FOREST LEARNING

Teacher

Depth Study - Module One

Scientific Models

Using models to develop an improved knowledge and understanding of Earth and Environmental Science outcomes.

Teacher Overview

This is the first Module - teacher and student modelling with student feedback - of a 3-part series.

Aims:

- teach the theory of plate tectonics, and
- allow students to study, create, and assess the use of models in science.

Within this lesson, students will:

- learn what a model is,
- compare and assess a teacher's use of models covering the theory of Plate Tectonics and
- explore how models are being used in the forestry industry to improve outcomes.

This module fulfils the requirements of the NESA Depth Study for Earth and Environmental Science by being followed by:

- Module Two - Student modelling with teacher feedback - Plate Boundaries, and
- Module Three - Student modelling with student feedback and teacher formal assessment - Erosion and Salinity using forestry as a context.

Read more about the Earth and Environmental Science Depth Study requirements at the NSW Education Standards Authority: URL: https://syllabus.nesa.nsw.edu.au/earth-and-environmental-science-stage6/depth-studies/

Teacher

Stage

Year 11 Earth and Environmental Science

Syllabus Links

Working Scientifically Skills

- Mandatory Skills:
  - *Questioning and Predicting*
    A student: Develops and evaluates questions and hypotheses for scientific investigation EES11/12-1
    Students:
    - Develop and evaluate inquiry questions and hypotheses to identify a concept that can be investigated scientifically, involving primary and secondary data (ACSES001, ACSES061, ACSES096)
    - Modify questions and hypotheses to reflect new evidence
  - *Communicating*
    A student: Communicates scientific understanding using suitable language and terminology for a specific audience or purpose EES11/12-7
    Students:
    - Select and use suitable forms of digital, visual, written and/or oral forms of communication
    - Select and apply appropriate scientific notations, nomenclature and scientific language to communicate in a variety of contexts (ACSES008, ACSES036, ACSES067, ACSES102)
    - Construct evidence-based arguments and engage in peer feedback to evaluate an argument or conclusion (ACSES 034, ACSES036)
  - Additional skills:
    - *Processing Data and Information*
      A student: Selects and processes appropriate qualitative and quantitative data and information using a range of appropriate media EES11/12-4
      Students:
      - Select qualitative and quantitative data and information and represent them using a range of formats, digital technologies and appropriate media (ACSES004, ACSES007, ACSES064, ACSES101)
      - Apply quantitative processes where appropriate evaluate and improve the quality of data

Content Outcomes of Module One

Inquiry question: What is the current evidence for the theory of plate tectonics and how did the theory develop?

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)
- the profile of the ocean floor
- the age of sea floor rocks (ACSES004)
- magnetic reversals in sea floor rocks (ACSES035)

Contents

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Overview of Module Two and Module Three Content Outcomes

Module Two

Student model with teacher feedback

Plate Boundaries - ACSES006, ACSES035, ACSES099

Inquiry question: What occurs at plate boundaries? *Students*:

- use geological maps of the Earth to locate boundary types, and
- model the processes that have contributed to their formation including divergent boundaries, convergent boundaries and transform boundaries.

Plate Boundaries and Tectonic Structures - ACSES006

Inquiry question: What are the geological and topographic features that have resulted from plate tectonics at each plate boundary type? *Students*:

- model types of plate boundaries showing the dominant topographic and geological features, including ***divergent boundaries***: rift valley, mid-ocean ridge, normal and transform faults and ***convergent boundaries***: mountain range, trench, reverse faults and folds.

Module Three

Student model with student feedback and teacher assessment

Salinity and Erosion

Inquiry question: How does human use of land affect soil? *Students*:

1. explain causes of salinisation (ACSES024), including but not limited to land clearing and irrigation,
2. investigate the rehabilitation of salinity-affected area(s) by preparing a case study (ACSES070),
3. conduct a practical investigation into soil erosion prevention and analyse the efficacy of the method(s) used (ACSES060, ACSES102).

Module One – Overview

1. Scientific Models

   Activity 1.1: What is a model? (Approx. 20 minutes)

   - Students are introduced to what a model is and complete a cloze passage activity.

   Activity 1.2: What models do you know? (Approx. 30 minutes)

   a) Students reflect on their prior learning of models and as a class discuss criteria for judging models.
   b) Students watch a multimedia source to visualise an example of current models and complete a set of notes of scientific modelling.

   Activity 1.3: Model Earth or Model of the Universe (Approx. 60 minutes)

   a) Students use an example of a model that has changed over a period of time and as a group research the changes and model the changes over time. The class will then reflect on the series of changes and discuss why the changes eventuated.

   Activity 1.4: Text Versus Models (Approx. 120 minutes)

   a) Students will complete a hypothesis for their depth study and engage in learning theory pertaining to outcomes on Plate Tectonics through the use of text only.

2. Evidence for the Theory of Plate Tectonics

   Students will engage in a series of lessons that utilise models to teach theory such as:

   i. Constructing a jigsaw map of Gondwana,
   ii. Researching fossil evidence,
   iii. Constructing and analysing a paper model of the seafloor,
   iv. Building a model of the ocean floor, and
   v. Graphing a model of the ocean floor profile.

3. Assessment of understanding theory via text or models (Approx. 20 minutes)

   Students will complete two tables reviewing their opinion of learning and understanding content with and without the use of models.

4. The use of models by the forestry industry (Approx. 30 minutes)

   a) Students will complete a cloze passage on the use of models in a real-life situation - Forestry.
   b) Students will engage in a short case study reviewing four source materials in the forestry industry detailing how models are being used to improve outcomes.

Teacher preparation suggestions:

Activity	Preparation suggestions
1.2	Preview the URL segment on **Models in Marine Science** (1.33mins). URL: https://www.sciencelearn.org.nz/resources/575-scientific-modelling
2.1	Preview the Tectonic plates animation using the URL on **Continental Drift**. URL: https://www.sciencelearn.org.nz/resources/952-continental-drift
2.2	Make available for students (as per page 12 of the Student Workbook): • Student puzzle pieces on cardboard - See page 13-14 for ideas of where to source. • Map of the world today • Coloured pencils • Scissors • Glue • Internet access and iPad/laptop access
2.3	Preview the URL Magnetic Reversals and Sea Floor Spreading: https://www.youtube.com/watch?time_continue=86&v=BCzCmldiaWQ
2.4	Make available for each student (as per page below) • 1 Cardboard template of oceanic lithosphere – print out template A on to cardboard prior to lesson to save time. • 1 Model of the mid ocean ridge (MOR) • 1 pair Scissors • 1 Sticky Tape • Glue
2.5	For each student group make available: • Craft items e.g. cotton wool, cotton balls or wool • 1 Shoebox • 1 Tape • 1 PVA glue • 1 Scissors • 1Graph Paper • 1 Bamboo skewer • 1 Ruler
4.1	Pre-read the fact sheet with the Teachers Guide - The Use of Models in the Forestry Industry. This can be verbally dictated to students to complete a cloze passage, or projected on to a screen.
4.2	Optional: preview the weblinks outlined: • Model and demonstration Forests. URL: http://www.fao.org/forestry/modelforests/en/ .

