

The study of Earth and Environmental Science in Stage 6 enables students to develop an appreciation and understanding of geological and environmental concepts that help explain the changing face of the Earth over time. Through applying Working Scientifically skills processes, the course aims to examine how earth and environmental science models and practices are used and developed.

Earth & Environmental Science

- Modules
 - 5) Earth's Processes
 - 6) Hazards
 - 7) Climate Science
 - 8) Resource Management

Geology n noun

1 the science which deals with the physical structure and substance of the earth.

2 the geological features of a district.

ORIGIN C18: from modern Latin geologia, from Greek ge 'earth' + -logia (see -logy).

Year 12

Module 5: Earth's Processes

Outcomes

A student:

- › analyses and evaluates primary and secondary data and information EES11/12-5
- › solves scientific problems using primary and secondary data, critical thinking skills and scientific processes EES11/12-6
- › communicates scientific understanding using suitable language and terminology for a specific audience or purpose EES11/12-7
- › describes and evaluates the models that show the structure and development of the Earth over its history EES12-12

Content Focus

Since the formation of the Earth, both the atmosphere and lithosphere have been continually changing, each influencing the other. The processes of plate tectonics, together with the formation of water and the introduction of life, have further contributed to these changes. All three, in combination, have altered and continue to alter both the atmosphere and lithosphere.

With the discovery of fossils, it became possible to develop the geological timescale and to determine when mass evolution and extinction events occurred. Both were and are strongly influenced by the phases of the plate tectonic supercycle, which has a significant effect on climate. This knowledge gives us new information about climate and natural cycles of change.

Working Scientifically



In this module, students focus on analysing trends, patterns and relationships in data to solve problems and communicate ideas about the evolution of the Earth. Students should be provided with opportunities to engage with all Working Scientifically skills throughout the course.

Content


Development of the Biosphere

Inquiry question: How did today's biosphere originate and develop?




Students:

- investigate evidence for the origin of organic molecules on the Earth, including: (ACSES025) 
 -  Urey and Miller's experiments (ACSES026)
 - communities around Black smokers (ACSES026, ACSES027)
 - meteorites/panspermia

Students:

- investigate the evidence for the development of photosynthetic life, including cyanobacteria and stromatolites (ACSES021, ACSES028) 

Students:

- evaluate the evidence for the origin of multicellular life and resulting changes to ecosystems, for example, the Ediacaran and Cambrian fauna (ACSES029)   

[illegible]

Students:

- investigate the conquest of land by both plants and animals (ACSES029) 🎓

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Students:

- investigate the conquest of land by both plants and animals (ACSES029) 📖

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Changes in the Geosphere, Atmosphere and Hydrosphere

Inquiry question: How did the changes to the biosphere affect the Earth’s geosphere, atmosphere and hydrosphere?

Students:

- analyse the changes in the geosphere, atmosphere and hydrosphere that resulted from the development and evolution of the biosphere, for example: (ACSES022, ACSES023) ⚙️ 📖
 - effect of photosynthesising cyanobacteria on each of the spheres (ACSES021, ACSES025)
 - role of oxygen in the production of banded iron formations

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Plate Tectonic Supercycle

Inquiry question: What effect does the plate tectonic supercycle have on the Earth?

Students:

- model the plate tectonic supercycle (ACSES025, ACSES038) ⚙️💻

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Students:

- outline the effect of the plate tectonic supercycle on large-scale phenomena, including climate and evolution (ACSES003, ACSES010, ACSES013, ACSES014) ⚙️💻

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Fossil Formation and Stratigraphy

Inquiry question: What is the role of fossils in expanding what is known of geological time and past life on Earth?

