# Sample Unit: Earth and Environmental Science – Year 12

Including Earth and Space Science Life Skills

***Sample for implementation for Year 12 from Term 4, 2018***

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| **Module 6: Hazards** | **Duration:** 30 hours including 10 hours for Depth Studies |
| **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.**Module Focus*** This unit is designed to help students explore the question, ‘Do we have the capacity to disaster-proof the planet?’ and ‘What are the impacts of natural disasters and how can communities prepare?’ for students undertaking Earth and Space Science Life Skills.

**Working Scientifically**Students analyse qualitative and quantitative data about the evolving Earth. In order to do this, students should focus on formulating questions to guide their secondary research. The need to plan and target their research to access relevant data and evaluate the reliability and validity of the resources are important aspects of this module. |
| **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 EES12-13The following **Life Skills outcomes** have been integrated into this unit:A student:* poses questions and hypotheses for scientific investigation SCLS6-1
* collects and represents qualitative or quantitative data and information using media as appropriate SCLS6-4
* develops conclusions from primary or secondary data and information SCLS6-5
* communicates information about an investigation using scientific language and terminology SCLS6-7
* uses patterns and trends in data to make observations and draw conclusions SCLS6-9
* investigates technologies used in science SCLS6-12
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| **Inquiry questions*** How and why do geological disasters occur?
* How do natural disasters such as explosive volcanic eruptions, earthquakes and extreme weather events influence the biosphere and atmosphere?
* What technologies enable prediction of natural disasters and minimisation of their effects on the biosphere?
 | **Formal assessment – Depth Study*** Do we have the capacity to disaster-proof the planet?
* Life Skills – What are the impacts of natural disasters and how can communities prepare?

Note: There is no requirement for formal assessment of Life Skills outcomes. |
| **Depth Study options:**There are some possibilities for smaller Depth Studies, or the smaller studies can be combined to be undertaken over 10 hours.Analyse data to find the epicentre of an earthquake (2 hours)Research the technologies used to predict natural disasters (5 hours)How do gas emissions from volcanic eruptions contribute to natural climate change (Module 7 – Climate Science) (3 hours) |

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| **Geological Natural Disasters: Earthquakes** |
| **Inquiry question:** How and why do geological disasters occur? |
| **Content** | **Teaching, learning and assessment** | **Life Skills** |
| **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) Asia and Australia’s engagement with Asia icon Critical and creative thinking icon  Information and communication technology capability icon Numeracy icon
* using secondary sources, investigate and model the changing depth of the focus of earthquakes at convergent and divergent boundaries (ACSES100) Asia and Australia’s engagement with Asia icon Critical and creative thinking icon  Information and communication technology capability icon Numeracy icon
* using secondary sources, investigate and explain the hazards associated with earthquakes, including ground motion and tsunamis (ACSES100) Asia and Australia’s engagement with Asia icon Critical and creative thinking icon  Information and communication technology capability icon Numeracy icon

**Life Skills****Students:*** identify a range of natural disasters caused by geological processes
* explore the geological processes that cause natural hazards Sustainability icon
 | * Students find data relating to major earthquakes, predict where earthquakes and volcanic eruptions are likely to occur and plot them on a map of the Earth.
* Students relate the occurrence of earthquakes and volcanic eruptions to the plate boundaries.
* Students use various websites to track recent earthquake activity.
* Students define the terms ‘earthquake’, ‘P waves’, ‘S waves’, ‘magnitude’, ‘epicentre’, ‘focus’, ‘seismogram’, ‘seismograph’.
* Students gather data to graph the frequency of earthquakes of varying magnitude per year.

