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| **Year 10 Unit of Study: Earth Science /Geology** | |
| **About this Unit:**  This unit is vital to students understanding of the place of humans in the natural world. It is a wonderful opportunity to show students the way in which science works and how grand ideas can change the established thinking of the time. Without the idea and subsequent evidence that the earth formed billions of years ago, the theory of evolution could not have been developed … the foundation of modern biology.  During this topic, constantly stress the way science works … observations made, evidence collected, ideas/hypothesis proposed then tested. Ideas and theories have to well communicated, tested by others. However, it is a human process and it is often very difficult to convince people to change their views … it is the quality and quantity of evidence that counts. Relate these ideas to the current issue of Global warming as you expose students to the radical ideas of the past on the age of the earth and the theory of tectonic plates.  The total time for this topic is 20 lessons. It is not possible to do all the experiments and activities in the time available, so plan your time carefully and select ones that suit you and the class. Students have the opportunity to research for the achievement standard 90952 (Science 1.13) Demonstrate an understanding of the formation of surface features in NZ….but this should only be offered to top classes, and probably best made optional, primarily as a homework exercise.  Major project/investigation: The [My Volcano](file:///C:\Users\pt\AppData\Roaming\Microsoft\Investigations\Project%20My%20Volcano) project in the “investigations” folder is well worth doing and should be read over thoroughly before the topic as there are various ways this can be managed according to the ability/behavior of the students.  Resources: Text books … Pathfinder, ESA study guide and Nature of Science all have useful information and questions.  [Differentiation made easy](file:///C:\Users\pt\AppData\Roaming\Microsoft\Class%20Activities\Book%20of%20worksheets%20on%20earth%20science%20and%20space.pdf) a book of worksheets pitched at 3 levels on Earth Science topics … in the electronic file under “class activities”, sheets can be printed or shown using the data projector  Science Learning Hub has three relevant contexts … [Dating the Past](http://www.sciencelearn.org.nz/Contexts/Dating-the-Past), [Earthquakes](http://www.sciencelearn.org.nz/Contexts/Earthquakes) and [Volcanoes](http://www.sciencelearn.org.nz/Contexts/Volcanoes) … some of these resources are incorporated into the scheme, but there are many others, plus good video clips and animations with NZ scientists and content.  Several experiments/activities in this unit are taken from Earth Learning Ideas <http://www.earthlearningidea.com/home/Teaching_strategies.html> where there are many more.  Year 9 links: Chemistry topic … crystal formation, movement of particles, convection of heat  Space: Age of the universe and life cycle of stars  Year 10 links:, Fire and Fuels… coal is a rock that can be classes as sedimentary or metamorphic rock depending on the degree of heat and pressure experienced. … natural greenhouse effect is greatly affected by volcanic eruptions, a key part of the carbon cycle.  Metals: All metals come from earth processes. Most are mined as oxides, the oxygen content a result of photosynthesis by early organisms.  Humans: we have evolved to operate in an oxygen rich atmosphere as a result of changes over geologic time due to plants. The earth’s atmosphere originally contained no oxygen.  Future importance: Concept of geologic time needed for evolution in yr 12 and 13 Bio  Structure and bonding of materials (rocks) in yr 12 and 13 chem  Geology/earth science units in yr 12 and 13 science | **Language for Learning**  plate tectonics  earthquakes and volcanic eruptions  crust, mantle, outer core, inner core, subduction zone, constructive, destructive and conservative plate boundaries.  Richter and Mercalli scale, epicenter, focus, p and s waves, viscosity of larva, shield, dome, caldera  sedimentary (including fossils), metamorphic and igneous rocks  erosion and weathering |
| **Learning Area Statements (Nature of Science)**  **Level 5 Planet earth and Beyond:**  **Earth Systems**   * Investigate the composition, structure and features of the geosphere, hydrosphere, and atmosphere.   **Interacting Systems**   * Investigate how heat from the Sun, the Earth and human activities is distributed around the Earth by the geosphere, hydrosphere, and atmosphere.   **The Nature of Science**  **Understanding about science**   * Appreciate that science is a way of explaining the world and that science knowledge changes over time (level 3 & 4) * Identify ways in which scientists work together and provide evidence to support their ideas (level 3 & 4) Understand that scientists’ investigations are informed by current scientific theories and aim to collect evidence that will be interpreted through processes of logical argument. (level 5 & 6) | |

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| LEARNING OBJECTIVES POSSIBLE TEACHING ACTIVITIES LEARNING OUTCOMES NOTES | | | |
| The structure of the Earth (geosphere) 2 - 3 periods | | | |
