# Sample Unit – Earth and Environmental Science - Year 11

***Sample for implementation for Year 11 from 2018***

***(This unit compliments sample Assessment Schedule B on the NESA website)***

| **Module 2: Plate Tectonics** | **Duration**  | 30 hours (including 15 hours for Depth Studies) |
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| **Content Focus**The Earth’s surface is made of a series of tectonic plates that move and interact with one another. Solid evidence for the theory of plate tectonics was not proposed until the early 20th century. Initially, the theory was dismissed due to a lack of evidence. Eventually, however, the work of a series of scientists was combined to produce enough evidence to support acceptance of the theory. In many cases, the development of new technologies has allowed the individual pieces of this scientific puzzle be put together. The theory of plate tectonics can explain not only the location and causes of earthquakes and volcanoes, but also the location of mountain ranges (both above and under the oceans) and deep ocean floor trenches. This theory also helps to explain many aspects of climate, evolution and extinction, and supports predictions about the future.**Module Focus**Students investigate the work of a number of pioneers illustrating the development of our current view of the dynamic nature of the Earth.**Working Scientifically**Students focus on developing questions and hypotheses when processing data while conducting investigations to analyse trends, patterns and relationships in plate tectonics, and the energy transformations and geological changes that continue to occur. |
| **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
* analyses and evaluates primary and secondary data and information EES11/12-5
* describes the evidence for the theory of plate tectonics and the energy and geological changes that occur at plate boundaries EES11-9
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| **Assumed prior knowledge**SC5-12ES, SC5-13ES, ES2: The theory of plate tectonics explains global patterns of geological activity and continental movement. (ACSSU180)**Students**a. outline how the theory of plate tectonics changed ideas about the structure of the Earth and continental movement over geological timeb. relate movements of the Earth's plates to mantle convection currents and gravitational forcesc. outline how the theory of plate tectonics explains earthquakes, volcanic activity and formation of new landforms  d. describe how some technological developments have increased scientific understanding of global patterns in geological activity, including in the Asia-Pacific region   | **Formal assessment** **Task 2****Nature of task:** Independentresearch.**Assessment overview:** Students outline the theory of plate tectonics and assess the evidence supporting the theory.  |
| **Overarching Learning Intentions using UBD**1. Students will understand the development of the theory of plate tectonics and the evidence supporting the theory.
2. Students will understand the geological processes that have shaped the Earth.
 | **Inquiry Questions**1. What is the current evidence for the theory of plate tectonics and how did the theory develop?
2. What occurs at plate boundaries?
3. What are the geological and topographic features that have resulted from plate tectonics at each plate boundary type?
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| **Topic: Evidence for the Theory of Plate Tectonics** |
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| **Inquiry question:** What is the current evidence for the theory of plate tectonics and how did the theory develop? |
| **Content** | **Teaching, learning and assessment** | **Differentiation** |
| **Students:**analyse evidence, including data and models, that supports the theory of plate tectonics, including but not limited to:* the ‘jigsaw fit’ of the continental shelves (ACSES004, ACSES006)
* matching up identical fossils on different continents (ACSES004, ACSES006)

evaluate the contributions of the following theories, models and research to our understanding of the movement of plates, including but not limited to: (ACSES005, ACSES009, ACSES035, ACSES038)* Wegener – continental drift
* Holmes – convection in the mantle
* Hess – sea floor spreading
* Vine and Matthews – magnetic reversals (ACSES004)
* Glomar Challenger – age of oceanic floors
 | View: Evidence of the theory of plate tectonics Khan Academy video (14 mins)**Wegener – jigsaw fit and fossil evidence**Studnets * View continental drift theory videos
* Alfred Wegener and the continental drift – <https://www.youtube.com/watch?v=MEh4B1Pv8YE>
* Continental drift – 100 Greatest Discoveries – <https://www.youtube.com/watch?v=rDKiNwTwaNw>

Outline the evidence supporting Wegener’s theory of Continental Drift**Holmes – convection in the mantle**Students* demonstrate convection currents: using a fish tank filled with cold water and a small flask with hot water and potassium permanganate
* demonstrate convection currents and the movement of tectonic plates using tomato soup and bread
* discuss how the convection currents in the mantle allow movement of the plates
* use cause-and-effect to explain the movement of the plates as a result of convection in the mantle