**Differentiation (Structured)**: recall knowledge of plate boundaries:* Ocean – ocean (convergent and divergent)
* Ocean – continent (convergent and conservative)
* Continent – continent (convergent).
* Students define the characteristics of shallow, intermediate and deep focus earthquakes, view the [interactive map](https://www.classzone.com/books/earth_science/terc/content/investigations/es1001/es1001page04.cfm) and plot the location of these on a world map.
* Students consider the causes and types of earthquakes (View the Australian Government’s teacher and student [resources](https://d28rz98at9flks.cloudfront.net/76611/Rec2014_006.pdf) for earthquakes).
* Students model an earthquake.
* View the YouTube video [How a seismograph works](https://www.youtube.com/watch?v=Gbd1FcuLJLQ). Students design and create a seismograph to create seismograms.
* Students review significant earthquakes in Australia’s history.
* View the YouTube video [Can we predict earthquakes](https://www.youtube.com/watch?v=gFB-qpiKccs)? Students note methods used to predict earthquakes.
* Students model P and S waves using a slinky, examine seismograms and use data to compare the progress and effects of P and S waves.
* Students view [The effects of earthquakes in California vs China](https://ed.ted.com/featured/dYOyI5wW). Conduct a class discussion on the reasons for the different levels of impact on natural and built environments when earthquakes are of the same intensity.
* Students work in groups to research different hazards associated with earthquakes to relate cause and effect.
 | * Students recall or revise their knowledge of the structure and composition of the Earth including plate boundaries.
* Students compare maps showing volcanic eruptions, earthquake activity and plate boundaries making connections between the locations.
* Discuss ways for measuring the size of an earthquake using key terms such as ‘magnitude’ and graph historical earthquakes from smallest to largest.
* Explore the impact of different earthquakes on people and environments by comparing data such as magnitude with death rates.
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| **Possible depth study** | * Students explore [virtual earthquake](http://www.sciencecourseware.com/virtualearthquake/VQuakeExecute.html) to analyse data to find the epicentre of an earthquake.
* Students write a set of instructions outlining how data can be used to locate the epicentre of an earthquake.
* Students use this [data](https://www.catalystforscience.ca/pdf/10/ESS/NRCEarthquakes/Earthquake_7.pdf) to locate the epicentre of a Canadian earthquake.
 | * Students make connections between the epicentre of an earthquake and increased rates of damage, considering the differing impacts on a variety of environments, eg damage to crops, waterways, buildings, animals and people.
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| **Geological Natural Disasters: Volcanoes** |
| **Inquiry question:** How and why do geological disasters occur? |
| **Content** | **Teaching, learning and assessment** | **Life Skills** |
| **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) Asia and Australia’s engagement with Asia icon Critical and creative thinking icon  Information and communication technology capability icon Numeracy icon
* using secondary sources, investigate and explain the hazards associated with volcanoes, for example:
* ash eruptions and lava flows
* lahars and poisonous gas emissions Critical and creative thinking icon  Information and communication technology capability icon Numeracy icon
* account for the types of magma in each of the above types of volcanoes, and analyse how this affects the explosivity of their eruptions
* investigate the point at which a geological hazard becomes a disaster Asia and Australia’s engagement with Asia icon

**Life Skills****Students:*** identify a range of natural disasters caused by geological processes
* explore the geological processes that cause natural hazards Sustainability icon
 | * Students view [Volcano 101](http://ed.ted.com/on/DwB3oapV) to recall and draw a labelled diagram of a volcano.
* Students define effusive and explosive volcanic eruptions.
* Students add volcanic eruptions to the map of the Earth on which they plotted the location of earthquakes and indicate effusive and explosive volcanic eruptions in different colours.
* Students draw conclusions about the types of earthquake and volcanic activity that happen at different plate boundaries.