	• Model predicts how forests will respond to climate change - URL: https://www.sciencedaily.com/releases/2016/04/160426162555.htm , • Forests in the landscape - URL: https://www.csiro.au/en/Research/LWF/Areas/Landscape-management/Forests • A Novel Modelling Approach for Predicting Forest Growth and Yield under Climate Change - URL: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0132066

Lesson Activities

1. Scientific Models

Activity 1.1: Teacher Introduction to Models.

1. What is a model?

A general definition of a scientific **model** is that it is a physical and/or mathematical and/or conceptual representation of an:

- idea,
- an object
- a process or
- a system

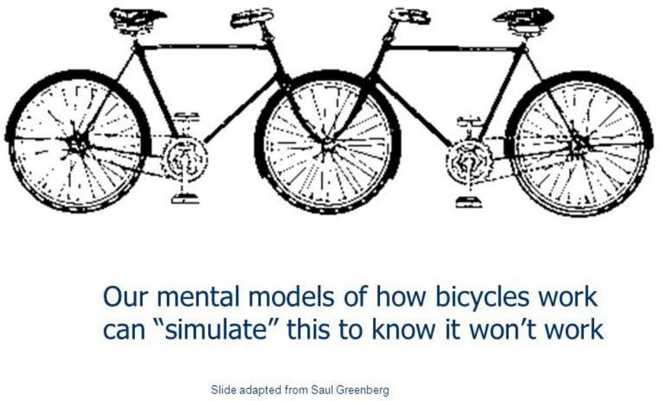
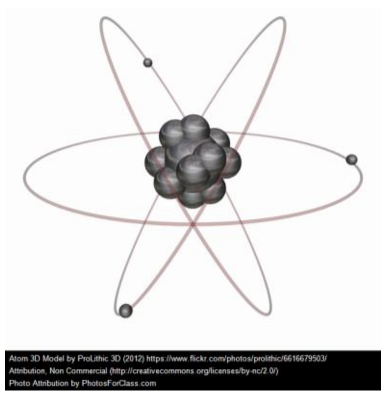
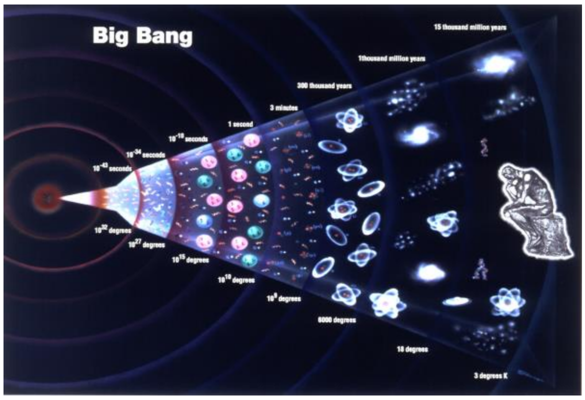
that is used to describe and explain phenomena. Models are central to what scientists do, both in their research as well as when communicating their explanations. (Science Hub, 2011)


Air France Concorde #205 F-BVFA in flight by jmv (2011) https://www.flickr.com/photos/jmv/5965117349/
Attribution, Non Commercial (http://creativecommons.org/licenses/by-nc/2.0/)
Photo Attribution by PhotosForClass.com

Simple models can be thought of as copies of reality (e.g. 'model cars', 'model airplanes', 'model railways'). Students often think of models as useful because they are copies (or even scale reproductions) of actual objects or actions. It is important however to look beyond the surface similarities between the model and the object or idea being represented.

A more developed view is that 'models' can be more than just physical representations of objects. Models can also be used to test ideas and processes in ways that may be impossible to do in the real world. This notion might be reinforced by the everyday use of such terms as 'computer modelling' and computer game simulations. Additionally, testing 'models' can lead to their redesign to give improved predictions.

It is helpful to categorise scientific models as:

Mental models (i.e. a representation of a complicated idea, e.g. how we think of an abstract idea like atoms) *Image source:* http://bit.ly/2AJjZxK	
Expressed models (i.e. a version of a mental model that is expressed by an individual through action, speech or writing such as in a diagram)	
Consensus models (i.e. an expressed model that has been subjected to testing by scientists and consensus reached that the model has merit, e.g. The Big Bang Model). *Image source: grandunificationtheory.com -* https://www.universetoday.com/54756/what-is-the-big-bang-theory/	

The most useful scientific models will possess:

- Explanatory power (a model that contributes nothing to explanations is of very little value)
- Predictive power (the testing of predictions derived from the model is fundamental in establishing the robustness of the model)
- Consistency across contexts (e.g. the model of an atom is the same when considering an atom of lead or an atom of gold)
- Consistency with other scientific models (e.g. the model of an atom is the same for atoms in metal as it is for atoms found within a biological cell; the biological cell is another scientific model).

Research: Gilbert & Boulter (1998)

Activity 1.2: What models do you know?

1. In small groups, ask students to consider their prior science learning on models and list all the scientific models they can identify (their list can also include scientific models they are aware of outside of the classroom).

2. Facilitate a whole class discussion combining the examples of each group. After their lists are presented:
   A. allow the groups to select the model which they believe is the best model, and
   B. allocate criteria as to why it is the best model.

3. View the URL below and watch the segment on Models in Marine Science (1.33mins). Prof John Montgomery discusses how and why scientists use models, using climate change as an example. *URL Source: Science Learning Hub. Scientific modelling.* URL: https://www.sciencelearn.org.nz/resources/575-scientific-modelling

4. Ask students to take notes from the hyperlink under the headings;
   A. Why scientists use models
   B. Building a model
   C. Using models for predicting
   D. How do we know if a model works?
   E. The nature of science.

Activity 1.3: Model Earth and/or Universe

The model of the Earth and / or universe has changed significantly over time.

1. Assign students into groups of 3-4 and set them a specified time (e.g. 40-60mins) to research and represent the changing model over time.

TIP: Students can use play dough, comic strips, etc. to represent these changes.