| To describe the main events in the history of the earth which is at least 4.5 billion years old  To recall and describe the composition of the main layers the earth  To compare oceanic to continental crust | Complete the toilet paper timeline (Expt 1) to grasp the age of the earth and how little humans have been on the planet or get students to guess the key dates in earth’ history using PowerPoint 1 The history of the earth. : the <http://youtu.be/toQ14R9yDCU> is a great introduction to this. Extension: students research how scientists have dated the earths without any rocks left from 4.6 billions years ago.  Identify the different layers of the earth using PowerPoint 2 – Structure of the Earth or internet research using the worksheet. Give students pictures or data on the density of oceanic and continental crust and give students to compare.  AND/OR show Brainpop clip on the [Earth’s structure.](http://www.brainpop.com/science/earthsystem/earthsstructure/) Many other Brainpop clips available for this topic too.  Expt 2 Density does matter … use this to clarify ideas about density.  Optional thinking/literacy activity: [Earth’s core](file:///C:\Users\pt\AppData\Roaming\Microsoft\Class%20Activities\Earth's%20Core%20evidence%20activity.pdf) … requires cards cut out, set available from technician. Good NOS activity, thinking about evidence and its interpretation.  Extension: A few periods on density can be inserted here if time permits.  Expt. Salty surprises … teacher demo  Expt. Rainbow Stack Challenge  Expt. Net floats Density experiment using fishing floats for Maori as a context. Use this to re-inforce ideas about density if time. Can run whole experiment as an investigation, or use parts to focus on graphing, interpreting results.  Students to explain how scientists calculate the density of each layer of the earth using seismic waves. | I can recall some key points in the history of the earth  I call label the inner and outer core, mantle and crust on a diagram of the earth.  I can describe how each layer is different in terms of temperature, density and composition.  I can compare oceanic to continental crust | Students can complete the timeline with either toilet paper or string. It shows how difficult it is to grasp the age of the earth. This can also be shown with the history of earth in a year ( <http://climatecrocks.com/2010/12/31/david-brower-the-earths-history-in-one-year/>)  There is also a great, if long, documentary “How the Earth was made” to help show structure and history of the earth (in ICT file and DVD in library). One technique for using this dvd is to show a 10 min section each period. It is very good at showing scientists at work and the gradual build up of evidence… could ask students to note down key pieces of evidence each time.  Homework: Earth’s structure  Internet research sheet. |
| Continental Drift and Plate Tectonics 4-5 periods | | | |
| To appreciate that the earth’s crust is composed of sections which sit on the mantle called Tectonic Plates  To describe Wegners theory of continental drift relating to the evidence to support the theory  To explain how and why tectonic plates move  To classify the type of movement that arises when plates meet. | Introduce the [My Volcano](file:///C:\Users\pt\AppData\Roaming\Microsoft\Investigations\Project%20My%20Volcano) project early in this section to allow for completion in the time available. Can show PowerPoint 7 Volcanoes at this stage, and return to volcanoes in more detail later.  Expt 5 Paper mache volcanoes …. And plan ahead if you intend using Expt 6, but do this in the section on volcanoes if you can.  Assemble jigsaws of the earth’s tectonic plates – relate to how the plates have changed through time. The you tube video explains this nicely: <http://youtu.be/QDqskltCixA>  Show powerpoint or video to describe the story Wegener’s theory of continental drift. Discuss the evidence to support Wegner’s theory such as sea floor spreading, fossil and rock evidence.  Use Wegener’s theory activity sheet  Creative writing activity: student write a letter to the Geological Society dated 1912 either supporting or disagreeing with Wegener’s  Biography of a scientist. This class or homework task is in the homework folder. Good NOS activity to show that science is a human endeavor. A chance to show there are lots of NZ scientists and find out their stories.  Critical thinking: Explain how tectonic plates move through convection currents. Relate the outcomes of the practical activity (expt. 3, or simply heating a crystal of potassium permanganate in water or use rice) to the behaviour of magma in the mantle through changes in density. Reinforce with teacher demo 4. wax volcano.  Get students to understand the heat generated by the mantle is through a series of nuclear reactions.  Video <http://www.youtube.com/watch?v=QDqskltCixA>  Classify plate boundary movement as divergent, convergent or conservative and explain how each type behaves using powerpoint to aid understanding.  Experiments:  3. A Magma model – models convection in the mantle and movement of cardboard plates. Use conclusion to compare model with our best explanation of what happens … bring out NOS ideas about modeling and communicating.  4. Wax volcano demo … this shows how magma can rise through the crust and form different structures, including volcanoes. | I can describe a tectonic plate  I can explain the theory of ‘Continential Drift’ and list some evidence to support the theory  I can explain how tectonic plates move  I can describe the 3 types of movement that happens when the plate boundaries meet | On-going homework on the My Volcano project …e-mail parents with details.  