**Differentiation (Extension)**: Conduct research to answer the question: ‘If there were no humans would there be natural disasters?’ Critical and creative thinking icon  Information and communication technology capability icon* Students view [how volcanoes work](http://ed.ted.com/on/4tr62UBG) and a series of resources such as [USGS website](http://earthquake.usgs.gov/hazards/), [presentation slides and resources](https://www.tes.com/teaching-resource/volcanic-hazard-6016340) to describe and explain hazards associated with volcanoes.
* Students describe the characteristics of different types of magma and how these affect the explosivity and size of volcanic eruptions.
* Students create a summary table to describe the characteristics of geological hazards and explain the reasoning that determines the point at which a geological hazard is considered a disaster.
* Using the information gathered, students formulate a response to the Inquiry Question.
 | * Students label an image of a volcano with key terms such as ‘crater’, ‘lava’, ‘vent’ and ‘ash cloud’.
* Students describe the differences between active, dormant and extinct volcanoes.
* Students compare maps showing volcanic eruptions, earthquake activity and plate boundaries making connections between the locations.
* Students explore and describe differences in lava flow and rock formations from different volcanic eruptions.
* Students discuss the impact of volcanic activity on people and environments.
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| **Possible depth study** | * Students research and produce a multimedia presentation on how gas emissions from volcanic eruptions contribute to natural climate change (this may be linked with the Module 7 – Climate Science module).
 | * Students research and produce a multimedia report on a specific volcanic eruption
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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? |
| **Content** | **Teaching, learning and assessment** | **Life Skills** |
| **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)  Information and communication technology capability icon Literacy icon Numeracy icon
* analyse the effects of a major volcanic eruption on the atmosphere in terms of changing the climate (both warming and cooling) (ACSES099) Critical and creative thinking icon  Information and communication technology capability icon
* 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) Asia and Australia’s engagement with Asia icon  Information and communication technology capability icon Intercultural understanding icon Literacy icon

**Life Skills****Students:*** identify a range of natural disasters caused by geological processes
* predict changes that result from the impact of specific natural disasters on native plants Sustainability icon
 | **Impact on biosphere and atmosphere*** Students summarise the content of the YouTube video [The effect of volcanoes on the atmosphere](https://www.youtube.com/watch?v=8YpRaL6USow) by Jon Bergmann and [The colossal consequences of supervolcanoes](https://ed.ted.com/lessons/the-colossal-consequences-of-supervolcanoes-alex-gendler) by Alex Gendler.
* Students research the 1991 Mount Pinatubo eruption, including the short and long-term impacts on the biosphere and atmosphere and the impact of the 1815 Tambora volcanic eruption (the largest eruption recorded in the past 10 000 years).
* Using data and information gathered, students determine the long and short-term impact of different volcanic eruptions on the biosphere and atmosphere.

**Differentiation (Extension)**: consider the question: ‘Are there any positive impacts of volcanic eruptions?’ Critical and creative thinking icon | * Students explore the similarities and differences between volcanoes and supervolcanoes
* Students use maps to identify the location of supervolcanoes
* Students explore a case study of a volcanic eruption identifying the advantages (such as increased soil fertility) and disadvantages (such as damage to flora and fauna) of the eruption and present findings.
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| **Students:*** evaluate the causes and physical impact of climatic phenomena on a local ecosystem, including:

(ACSES101, ACSES103) Critical and creative thinking icon  Information and communication technology capability icon Intercultural understanding icon Literacy icon Numeracy icon* hailstorms
* east coast lows
* droughts or floods
* bushfires
* investigate how human activities can contribute to the frequency and magnitude of some natural

disasters, including: (ACSES102) Asia and Australia’s engagement with Asia icon  Information and communication technology capability icon Intercultural understanding icon* droughts or floods
* bushfires
* landslides