2. After the students have modelled this development, have them consider:

a) What specific changes has the model undergone?

b) Over what period of time have these changes to the model occurred?

c) Why have the changes/developments in the model occurred?

d) What new information or technology may have led to their rethinking of the design of the original model?

Activity 1.4: Text versus Models

Depth Study Title:

Using models to develop an improved knowledge and understanding of Earth and Environmental Science outcomes.

Depth Study Question and Hypothesis:

Question: Do we (the students) gain a better knowledge and understanding of concepts by using models?

Hypothesis: *(students in collaboration with the teacher, design a hypothesis)*

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1. Teacher uses their own materials or relevant textbook sections of predominately text based theory to present the content below.

FOREST LEARNING

Teacher

<u>NSW Syllabus for the Australian Curriculum</u>

Evidence for the Theory of Plate Tectonics

Inquiry question: What is the current evidence for the theory of plate tectonics and how did the theory develop?

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)
  - The profile of the ocean floor
  - The age of sea floor rocks (ACSES004)

2. Students should spend 20-30 minutes generating their own* notes ***(*with no/limited teacher input during this time)*** under the heading

'Evidence for the Theory of Plate Tectonics'

and using ***subheadings***:

a) Continental shelves 'jigsaw fit'
b) Matching of fossils
c) Magnetic reversals in sea floor rocks
d) Age of the seafloor
e) Ocean floor profile

N.B: the rationale of this activity is that students will be asked to assess, analyse and formulate an opinion on learning material by predominately text-based information versus that of model based learning / teaching of the same content.

3. <u>After the allocated time, the teacher:</u>
   a. begins presenting a series of work on: Modelling the Theories of Plate Tectonics.
   b. At the conclusion of the presentation of all models, students will complete <u>Activity 3.1</u> focusing on a reflection of whether the use of models facilitated a better knowledge and understanding of the content and why.

2. Evidence for The Theory of Plate Tectonics

The 'Jigsaw' Fit of the Continental Shelves and Matching of Fossils

Activity overview:

- Activity 2.1 – Introduction to the 'jigsaw fit' of the continental shelves (ACSES004, ACSES006)
- Activity 2.2 – Make a model to demonstrate jigsaw fit (ACSES004) and matching up identical fossils on different continents (ACSES006)
- Activity 2.3 – Introduction to the age of sea floor rocks (ACSES004) and magnetic reversals in sea floor rocks (ACSES035)
- Activity 2.4 – Make a model of the mid ocean ridge (ACSES004, ACSES035)
- Activity 2.5 – Make a model of a profile of the ocean floor.

Activity 2.1: Jigsaw Fit of the Continental Shelves

In the following activity, students will:

a) examine two pieces of evidence for Continental Drift
b) construct a jigsaw map of Gondwana by matching up the continental shelves, and
c) draw the location of fossils found on the continents that make up Gondwana.

Students should access the following URL and complete a cloze passage and take notes on a video clip. *URL Source: Science Learning Hub: Article Continental Drift*

URL: https://www.sciencelearn.org.nz/resources/952-continental-drift

Students to complete a cloze passage included in Student Workbook page 11.

Activity 2.2: Evidence for Continental Drift and Matching Fossils

Using a current world map and a cut out of continents that make up Gondwana, (supplied by the teacher - see ideas below), students will work in groups to reconstruct Gondwana by matching the continental shelves of the continents. They will label the continents and glue them onto cardboard.

Potential useful sites for continent cut outs for the jigsaw activity:

1. Source: The Dynamic Planet Teaching Companion Packet
   URL: https://volcanoes.usgs.gov/vsc/file_mngr/file-139/This_Dynamic_Planet-Teaching_Companion_Packet.pdf
2. Source: Earth Learning Idea – the continental jigsaw puzzle

URL: http://www.earthlearningidea.com/PDF/85_Continental_jigsaw_puzzle.pdf

Students will then:

a) access the Internet and search for a map of Gondwana that shows the fossils that have been found on the continents.
b) use pencils to colour the map with the different colours to show the different fossils found on them.
c) annotate the map with a brief description of the fossils.

Instructions for the Activity could include the following:

1. Make a model to demonstrate the jigsaw fit of the continents that made up Gondwana.
2. Map the distribution of fossils on Gondwana.

Equipment:

- ☐ Student puzzle pieces on cardboard
- ☐ Map of the world today
- ☐ Coloured pencils
- ☐ Scissors
- ☐ Glue

Method:

1. In groups of 2-3, cut out the continents as close to the margins as possible.
2. Label the continents using the current map of the world if needed.
3. Join the continents so they match up like a jigsaw puzzle.
4. Using the internet, Google search keywords such as "Gondwanan fossils" to find a map of Gondwana that shows the fossils that have been found on the continents (aim to find information on at least <u>4 fossils</u>)
5. Compare the jigsaw map your group has constructed against the one you find. Check the continents are arranged correctly. If they are, glue them on to cardboard. If not, rearrange them to form Gondwana and then glue.
6. Using coloured pencils (one colour per fossil type), colour in areas on Gondwana to show their location across the continents. Include a key at the side.
7. Annotate the map to name the fossils. Include a brief description of what they are and if they could have dispersed with the continents in their present-day location.

Age of the Seafloor Lesson and Magnetic Reversals

Activity 2.3: Introduction to seafloor rocks

Students will be introduced to some preliminary information by watching a YouTube clip "Magnetic reversals and Sea Floor Spreading" URL: https://www.youtube.com/watch?time_continue=86&v=BCzCmldiaWQand answer questions in their student worksheet based on the clip.

Activity 2.4: Making a Model of the Seafloor

Using both templates A and B, students will construct a model of the seafloor.

Method:

1. Print Template A (model of oceanic lithosphere) onto cardboard.
2. Students are to cut out the black lines so that they are completely gone from the cardboard.
3. Template B is to be cut out as per the student method.
4. The three sections of lava flow are to be inserted into the slots on template A.
5. The two pieces of continent are then pulled apart horizontally to show the patterns in the age of rocks and the patterns in the magnetic reversals as seafloor spreading occurs.
6. Once the model is constructed, the students then answer questions that relate to the model.