**Hess – sea floor spreading**Students* Introduction to oceanic and continental crust –<https://www.youtube.com/watch?v=ZwV-OfUGxNQ&index=2&list=PLkZwWnggJDDu17pBeuUk6bNiATGnbSffR>
* create a table containing similarities and differences between oceanic and continental crust, eg basaltic vs granitic/metamorphic structure
* research mid-ocean ridges, underwater mountain ranges, trenches etc
* draw diagrams representing the main features of the ocean floor, including continental shelf, oceanic ridge, rift valley, oceanic trench, underwater volcanoes, faults, subduction zones.
* outline Hess’s theory of sea floor spreading
* use Australian-Indian plate to discuss subduction to the north and sea floor spreading to the south
* describe the composition of rocks found at mid-ocean ridges
* describe volcanic activity that occurs in conjunction with sea floor spreading
* use data from secondary sources to graph the movement of each of the tectonic plates in cm/year and compare

**Depth study component:** students evaluate the use of GPS mapping for the creation of velocity vectors of the movement of the tectonic plates. GPS Measuring Plate Motion – <http://www.iris.edu/hq/files/programs/education_and_outreach/aotm/14/1.GPS_Background.pdf>.**Depth study component:** completesea floor spreading.Sea floor spreading extension worksheet – <https://www.geolsoc.org.uk/~/media/shared/documents/KS4/T%20ZONE%20Sea%20floor%20spreading.pdf?la=en> **Glomar Challenger – age of seafloor rocks**Students* research the Glomar Challenger and how its expeditions provided evidence for plate tectonics
* outline radioisotope dating methods for determining the age of seafloor rocks
* model the rate of decay of carbon-14 and other radioactive substances

**Depth study component:** students complete mathematical problems for the absolute dating of radioisotopesExplain why the age of the rocks form a mirror image from the mid-ocean ridge and the age increases the further away from the MOR.**Depth study component**: students research how cores collected by the Glomar Challenger also provided evidence for the way in which the earth’s climate has changed throughout history**Vine and Matthews – magnetic reversal**Students* run a compass over magnets facing different directions to see how the compass changes. Students also move a compass around one magnet to see how the magnetic field affects the compass
* model sea floor spreading and magnetic reversal at mid-ocean ridges using two toilet paper rolls. Also link in how the age of the rocks increases the further you move from the Mid Oceanic Ridge (MOR).
* view Magnetism in Rocks video– <https://www.youtube.com/watch?v=FYriCZOVbFQ> (3 mins)
* interact with Phet colorado simulation – Simplified MRI <https://phet.colorado.edu/en/simulation/mri>
* showing magnetic reversals
* interact with magnetic reversals Magnet and compass simulation – <https://phet.colorado.edu/en/simulation/legacy/magnet-and-compass>
* magnetic reversals sea floor spreading <http://www.windows2universe.org/teacher_resources/magnetism/extension_worksheet_seafloor.html> & <http://www.windows2universe.org/teacher_resources/magnetism/extension_worksheet_seafloor.html>
* observe a chart representing magnetic reversals over the past 160 million years
* summarise *National Geographic* sea floor spreading <http://nationalgeographic.org/encyclopedia/seafloor-spreading/> and view <http://earthguide.ucsd.edu/eoc/teachers/t_tectonics/p_seafloorspreading.html>
* create a timeline to show the development of our understanding of the movement of the tectonic plates including all the above examples

**Depth study component:** research other models that support the theory of plate tectonics and include them to the timelineStudents* prepare oral/written/poster/PowerPoint reports in small groups to analyse the various pieces of evidence supporting the theory of plate tectonics
* consider which of the studied scientists contributed the most to our current understanding of plate tectonics
 | **Structured**review Stage 5 knowledge of plate tectonicsGondwanaland and continental drift introduction activities:* cut and paste the continents like a jigsaw to form Pangaea
* map the locations of the fossils found across the different continents

convection roll activity (students lie side by side on the floor and one student lies perpendicular on top of them. Everyone on the bottom layer starts rolling in the same direction)**Structured*** design a model to simulate the formation of mid-ocean ridges
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| **Topic: Plate Boundaries and Tectonic Structures** |
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| **Inquiry questions:** What occurs at plate boundaries?What are the geological and topographic features that have resulted from plate tectonics at each plate boundary type? |
| **Content** | **Teaching, learning and assessment** | **Differentiation** |
| **Students:**use geological maps of the Earth to locate boundary types and model the processes that have contributed to their formation, including: (ACSES006, ACSES035, ACSES099)* divergent boundaries
* convergent boundaries
* transform boundaries

**Students:**model types of plate boundaries showing the dominant topographic and geological features, including: (ACSES006)* divergent boundaries: rift valley, mid-ocean ridge, normal and transform faults
* convergent boundaries: mountain range, trench, reverse faults and folds
 | **Plate boundaries introduction**Students* view [Plate tectonics, Types of plate boundaries](https://www.tes.com/teaching-resource/plate-tectonics-types-of-plate-boundaries-6442886) describing the different types of plate boundaries
* construct diagrams representing the three main tectonic plate boundary types <http://www.age-of-the-sage.org/tectonic_plates/boundaries_boundary_types.html>
* model the different types of movement at plate boundaries using a mars bar and use the terms constructive, destructive and conservative to describe the plate boundaries
* draw the tectonic plate boundaries on a map of the earth and relate to the position of volcanoes and earthquakes
* identify examples of transform, divergent and convergent plate boundaries on a map