Powerpoint 3. Wegeners Theory  Students should appreciate that the scientific community at the time, literally laughed at Wegner’s claims, partly due to lack of evidence for the theory. It wasn’t until after Wegner’s death that more evidence  When heating the potassium permangante, the bunsen flame must be directly under the crystal to show the direction of the current accurately.  Relating the upward movement of water to other processes such as smoke rising, hot air baloons would be useful to help students understand that this a process of heat transfer that uses a medium.  Homework: pangaea cloze passage or students summarise the work of Wegner through research.  Powerpoint 4. How tectonic plates move.  Homework: p68, 69 or 70 from Book of Worksheets. |
| Explaining the phenomena of earthquakes and volcanoes (4-5 lessons) | | | |
| Identify what an earthquake is and why it happens  Describe the location of earthquakes and volcanoes around the world  Explain why New Zealand has so many earthquakes and volcanoes | Map the location of earthquakes and relate to plate tectonics. Make notes on the effects of divergent, convergent and conservative plate movement and explain how each type behaves using powerpoint.  Discuss the behaviour of the different plate movements in NZ (the north being convergent through the process of subduction) and the south creating mountains chains. Look at the evidence to support sub-duction in the north in regards to the depth of volcanoes and the shallowness of volcanoes in the south. This is supported well by the Science Learning Activity: Shaky NZ  Science Learning Activity: Earthquakes: Past and Future (students look at historical earthquakes in NZ)  PowerPoint 6 Earthquakes ….Use slinky spring to demo transverse and longitudinal waves.  Use PowerPoint 6a Earthquake waves to focus on this area in particular if time permits, supported by Earthquake waves worksheet. Lots of video clips in ICT file.  Science Learning Activity: Earthquake Intensity (looks at Mercalli scale)  Discuss the Canterbury Earthquakes and how different people experienced it  Investigating the Canterbury earthquakes: Achievement standard research task (see assessment folder)  Extension: PowerPoint 6b Earthquake epicenter. Students should be able to calculate the location of an earthquake based on seismic data (worksheet ‘locating earthquakes’ or ‘finding the epicentre’) | I can describe an earthquake and explain why it happens  I can explain the behaviour of plate movement in NZ | Powerpoint 5. NZ plate tectonics  The creation of mountains in the south is unique for conservative plate boundaries which generally create fold mountains rather than the distinctive southern Alp range which is more symptomatic of convergent plate boundaries (this information is in the powerpoint)  Science Learning Worksheet: Shaky NZ  Science Learning Worksheet: Earthquakes: Past and Future  Science Learning Worksheet: Earthquake Intensity  [www.christchurchquakemap.co.nz](http://www.christchurchquakemap.co.nz) |
| Volcanoes and Volcanic Rocks (2-3 lessons) | | | |
| Identify what a volcano is and why it happens  Identify the types of rocks that form in volcanoes | Discuss the different types of volcano. Watch Learning Hub video: DEVORA about risk assessment of volcanos in Auckland. Build a paper Mache volcano modelled after a NZ example. Science Learning Activity: Watching Rangitoto erupt.  Volcano activities can be combined using the resources in: V:\Science\The SCIENCE file\Year 10\Geology PT 2013\Homework\Project My Volcano  Inviting a guest marker into see the student presentations is a good motivator … HOS or DP responsible for year group  Expt 6 Volcanic eruption simulations. Fit his in if possible as part of the discussion on different types of larva and why they produce different types of igneous rocks.  In Class Activity folder, [Igneous rocks](file:///C:\Users\pt\AppData\Roaming\Microsoft\Class%20Activities\Igneous%20rocks)  Investigate the different types of rock formed by volcanoes (identifying different rocks & related video) and why they are useful, in everyday life and to help us understand volcanoes. Can be done in a classroom.  A short sequence at the end of the film Dante’s Peak is effective at showing the effect of pyroclastic erruptions  Expt 7 Igneous rock experiments. In this folder are several ways of showing how the rate of cooling affects crystal growth.: growing crystals. Student cool saturated solutions quickly and slowly to model crystal size in igneous rock.  Combine with samples of actual volcanic rocks  Extension: Try the ‘Tasty Earth science’ experiments with a Maori context. Compares obsidian, pumice and basalt through making of toffee, hokey pokey and fudge. Ask to use a food tech room or set for homework. | I can recall the main shapes of volcanoes  I can explain why the North Island has volcanoes due to subduction  I can recall the names of some common volcanic rocks and identify them by different features including crystal size | Science Learning Worksheet: Watching Rangitoto erupt (needs the text book: *Rangitoto* by Maria Gill and Heather Arnold  Homework: Predicting volcanic eruptions  Science Learning worksheet: growing crystals  Science Learning worksheet: Making Lava Fudge.  Research Activity on Volcanoes (in homework folder)  Science Learning worksheet: Identifying different rocks and Video: differences in rocks  Homework: [Making Lava Fudge](file:///C:\Users\pt\AppData\Roaming\Microsoft\Homework\Making+lava+fudge.doc) (to model the different proportions of mineral in [basalt](http://www.sciencelearn.org.nz/About-this-site/Glossary/basalt), [andesite](http://www.sciencelearn.org.nz/About-this-site/Glossary/andesite) and rhyolite … good as homework (could be optional) as no food in lab. Suggest they bring fudge for judges of presentation! |