Students:

- investigate and model processes of fossil formation by examining a variety of methods in rock, including: (ACSES028) 
 - mould formations
 - cast formations
 - trace fossils
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Students:

- discuss the significance of index fossils in generating a geological timescale 
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Students:

- extrapolate how the principles of uniformitarianism and superposition as well as fossils and absolute dating can be used to date events of geological significance, for example: (ACSES006, ACSES015, ACSES016) ⚙️💻📖
 - the evolution of the Cambrian fauna (ACSES029)
 - mass extinction events (ACSES029)

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Module 6: Hazards

Outcomes

A student:

- › develops and evaluates questions and hypotheses for scientific investigation EES11/12-1
- › designs and evaluates investigations in order to obtain primary and secondary data and information EES11/12-2
- › conducts investigations to collect valid and reliable primary and secondary data and information EES11/12-3
- › selects and processes appropriate qualitative and quantitative data and information using a range of appropriate media EES11/12-4
- › describes and evaluates the causes of the Earth's hazards and the ways in which they affect, and are affected by, the Earth's systems EES12-13

Content Focus

Natural disasters such as earthquakes, volcanic activity and cyclones have a significant impact on the Earth's environment, and often affect thousands of people, causing enormous damage. In many cases, the probability of such an event occurring is closely linked to an area's proximity to a plate boundary. The type of plate boundary can also influence the severity of the event.

To some extent, technologies can be used to predict hazardous events and mitigate their effects. However, humans are still not able to prevent these events from occurring. Whether the climate alters the frequency and magnitude of these events is also uncertain. Students will explore the use, development and analysis of seismic data in order to examine significant seismic events.

Working Scientifically





In this module, students focus on developing and evaluating questions and hypotheses when designing and conducting investigations. They analyse qualitative and quantitative data about the evolving Earth. Students should be provided with opportunities to engage with all Working Scientifically skills throughout the course.

Content

Geological Natural Disasters

Inquiry question: How and why do geological disasters occur?

Students:

- using data, predict the zones along which earthquakes and both effusive and explosive volcanic eruptions are likely to occur and relate these to plate boundaries (ACSES094)    

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Students:

- using secondary sources, investigate and model the changing depth of the focus of earthquakes at convergent and divergent boundaries (ACSES100)    

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Students:

- using secondary sources, investigate and explain the hazards associated with earthquakes, including ground motion and tsunamis (ACSES100)    

Students:

- using secondary sources, investigate and explain the hazards associated with volcanoes, for example:
 - ash eruptions and lava flows
 - lahars and poisonous gas emissions ⚙️💻📄

Students:

- account for the types of magma in each of the above types of volcanoes, and analyse how this affects the explosivity of their eruptions

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Students:

- investigate the point at which a geological hazard becomes a disaster 🌀

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Impact of Natural Disasters on the Biosphere

Inquiry question: How do natural disasters such as explosive volcanic eruptions, earthquakes and extreme weather events influence the biosphere and atmosphere?





Students:

- using data from secondary sources, compare the eruptions that occur at explosive and effusive volcanoes in terms of the impact on the biosphere and atmosphere (ACSES099)   
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Students:

- analyse the effects of a major volcanic eruption on the atmosphere in terms of changing the climate (both warming and cooling) (ACSES099)  
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Students:

- in a case study, investigate one eruption that has had a significant effect on the biosphere and atmosphere and assess its impact, including but not limited to:
 - Mount Pinatubo (ACSES099)    
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Students:

- evaluate the causes and physical impact of climatic phenomena on a local ecosystem, including: (ACSES101, ACSES103)     
 - hailstorms
 - east coast lows
 - droughts or floods
 - bushfires
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Students:

- investigate how human activities can contribute to the frequency and magnitude of some natural disasters, including: (ACSES102)   
 - droughts or floods
 - bushfires
 - landslides

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Prediction and Prevention of Natural Disasters

Inquiry question: What technologies enable prediction of natural disasters and minimisation of their effects on the biosphere?

Students:

- using secondary sources, evaluate the effectiveness of technologies in predicting natural disasters, for example:
 - volcanoes: three-dimensional imaging, seismic data, early-warning systems, ground-movement data, analysis of historical data (ACSES095, ACSES098, ACSES100)    
 - earthquakes: ground movement detectors, anomalous animal behaviour, strain meters
 - east coast lows: temperatures, pressure systems

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- investigate and evaluate the technologies used to minimise the effect of natural disasters associated with volcanoes and earthquakes, including building codes, disaster warning systems and education (ACSES103) 🛠️💻📖📱👤

- using secondary sources, assess the accuracy of technologies used in meteorology to predict and prevent damage to life and infrastructure as a result of natural weather events 🛠️ ⚙️ 💻 📺

Module 7: Climate Science

Outcomes

A student:

- › develops and evaluates questions and hypotheses for scientific investigation EES11/12-1
- › solves scientific problems using primary and secondary data, critical thinking skills and scientific processes EES11/12-6
- › communicates scientific understanding using suitable language and terminology for a specific audience or purpose EES11/12-7
- › analyses the natural processes and human influences on the Earth, including the scientific evidence for changes in climate EES12-14

Content Focus

A significant global concern of governments and non-government bodies relates to natural and scientific evidence of anthropogenic climate variation. The acidification and warming of oceans can impact on marine life, and evidence indicates that rising sea levels could also impact on human communities in low-lying locations around the world.

Students examine the mechanisms and scientific evidence for climate variation. They distinguish between evidence of natural processes and scientific evidence of anthropogenic influences, which both cause the Earth's climate to change. Students are provided with opportunities to form evidence-based opinions on, and develop strategies to manage, the effects of climate variation in the future.

Working Scientifically





In this module, students focus on developing and evaluating questions and hypotheses, analysing primary and secondary data, and solving problems to communicate scientific understanding about climate science. Students should be provided with opportunities to engage with all Working Scientifically skills throughout the course.

Content

Natural Processes of Variations in Climate

Inquiry question: How long does it take for the climate to change naturally and what causes these changes?

Students:

- use modelling to explain the causes of the natural greenhouse effect and examine the timescales in which changes occur (ACSES049, ACSES084)    

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Students:

- using secondary sources, assess the different causes of natural climate variation and the timescales in which changes occur, including: (ACSES104, ACSES105)   
 - the plate tectonic supercycle
 - massive volcanic eruptions, in the Deccan and Siberian Traps
 - changes in the Earth’s orbit around the Sun
 - changes in ocean currents and ocean circulation

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Evidence for Climate Variation

Inquiry question: What scientific evidence is there of climate variations in the past?

Students:

- describe and discuss ancient evidence of variations in global temperature, including but not limited to: (ACSES088, ACSES108) 📖 📱
 - pollen grains in sedimentary rocks
 - changes in rock types
 - fossils and microfossils
 - changing isotope ratios in rocks and deep sea sediments
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Students:

- identify and explain more recent evidence of climate variation, including but not limited to: (ACSES091, ACSES107, ACSES108) ⚙️ 📖 📱
 - ice cores containing gas bubbles and oxygen isotopes
 - dendrochronology
 - Aboriginal art sites showing now-extinct species and environments (ACSES107) 🖐️
 - human instrumental records (ACSES087, ACSES107)
 - isotope ratios shown in stalagmites, stalactites and corals
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Influence of Human Activities on Changes to Climate

Inquiry question: Is there scientific evidence to show that human activity has led to a variation in the Earth's climate since the Industrial Revolution?

Students:








- distinguish between the natural greenhouse effect and any anthropogenic greenhouse effects ⚙️



Students:

- investigate any influence that human activities may have had on the environment since the Industrial Revolution, for example: ⚙️ ⚖️ 📄 📊
 - increases in greenhouse gases (ACSES104)
 - ocean acidification (ACSES105)



Students:

- investigate flow-on effects of changes to climate, including but not limited to: (ACSES106, ACSES108)       
 - changing weather patterns (ACSES049, ACSES050, ACSES052)
 - changes in glaciers, sea ice and ice sheets
 - changing range of species due to rising sea level
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Mitigation and Adaptation Strategies

Inquiry question: Is there scientific evidence that demonstrates how humans could minimise and respond to the effects of increased global temperatures?

Students:

- investigate possible human-induced causes for the enhanced greenhouse effect, including: 
 - the burning of fossil fuels for energy 
 - land use and land cover change (ACSES092, ACSES093, ACSES094, ACSES105)
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Students:

- investigate scientific evidence suggesting ways in which humans may assist to minimise any human contribution to the greenhouse effect in their daily lives (ACSES098, ACSES108) ✎ ⚙️ 🖥️ 🌐

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Students:

- evaluate scientific evidence for the usefulness of a range of mitigation and adaptation strategies, including but not limited to: (ACSES090, ACSES097, ACSES108) ✎ ⚙️ ⚖️ 🖥️ 📖
 - urban design
 - geo-engineering strategies
 - alternative energy sources
 - using or changing agricultural practices of a range of cultural groups, including those of Aboriginal and Torres Strait Islander Peoples 🗑️