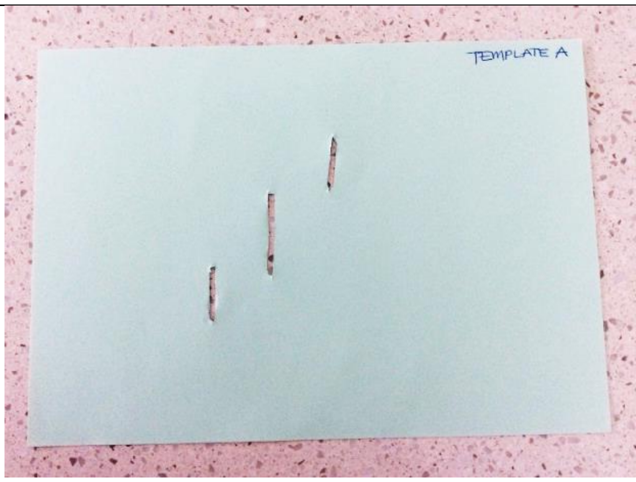
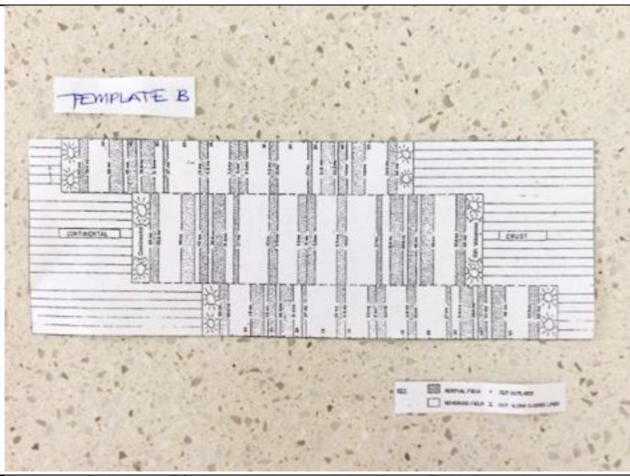
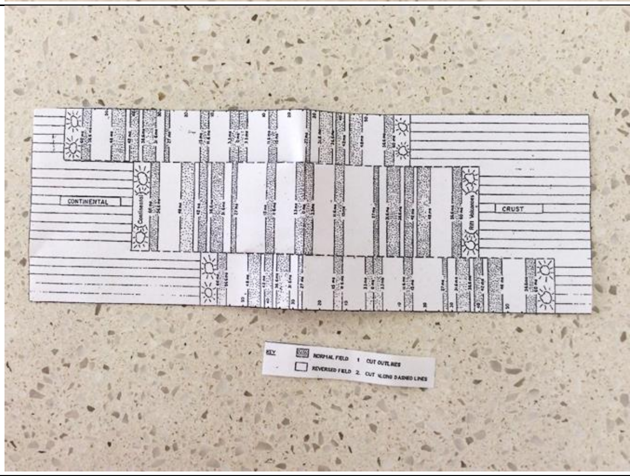
Activity outline:

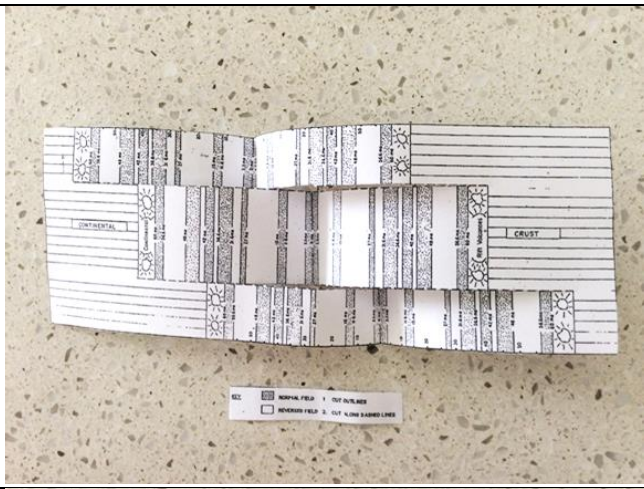
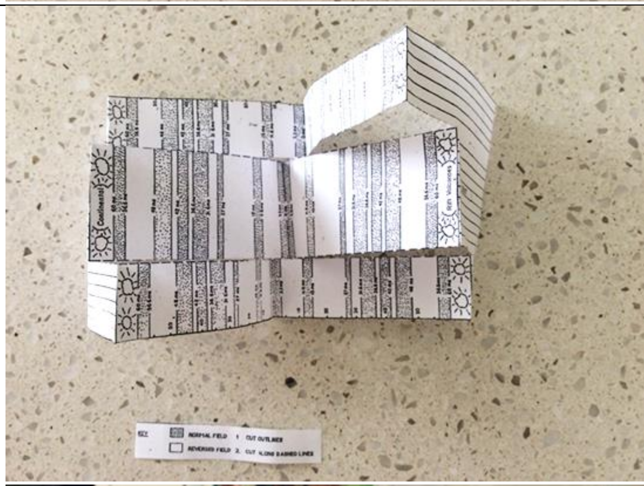
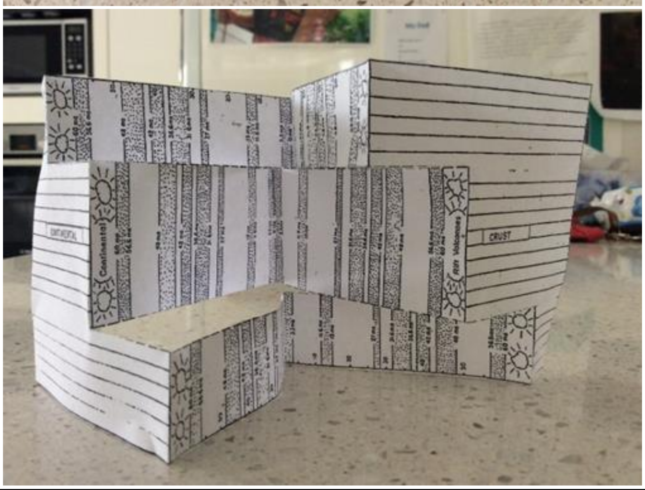
In this activity students will make a model of the mid ocean ridge. The model will show patterns in the age of rocks and magnetic reversals where the seafloor is spreading.