**Life Skills****Students:*** predict changes that result from the impact of specific natural disasters on native plants Sustainability icon
* investigate how disasters can be prevented or minimised, for example: Critical and creative thinking icon Civics and citizenship icon
* the use of warning systems in the home, eg smoke detectors and fire alarms
* emergency services
 | **Climatic phenomena*** Students gather data from the Scientific American article [How do volcanoes affect world climate](https://www.scientificamerican.com/article/how-do-volcanoes-affect-w/)?
* Jigsaw activity. In groups of 4 or 5, students conduct research to evaluate the causes and physical impact of one climatic phenomenon on a local ecosystem.
* Students, in groups discuss their phenomena. Students should include details of a specific occurrence of the phenomena.
* Students research how human activities have contributed to natural disasters and make suggestions for how these activities can be minimised.
* Using resources such as [Science Plan on Hazard and Disaster](http://www.icsu.org/icsu-asia/news-centre/publications/science-planning-reports/science-plan-on-hazards-and-disasters/Earthquake-%20Floods%20-%20Landslides.pdf) students consider how we can plan for and limit the impact of natural disasters([s](http://www.icsu.org/icsu-asia/news-centre/publications/science-planning-reports/science-plan-on-hazards-and-disasters/Earthquake-%20Floods%20-%20Landslides.pdf)).
* Students formulate a response to the inquiry question: How do natural disasters such as explosive volcanic eruptions, earthquakes and extreme weather events influence the biosphere and atmosphere?
 | * Students explore and describe the impact that ash clouds and lava flows from a volcanic eruption may have on the environment and discuss ways to prevent exposure to them.
* Students consider the impact of volcanic and earthquake activity on native plants and how this may impact on people and communities.
* Students consider ways in which people could prepare for a natural disaster and groups or agencies they could access for support during an emergency.
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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? |
| **Content** | **Teaching, learning and assessment** | **Life Skills** |
| **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)   Intercultural understanding icon Literacy icon
* earthquakes: ground movement detectors, anomalous animal behaviour, strain meters
* east coast lows: temperatures, pressure systems
* investigate and evaluate the technologies used to minimise the effect of natural disasters

associated with volcanoes and earthquakes, including building codes, disaster warning systemsand education (ACSES103)    Numeracy icon Personal and social capability icon* 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 Asia and Australia’s engagement with Asia icon Critical and creative thinking icon  Information and communication technology capability icon Literacy icon

**Life Skills****Students:*** investigate how disasters can be prevented or minimised, for example: Critical and creative thinking icon Civics and citizenship icon
* the use of warning systems in the home, eg smoke detectors and fire alarms
* emergency services
* explore how technological advancements have impacted on the ability to communicate warnings in relation to natural disasters  Information and communication technology capability icon
 | **Depth Study –** 10 hours**Research Question**Do we have the capacity to disaster-proof the planet?* Students use a variety of sources to investigate the effectiveness of technologies used to predict natural disasters and prevent damage to life and infrastructure, such as:
* [BBC bitesize](http://www.bbc.co.uk/schools/gcsebitesize/geography/natural_hazards/managing_hazards_rev1.shtml) – predicting volcanic eruptions
* [USGS interactive](https://volcanoes.usgs.gov/vhp/predict_flash.html) about predicting volcanoes including specific examples Kilauea and Mt St Helens
* [Early warning of disasters: facts and figures](http://www.scidev.net/global/communication/feature/early-warning-of-disasters-facts-and-figures-1.html) to consider the limitations of various technologies in predicting volcanic eruptions and other geological hazards
* [The role of science and technology in minimising the effects of natural disasters associated with volcanoes and earthquakes](https://www.unisdr.org/2001/campaign/pdf/Kit_2_The_Role_of_Science_and_Technology_in_Disaster_Reduction.pdf)
* [Technology to manage natural disasters and catastrophes](https://www.oecd.org/sti/outlook/e-outlook/stipolicyprofiles/newchallenges/technologytomanagenaturaldisastersandcatastrophes.htm) to assess, predict and mitigate natural disasters
* Students suggest and justify which technological method they would choose if they were in an earthquake-prone area and only had a budget to cover one of the options.
* Students investigate building codes and disaster warning systems in earthquake zones including:
* Christchurch
* Tokyo
* Students use media and other reports to assess the accuracy of technologies used in meteorology to predict and prevent damage to life and infrastructure as a result of natural weather events.
* Students prepare a multimedia response to the research question.
 | **Depth Study****Research Question**What are the impacts of natural disasters and how can communities prepare?* Students use a variety of sources to investigate different ways people and communities predict and prepare for natural disasters.
* Students explore the role of early warning systems and consider how much time might be needed to prepare or evacuate in the event of an emergency.
* Students create a text outlining the possible dangers of a chosen disaster, suggesting ways people can prepare for, and minimise risk before, during and after the event. Example texts include:
* poster
* brochure
* scripted interview
* video report
* multimedia presentation.
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| **Resources****Earthquakes*** recent earthquakes: <http://ds.iris.edu/sm2/eventlist/>
* track recent earthquake activity <http://www.ga.gov.au/earthquakes/initRecentQuakes.do>
* table to graph the frequency of earthquakes of varying magnitude per year <https://earthquake.usgs.gov/learn/topics/measure.php>
* legend to plot earthquakes <http://web.ics.purdue.edu/~braile/edumod/epiplot/epiplot.htm>
* Interactive map <https://www.classzone.com/books/earth_science/terc/content/investigations/es1001/es1001page04.cfm>
* Australian Government teacher and student resources <https://d28rz98at9flks.cloudfront.net/76611/Rec2014_006.pdf>
* Modelling earthquakes <http://www.3dgeography.co.uk/earthquake-models>
* Video on how a seismograph works <https://www.youtube.com/watch?v=Gbd1FcuLJLQ>
* Earthquakes in Australia’s history <https://d28rz98at9flks.cloudfront.net/76611/Rec2014_006.pdf>
* Video <https://www.youtube.com/watch?v=gFB-qpiKccs>
* P and S waves <http://studylib.net/doc/6982775/earthquake-worksheet---south-meck.-earth-and-environmental>
* Depth study P and S waves worksheet <https://www.catalystforscience.ca/pdf/10/ESS/NRCEarthquakes/Earthquake_7.pdf>
* TEDed <https://ed.ted.com/featured/dYOyI5wW>
* USGS website <http://earthquake.usgs.gov/hazards/>
* Earthquakes review <http://studylib.net/doc/7905039/ch-review>