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Module 8: Resource Management

Outcomes

A student:

- › analyses and evaluates primary and secondary data and information EES11/12-5
- › solves scientific problems using primary and secondary data, critical thinking skills and scientific processes EES11/12-6
- › communicates scientific understanding using suitable language and terminology for a specific audience or purpose EES11/12-7
- › describes and assesses renewable and non-renewable Earth resources and how their extraction, use, consumption and disposal affect the Earth's systems EES12-15

Content Focus

Australia is rich in both renewable natural resources (eg agricultural production, sunlight) and non-renewable natural resources (eg minerals, fossil fuels). Students examine how the extraction and disposal of waste can greatly impact on the surrounding environment, affecting the quality and availability of renewable resources such as water and living organisms. The extent of this impact is referred to as an 'ecological footprint'.

Scientific models of resource extraction, use and management have developed over time in response to new discoveries and through the incorporation of sustainable practices, many of which have been developed by Aboriginal and Torres Strait Islander Peoples. The world's population is increasing and more natural resources are being extracted to provide food, consumer goods, energy and infrastructure. Sustainable management of both natural resources and waste is vital for human long-term survival.

Working Scientifically




In this module, students focus on collecting and representing data to analyse trends and patterns and solve problems while communicating ideas about resource management. Students should be provided with opportunities to engage with all Working Scientifically skills throughout the course.

Content

Using Australia’s Natural Resources

Inquiry question: How are Australia’s natural resources extracted, used and managed?

Students:

- identify Australian renewable resources and where they are located, including but not limited to: (ACSES062, ACSES072)   
 - agricultural resources: terrestrial and aquatic
 - water
 - energy sources

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Students:

- investigate how mining sites affect the environment, including Aboriginal cultural sites, and examine methods of reclamation of the environment and those sites after mining operations cease, including:     
 - open-pit mining
 - underground mining methods
 - offshore and onshore drilling

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Students:

- prepare a case study to investigate the involvement of traditional owners in the planning procedures, mining practices and restoration of damaged lands after mining operations cease 🖐️ ✂️ ⚙️ ⚖️

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Students:

- prepare a case study of an important Australian renewable or non-renewable resource, including but not limited to: ⚙️ ⚖️ 🖥️ 📄 📱 📌
 - how the resource is found, extracted and/or managed (ACSES073, ACSES074)
 - how the resource is used (ACSES078)
 - whether the resource can be extracted and/or used sustainably (ACSES075, ACSES076) ✂️
 - the past, present and future use and importance of the resource (ACSES079)

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Waste Management

Inquiry question: How is waste managed?

Students:

- conduct a practical investigation of the composition of household or organisational waste (ACSES058)  

[illegible]

Students:

- outline the management options for different types of solid waste (ACSES062)

[illegible]

Students:

- evaluate the sustainability of a named waste management option, for example: (ACSES061, ACSES083) ✦ ⚙️ 🗑️ 🌍
 - energy used to produce and/or recycle the waste
 - environmental impact of waste disposal
 - space for disposal or storage of waste
 - local waste management facilities
 - demand for reused or recycled waste
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Sustainability

Inquiry question: How can humans manage the Earth’s natural resources sustainably?

Students:

- investigate different definitions of sustainability and the rationales that underpin those definitions (ACSES066) ✦ ⚙️ 🌍
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Students:

- investigate human activities that affect sustainability, including but not limited to: ⚙️
 - overharvesting (ACSES082, ACSES083)
 - water pollution (ACSES080)
 - habitat removal or destruction (ACSES081)

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Students:

- investigate the processes used by Aboriginal and Torres Strait Islander Peoples as sustainable resource managers, for example: (ACSES040) 🖐️🌱🌳
 - cultural traditions that preserve Country and Place and the resources located in those spaces 🖐️
 - ongoing engagement with groups such as land councils, national parks and municipal councils to improve resource management 🖐️
 - legislation and actions to protect significant areas of Country and Place 🖐️

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Students:

- research and present information about a sustainability initiative in their community (ACSES063)

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Students:

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