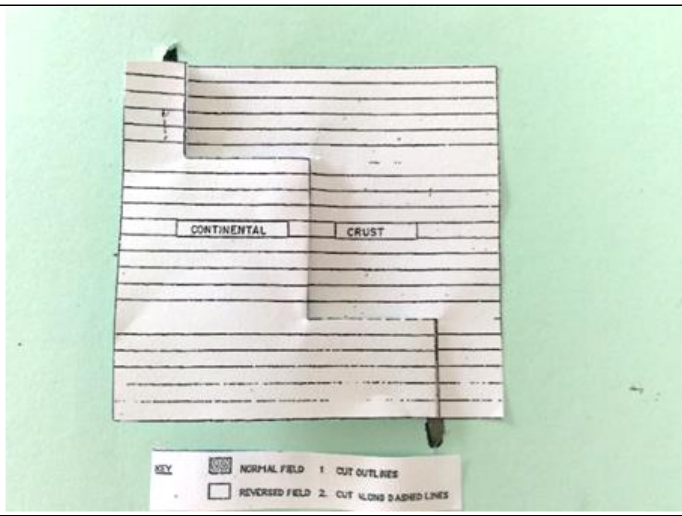
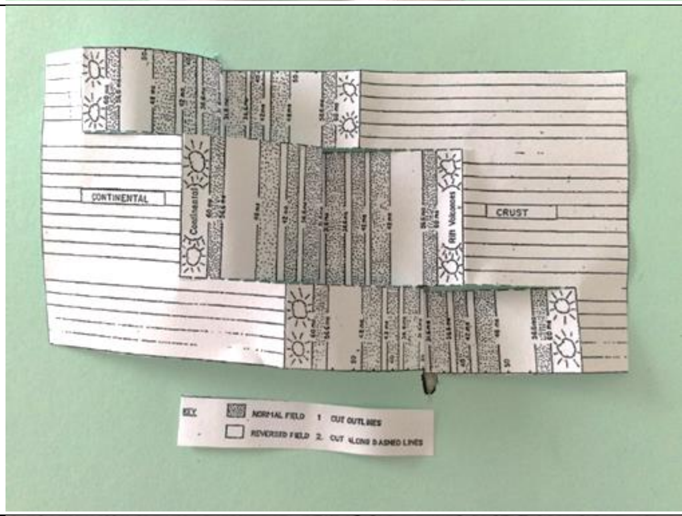
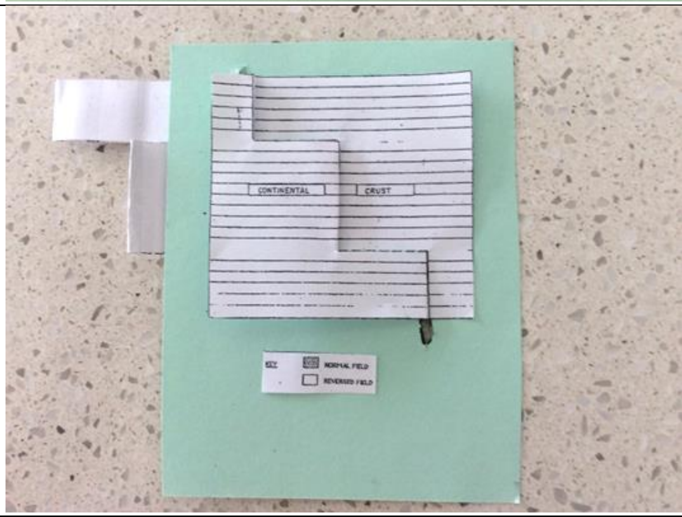
Equipment

- ☐ Cardboard template of oceanic lithosphere
- ☐ Model of the mid ocean ridge (MOR)
- ☐ Scissors
- ☐ Sticky Tape
- ☐ Glue

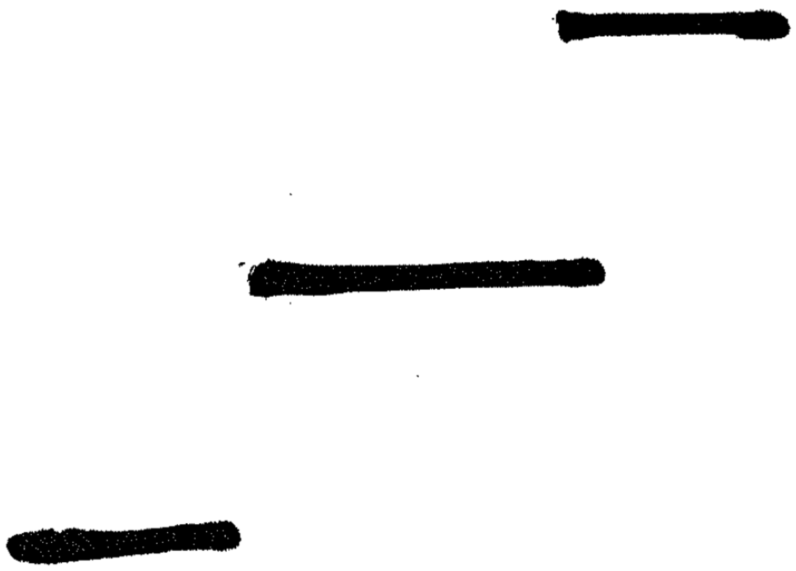
Method

1. Using **Template A**, use scissors to cut out the black lines. These represent mid ocean ridges on the oceanic lithosphere.	
2. Using **Template B,** complete the following a) Cut around the outside of the rectangle and keep the key	
b) Cut along the two dotted lines that run through the centre of the model (these are transform faults)	