| The rock cycle (4 periods) | | | |
| To classify rocks as igneous, metamorphic and sedimentary.    Identify the main agents of weathering as wind and water  Explain the erosion cycle and relate to the water cycle  Describe how mountains are formed and shaped by weather and climate  Explain how weathering affects the landscape  Identify the types of rock that form from erosion and deposition | PowerPoint 8 The Rock Cycle.  Expt 11 Rock Identification. Several activities here. Give the classification criteria of the 3 types of rock (igneous, metamorphic and sedimentary). Student observe and try to classify a range of rocks (from the rock kit) using observable features. Internet research activities.  Expt 9 Crayon Rock Cycle students could carry out one of the crayon rock activities which use grated crayons to model the rock cycle. Although these experiments do illustrate the rock cycle well they are messy and definitely need to be practiced beforehand … leave out if short of time.  PowerPoint 9 Rocks and Weathering … discuss NZ examples as you go through this, plus use one or more worksheets.  Expt 8 Cracking apart Practical to mimic the weathering of rocks by heating and cooling (by placing in ice water) a small piece of granite rock to break it up. Relate this to weathering of mountains. (see worksheet: breaking apart for more ideas and extension opportunity to compare different rocks).  Activity: matching statements ‘mechanical and chemical weathering’  Discuss the recycling of rocks (reminding students about the difficulty in aging rocks on earth due to this) linking to the rock cycle. Link this to the transformation of igneous/metamorphic rock due to weathering and erosion to the formation of sedimentary rocks. Complete the on line activity on rock types, the rock cycle, how rocks change and testing skills: <http://www.learner.org/interactives/rockcycle/index.html>  Expt 10 Heating carbonate rocks. A good simple experiment which draws together a number of factors and links to other topics. Read the teacher notes at the start of the expt for ideas on how to use/change it.  [What geologists do](../Class%20Activities/What%20geologists%20do.pdf) … pdf set of activities. Another good NOS activity linking careers with lives of real scientists. Simply read out one or more of the interviews as ‘stories’ or run the activities as suggested in the resource.  Summarize weathering and erosion using the [picture dictation task](../Class%20Activities/Picture%20dictation%20erosion%20and%20weathering.docx) … could be done as formative assessment.  Or try [Landform Detectives](http://www.brainpop.com/games/landformdetectives/), a great animated game where students have to predict the processes that made some of the world’s most distinctive geological features eg the Grand Canyon | I can classify rocks as either sedimentary, metaphoric or igneous  I can recall the processes that contribute to weathering of rocks  I can describe the difference between weathering and erosion  I can explain how rock types can be transformed via the rock cycle | Rocky crossword worksheet  Rock cycle worksheet  Sedimentary rock and rocky internet – internet research worksheets  Homework: There are several experiments that can be done at home … see investigations folder. These also make good science fair projects.  Weathering and Erosion sheet  Mechanical and chemical weathering’ worksheet  Rocks and the Rock Cycle internet worksheet (thiis activity is great and covers a lot of the rock types and the rock cycle in one lesson). |
| Formative assessment (1 to 2 periods) | | | |
| To prepare for the final topic test  To practice revision techniques | Use “Revision task – uses BBC bite sized” in homework folder. As is, this needs to be given out a few days in advance. Could be adapted for your class to cover certain part in less time.  And/or use Year 10 Science moodle geology topic revision links. Direct students to the revision notes on Geology on the moodle.  Use a revision technique such as: make flash cards, create a concept map,  Complete cloze exercises, do questions from text books, critique an excellence level answer to a sample problem.  Give out the student portfolios and have them fill in their ratings on the learning objectives sheet, and re-look at their target grade for this topic. | I have revised all parts of the topic.  I can use a revision strategy to help remember information. |  |
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| Assessment (1 to 3 periods) |  |  |  |
| 1. Topic test 2. Topic retest 3. My volcano project 4. NCEA | One period, use marking schedule to generate a number and grade  Optional for teacher. Run at lunchtime for those who want to improve their grade.  One or two periods for student presentations. Combine with test grade to generate the overall report grade ie can bump up test mark ‘A’ to report grade ‘M’ if the project was excellent  AS 90952 (Science 1.13) Demonstrate an understanding of the formation of surface features in NZ. Offer as optional hw task |  |  |