**Volcanoes*** TEDed lesson volcanoes <http://ed.ted.com/on/DwB3oapV>
* USGS website <http://volcanoes.usgs.gov/vhp/tephra.html>
* TEDed lesson how volcanoes work <http://ed.ted.com/on/4tr62UBG>
* Volcanic hazards slides <https://www.tes.com/teaching-resource/volcanic-hazard-6016340>.

**Impact on biosphere and atmosphere*** Flipped learning video <https://www.youtube.com/watch?v=8YpRaL6USow>
* TEDed lesson supervolcano <https://ed.ted.com/lessons/the-colossal-consequences-of-supervolcanoes-alex-gendler>

**Climatic phenomena*** Scientific American article <https://www.scientificamerican.com/article/how-do-volcanoes-affect-w/>
* Impact of natural disasters <http://www.icsu.org/icsu-asia/news-centre/publications/science-planning-reports/science-plan-on-hazards-and-disasters/Earthquake-%20Floods%20-%20Landslides.pdf>

**Technology*** BBC bitesize <http://www.bbc.co.uk/schools/gcsebitesize/geography/natural_hazards/managing_hazards_rev1.shtml>
* USGS interactive <https://volcanoes.usgs.gov/vhp/predict_flash.html>
* Article <http://www.scidev.net/global/communication/feature/early-warning-of-disasters-facts-and-figures-1.html>
* Article <https://www.unisdr.org/2001/campaign/pdf/Kit_2_The_Role_of_Science_and_Technology_in_Disaster_Reduction.pdf>
* Table 9.1 <https://www.oecd.org/sti/outlook/e-outlook/stipolicyprofiles/newchallenges/technologytomanagenaturaldisastersandcatastrophes.htm>
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**Resources, Reflection and Evaluation**

Teacher sign off……………………………………………………….Date commenced………………………………………………Date completed…………………………….

Program evaluation and recommended amendments

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Recommended additional text/resources

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