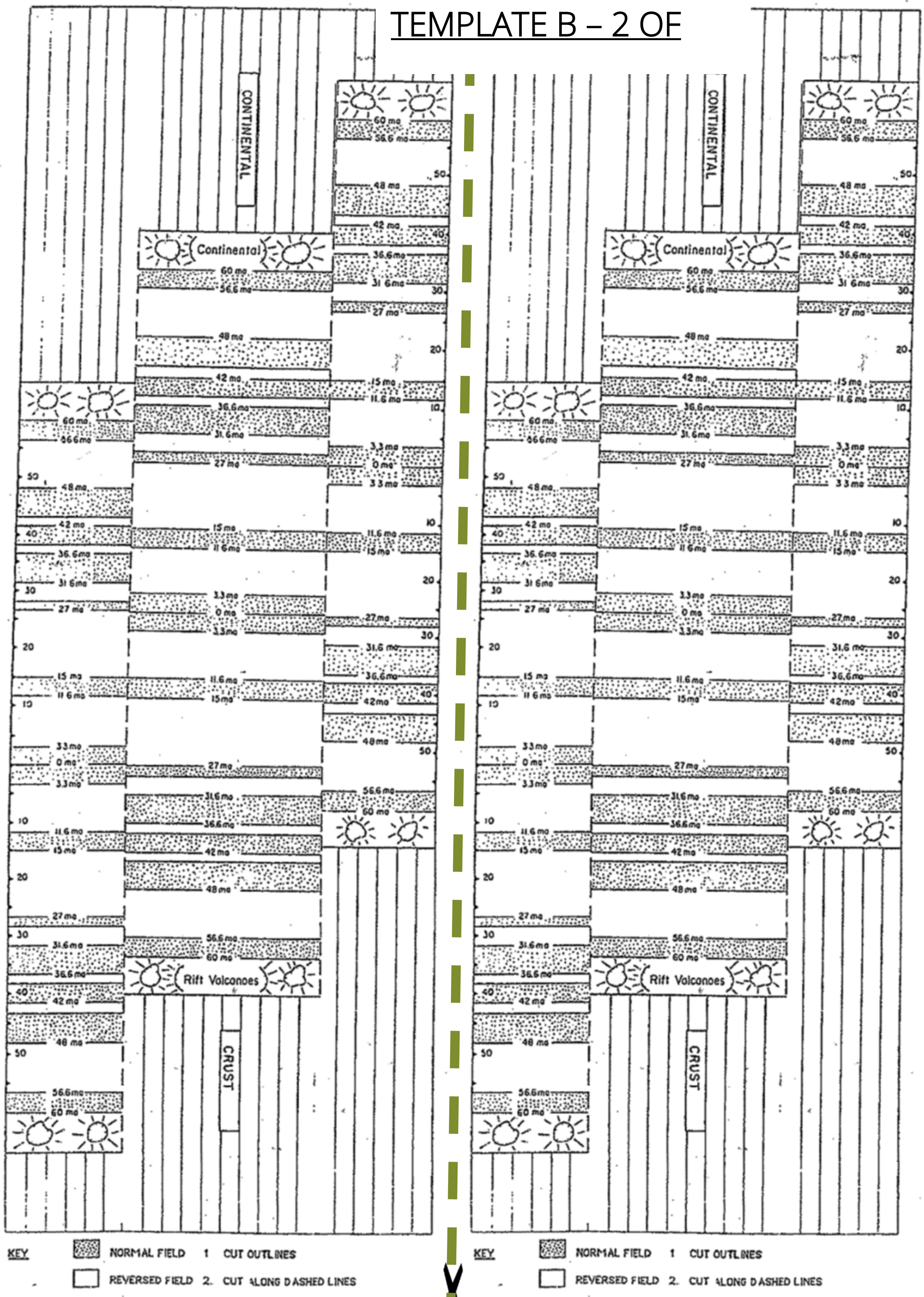
c) On each of the three sections of mid ocean ridge find 0Ma and fold inwards	
d) Fold the lines next to the continental crust, there will be three sections that need folding on each side of the continental crust.	 

3. Insert the three folded sections of lava flow (represented by magnetic reversals) into the three slots on template A (oceanic lithosphere).	
4. Slowly pull the continents away from each other and observe the lava flow from the spreading centre	
5. Paste the key onto template A and cut around the edges of the model and key. Paste the model into your books so the continents can still be pulled apart.	

TEMPLATE A



TEMPLATE B – 2 OF



Ocean Floor Profile Lesson

Activity 2.5:

There are two parts to this activity:

- **Part 1:** Build a model of the ocean floor
- **Part 2:** Swap models between groups and graph the ocean floor profile

Part 1: Model of the Ocean Floor

Complete the steps below to make a model of the ocean floor

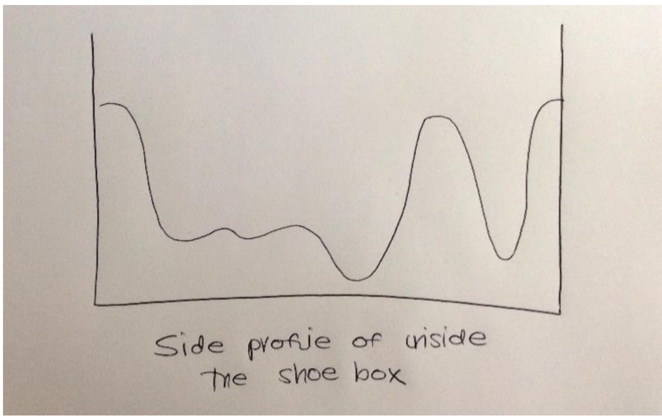
Equipment

For each group:

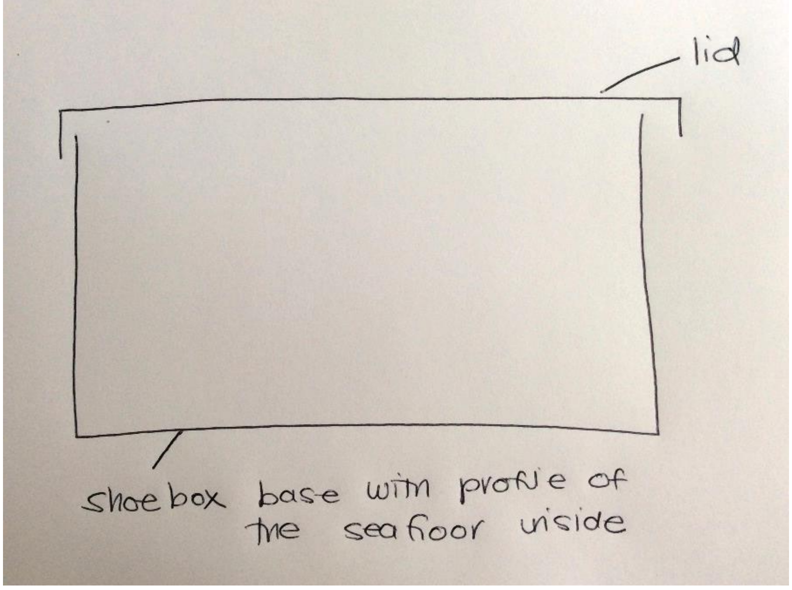
	Shoebox		Tape		Scissors		Bamboo skewer
	Craft items e.g. cotton wool, cotton balls/wool		PVA glue		Graph paper		Ruler

Method for students:

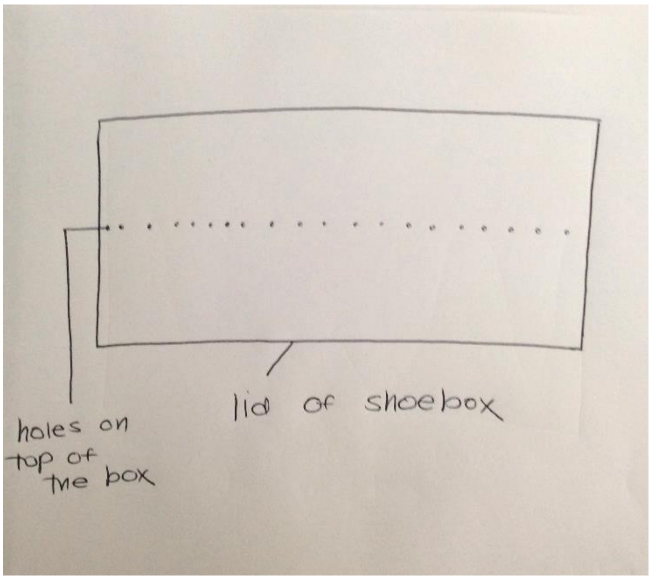
1. In the space below, sketch a plan of the side of the ocean floor you will be modelling. Brainstorm some features with your group that could be included in the model before starting.
2. Using the craft materials supplied make a model of the planned ocean floor inside the shoe box.