**Transform boundaries**Students* define transform boundaries as a boundary where two tectonic plates slide past each other
* investigate an example of a transform boundary, eg San Andreas Fault or the Alpine Fault, New Zealand

**Divergent boundaries**Students* define divergent boundaries as a boundary where two tectonic plates are moving away from one another
* define the following glossary terms:
* rift valley
* mid-ocean ridge
* normal fault
* transform fault
* construct diagrams to show the relative positions of geological features at divergent plate boundaries
* investigate an example of a divergent boundary, eg The Mid-Atlantic Ridge

**Convergent boundaries**Students* define convergent boundaries as a boundary where two tectonic plates are moving towards each other
* define the following glossary terms:
* mountain range
* trench
* reverse fault
* folds
* anticline
* syncline
* draw diagrams representing the three different types of convergent boundaries:
* oceanic-oceanic
* continental-continental
* oceanic-continental
* draw diagrams to show the relative positions of geological features at convergent plate boundaries
* research an example of each type of convergent boundary

**Conclusion**Students* create a table to compare and contrast the types of geological features present at each type of plate boundary
* students use modelling clay to create a stop motion film representing how a geological feature of their choice forms at plate boundaries
 | **Structured*** demonstrate the different types of movement at plate boundaries using foam

**Extension*** use secondary sources to identify evidence of plate tectonics on other bodies in our solar system
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| **Resources**Kahn Academy: Plate tectonics – Evidence of plate movement: <https://www.youtube.com/watch?v=6EdsBabSZ4g>Review game: Slip, Slide, Collide – <http://www.open.edu/openlearn/science-maths-technology/slip-slide-collide>Gondwanaland and continental drift introduction – Teacher’s notes. <https://imaxmelbourne.com.au/images/uploads/PDF/Study_Guides/Gondwanaland.pdf>Alfred Wegener and the continental drift – <https://www.youtube.com/watch?v=MEh4B1Pv8YE> Continental drift – 100 Greatest Discoveries – <https://www.youtube.com/watch?v=rDKiNwTwaNw> Sea floor spreading extension worksheet – <https://www.geolsoc.org.uk/~/media/shared/documents/KS4/T%20ZONE%20Sea%20floor%20spreading.pdf?la=en> Continental drift using bread and tomato soup demonstration – <https://www.youtube.com/watch?v=bz6DCVvskg8>Introduction to oceanic and continental crust – <https://www.youtube.com/watch?v=ZwV-OfUGxNQ&index=2&list=PLkZwWnggJDDu17pBeuUk6bNiATGnbSffR>GPS Measuring Plate Motion – <http://www.iris.edu/hq/files/programs/education_and_outreach/aotm/14/1.GPS_Background.pdf>.Magnetism in rocks – <https://www.youtube.com/watch?v=FYriCZOVbFQ> Phet colorado simulation – Simplified MRI <https://phet.colorado.edu/en/simulation/mri> Magnet and compass simulation – <https://phet.colorado.edu/en/simulation/legacy/magnet-and-compass> Magnetic reversals sea floor spreading activity – <http://www.windows2universe.org/earth/interior/seafloor_spreading_interactive.html> Worksheet on sea floor spreading – <http://www.windows2universe.org/teacher_resources/magnetism/extension_worksheet_seafloor.html> 2012 – No Geomagnetic Reversal – <http://www.universetoday.com/18977/2012-no-geomagnetic-reversal/>National Geographic – Seafloor Spreading – <http://nationalgeographic.org/encyclopedia/seafloor-spreading/> Seafloor Spreading – Animation – <http://earthguide.ucsd.edu/eoc/teachers/t_tectonics/p_seafloorspreading.html>Tectonic Plates – Boundary types – <http://www.age-of-the-sage.org/tectonic_plates/boundaries_boundary_types.html>Types of plate boundaries presentation – <https://www.tes.com/teaching-resource/plate-tectonics-types-of-plate-boundaries-6442886>  |

**Reflection and Evaluation**

# TEACHER: CLASS:

**DATE UNIT COMMENCED: DATE UNIT CONCLUDED:**

* **Variations to program:** (List additional resources and outline alternative strategies used.
* **The most effective teaching/ learning strategies and resources in this unit were:** (Please nominate 3 at least)
* **Less effective teaching strategies and resources for this unit were:** (Please nominate 2 at least)

**TEACHER’S SIGNATURE\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

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