of ultraviolet radiation to Earth's surface due to its interaction with atmospheric ozone, and by the physical characteristics of Earth's surface, including albedo (ACSES048)
Energy for atmospheric and hydrologic processes (continued)	Most of the thermal radiation emitted from Earth's surface passes back out into space but some is reflected or scattered by greenhouse gases back toward Earth; this additional surface warming produces a phenomenon known as the greenhouse effect (ACSES049)
	The behaviour of the global oceans as a heat sink, and Earth's rotation and revolution, cause systematic ocean currents; these are described by the global ocean conveyor model (ACSES051)
	The interaction between Earth's atmosphere and oceans changes over time and can result in anomalous global weather patterns, including El Nino and La Nina (ACSES052)
Unit 3: Living on Earth – extracting, using and managing Earth resources	
	One of the main concerns associated with resource extraction is greenhouse gas pollution in the form of carbon dioxide, methane, nitrous oxide and perfluorocarbon emissions. The

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Use of non-renewable Earth resources	Kyoto Protocol adopted by the United Nations in 1997 sets obligations for industrialised countries to reduce emissions of greenhouse gases (ACSES069).
	One approach to reduce the level of carbon dioxide emissions adopted by the European Union, some American states and Australia has been to introduce carbon pricing. Carbon pricing can provide funds for investment in cleaner energy, and aims to act as an incentive for businesses to reduce their pollution. There is debate about the effectiveness of carbon pricing in reducing greenhouse gas emissions, partly because there are a number of factors that contribute to a reduction in emissions, including a decrease in economic activity, and these make it difficult to attribute significance to a single factor (ACSES068).
Unit 4: The changing Earth – the cause and impact of Earth hazards	
The cause and impact of global climate change	A range of evidence has been put forward by organisations such as the Australian Academy of Science and NASA in support of recent climate change occurring as a result of human activities (ACSES092).
	Remote sensing technologies and ice core analysis have provided data, which is interpreted using climate models and computer simulations (ACSES091).
	Changes in near-surface air temperatures indicate that temperatures have increased in recent decades and are continuing to do so at an increasing rate. These data are corroborated by satellite observations of Earth's surface and lower atmosphere temperatures, and measurements of the heat absorbed by the oceans. In addition, data indicate widespread melting of mountain glaciers and ice caps, retreat of ice sheets, sea level rise, increases in average water vapour content in the atmosphere and a shift in weather systems. Analysis of gas concentrations in the atmosphere and ice cores indicates that greenhouse gas levels have increased as a result of emissions from human activities over the twentieth century, and the majority of scientists believe that these atmospheric changes are linked to global temperature increases. Although there is disagreement about the magnitude of human-induced climate change, and some scientists contend that it has no significant role, most agree that these data indicate human activity is responsible for the majority of measured global warming (ACSES092).
The cause and impact of global climate change (continued)	Analogues from geological time and recent centuries are used to study how the climate has responded to increased greenhouse gases in the past. Both approaches indicate that, in the absence of changes in any other factors, a continued increase in greenhouse gas concentrations should result in continued global warming and associated climatic changes. Predictions at a regional scale are less reliable than global predictions, owing to changes in atmospheric circulation and other regional factors, but it is likely that changes in surface and ocean temperature will lead to changes in the distribution of some species of plants and animals, with flow on effects for ecosystems (ACSES097).
	The United Nations Kyoto Protocol and the establishment of the Intergovernmental Panel on Climate Change aim to secure global commitment to a significant reduction in greenhouse gas emissions over the next decades, with the aim of significantly reducing long-term global warming (ACSES096).
	Climate change science involves a range of uncertainties, which mean that the scientific community cannot predict future warming precisely, or detail exactly how climate change will affect particular regions. Models improve as the scientific community collects, shares and analyses more data, but even though models can be improved, they will always

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	struggle to make reliable predictions for systems in which small changes can have large effects (ACSES095).
	However, although scientific models cannot predict the exact trajectory of change, they do provide significant evidence that climate change is occurring and that future global warming is likely. Decisions about actions to mitigate this effect depend on the perception of risk by individuals, communities, governments and international agencies and reflect their social, economic and ethical values (ACSES093).
	Natural processes (for example, oceanic circulation, orbitally-induced solar radiation fluctuations, the plate tectonic supercycle) and human activities contribute to global climate changes that are evident at a variety of time scales (ACSES104)
	Human activities, particularly land-clearing and fossil fuel consumption, produce gases (including carbon dioxide, methane, nitrous oxide and hydrofluorocarbons) and particulate materials that change the composition of the atmosphere and climatic conditions (for example, the enhanced greenhouse effect) (ACSES105)
	Climate change affects the biosphere, atmosphere, geosphere and hydrosphere; climate change has been linked to changes in species distribution, crop productivity, sea level, rainfall patterns, surface temperature and extent of ice sheets (ACSES106)
	Geological, prehistorical and historical records provide evidence (for example, fossils, pollen grains, ice core data, isotopic ratios, indigenous art sites) that climate change has affected different regions and species differently over time (ACSES107)
	Climate change models (for example, general circulation models, models of El Nino and La Nina) describe the behaviour and interactions of the oceans and atmosphere; these models are developed through the analysis of past and current climate data, with the aim of predicting the response of global climate to changes in the contributing components (for example, changes in global ice cover and atmospheric composition) (ACSES108)

GEOGRAPHY

Geographical Inquiry and Skills

Observing, questioning and planning	Formulates geographical inquiry questions (ACHGE054)
Reflecting and responding	Proposes individual and collective action taking into account environmental, social and economic factors; and predicts the outcomes of the proposed action (ACHGE064)

Unit 3: Land cover transformations

Nature, extent, causes and consequences of land cover change	The relationship between land cover change and climate change and the long-term impact of climate change on land cover. (ACHGE071)
	The impacts of land cover change on local and regional environments. (ACHGE072)
Climate Change	The causes, rate and projected impacts of global climate change. (ACHGE075)
	The interrelationships between land cover change and climate change, for example, the impacts of land cover loss on surface reflectivity (albedo) and the process of natural carbon sequestration. (ACHGE076)



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	The effects of climate change on land cover, for example, vegetation, ice sheets, glaciers and coral reefs. (ACHGE077)
	A local initiative designed to address the effects of global climate change on land cover. (ACHGE078)