3. When the model is complete, place the lid of the shoebox on the base and tape them together.

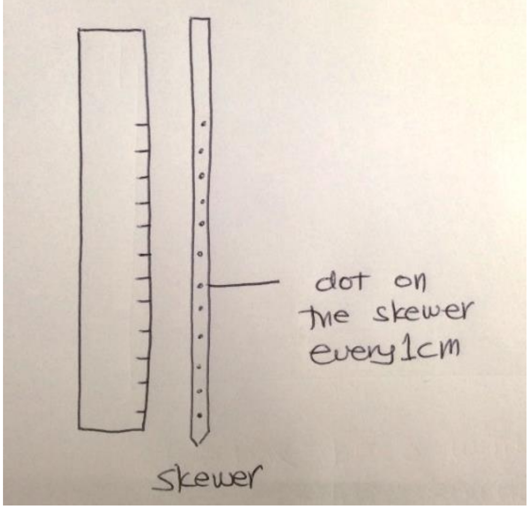


4. Using the bamboo skewer and a ruler, punch 20 evenly spaced holes in the top of the shoebox in a line down the centre of the box, they should cover the whole box. They should be large enough for the skewer to be placed into the hole and pushed down to the bottom of the model sea floor.

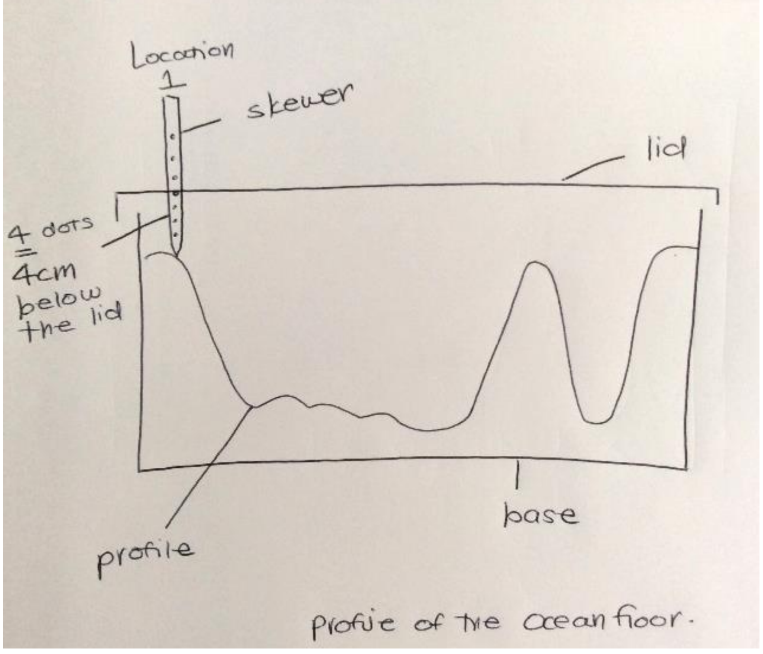


Part 2: Swap models between groups and graph the ocean floor profile

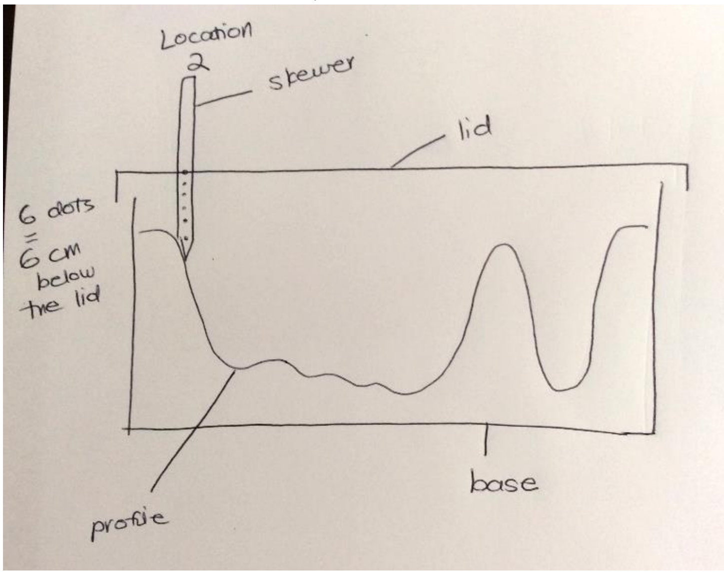
5. Swap your shoe box with another group.
6. Turn a bamboo skewer into a ruler by placing a dot on the skewer from the tip to the end every centimetre.



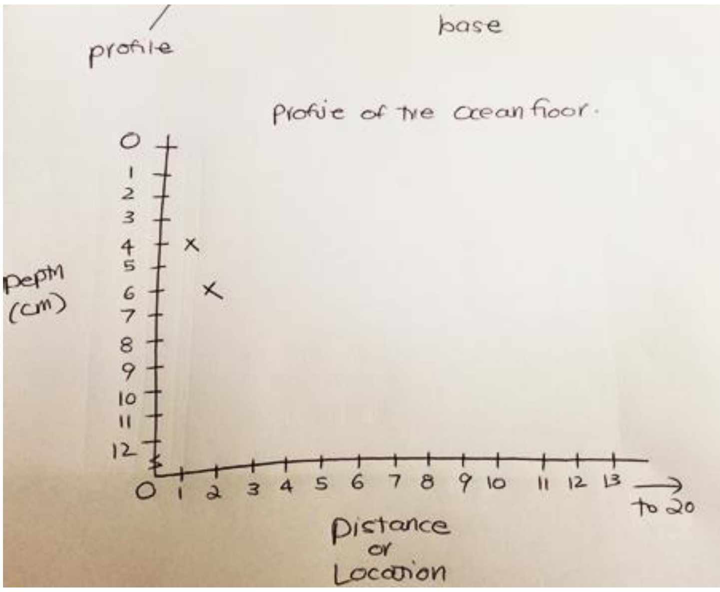
7. Place the wooden skewer into the first hole at the left of the shoebox. Count the number of dots on the skewer that are below the top of the shoebox. Record these in centimetres in the table below.



8. Continue this for all holes on the top of the shoebox.



9. Once complete, on graph paper, create a graph with <u>location on the x axis</u> (these will be the number 1-20 for the holes in the top of the shoebox) and <u>Depth (cm) on the y axis</u>. **Note:** these will be numbered 1 at the top of the y axis down to an appropriate number (depending on the depth of the ocean floor models) at the bottom of the y axis (where 0 would normally be placed). See below.
10. Plot the depth on the graph paper.



11. Once this is complete, compare the graph to the ocean floor inside the box.
12. Label the features of the ocean floor present inside the box and on the graph paper.

**Results table and questions are included within the student workbook.*

3. Assessment of understanding theory via text or models.

Assess: "Consider the value or importance of something, paying due attention to positive, negative and disputable aspects, and citing the judgments of any known authorities as well as your own." (UNSW, 2011).

Students should now consider the Plate Tectonics models they have been taught and reflect on whether using models assisted or improved their knowledge and understanding of the topics covered compared to reading text.

As this is their first attempt at an assessment of models they are likely to need assistance with this task, or benefit from a short discussion prior to their evaluations. Students will continue to practice this skill in Module 2 and Module 3 of the Depth Study.

Students should complete the two tables that are included in the STUDENT PDF.

Table 1:

MODEL	STRENGTHS of the Model	WEAKNESSES of the Model

Table 2:

Question	Yes	Not sure	No

Other Activities to assess your student's opinions on learning via the two different strategies.

Generate a series of approximately 10 questions related to the content of Plate Tectonics. Ask a question or make a statement about the content and then ask the students to move to an allocated corner of the classroom to show their answer. Each corner of the classroom may be a multiple-choice option e.g., A, B, C or D, or it may be a yes, no, not sure response etc.

3-2-1 Ready Game: At the conclusion of each of

- Continental shelves 'jigsaw fit' Lesson
- Matching of Fossils Lesson
- Ocean Floor Profile Lesson
- Age of the Seafloor Lesson
- Magnetic Reversals

Ask the students what they remember by writing on a piece of paper 3: of the most important pieces of content they remember from the lesson

2: aspects that they would like to learn more about

1: Question on a piece of content that they feel that they are unsure about

Ready: Give student's one question on the content that they have to answer.

4. The Use of Models in the Forestry Industry

Activity 4.1 and 4.2 overview

It is important for students to understand some practical applications of modelling in science and industry. Students should complete a cloze passage and then summarise the supplied source materials using the supplied instructions.

Activity 4.1

Students will complete a cloze passage using the information you provide them within the below short case study of how models are currently being used and applied within the forestry industry. This information can either be verbally dictated or projected onto a smart board or whiteboard.

Introduction to the use of models within the Forestry industry

Forest growth models attempt to quantify the growth of a forest and are commonly used for two main reasons.

forest-2 by Lauris Rubenis (2013) https://www.flickr.com/photos/beardforgood/9381572563/
Attribution (http://creativecommons.org/licenses/by/2.0/)
Photo Attribution by PhotosForClass.com

- To predict the future status of a forest and the nature of any harvests from that forest

- To help consider alternative cultivation practices.

Commercial forestry depends on reliable estimators of stem size (Basal Area BA) and has motivated much work on developing statistically based growth models.

Forest growth and yield models are used in other applications e.g. investigation of impacts of climate change.

Activity 4.2: Practical examples of the models being used today

Teachers should present the different sources to their students about the Forestry industry. The strategy to do so could be as a whole class, individual or as groups that present back on each of the sources.

- Allow students approximately 20-30 mins to read each of the sources and highlight the USE of the model/s and WHY the model/s is needed by the user (if this information is addressed). N.B: Students are only focusing on what information the model is supposed to do/collect and why.

- Teacher spends 10 minutes with class discussing this information with a focus on the need for models in the future within industries like forestry. Teachers should try to cover the importance to the forestry industry of;
    - Continuing supply of produce in predicted climatic changes in the future i.e. will still need wood products for a growing population.
    - Importance of maintaining profits and predicting profits
    - Predicting how to increase supply of products
    - Modelling and knowing impacts on the environment that may be caused by forestry and how to mitigate them
    - Modelling if carbon can be reduced by the industry in the future as a means of combating climate change.
    - Creating models that may indicate where there may be improved resource allocation, time efficiency etc.

Source 1:
Source: Food and Agriculture Organization of the United Nations. Model and demonstration Forests.
URL: http://www.fao.org/forestry/modelforests/en/

Source 2:
Source: Washington State University, April 26, 2016_Model predicts how forests will respond to climate change
URL: https://www.sciencedaily.com/releases/2016/04/160426162555.htm

Source 3:
Source: CSIRO, Forests in the landscape
URL: https://www.csiro.au/en/Research/LWF/Areas/Landscape-management/Forests

Source 4:
Source: A Novel Modelling Approach for Predicting Forest Growth and Yield under Climate Change. M. Irfan Ashraf ,Fan-Rui Meng,Charles P.-A. Bourque,David A. MacLean . PLoS ONE 10(7): e0132066.Published: July 14, 2015
URL: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0132066

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1. NSW Education Standards Authority www.syllabus.nesa.nsw.edu.au/earth-and-environmental-science-stage6/depth-studies/ Accessed 1/9/2017
2. Science Learning Hub: www.sciencelearn.org.nz/resources/575-scientific-modelling Accessed 1/9/2017
3. Credit: grandunificationtheory.com www.universetoday.com/54756/what-is-the-big-bang-theory/ Accessed 16/8/2017
4. Information of modelling based on work from Department of Education and Training Victorian Government www.education.vic.gov.au/school/teachers/teachingresources/discipline/science/continuum/Pages/scimodels.aspx Accessed 1/8/2017
5. Science Learning Hub. Scientific modelling www.sciencelearn.org.nz/resources/575-scientific-modelling Accessed 16/8/2017
6. Science Learning Hub: Article Continental Drift www.sciencelearn.org.nz/resources/952-continental-drift Accessed 16/8/2017
7. The Dynamic Planet Teaching Companion Packet www.volcanoes.usgs.gov/vsc/file_mngr/file-139/This_Dynamic_Planet-Teaching_Companion_Packet.pdf Accessed 16/8/2017
8. Earth Learning Idea – the continental jigsaw puzzle www.earthlearningidea.com/PDF/85_Continental_jigsaw_puzzle.pdf Accessed 25/9/2017
9. YouTube : Magnetic reversals and Sea Floor Spreading Accessed 21/8/2017 www.youtube.com/watch?time_continue=86&v=BCzCmldiaWQ Accessed 25/9/2017
10. Food and Agriculture Organization of the United Nations. Model and demonstration Forests.: www.fao.org/forestry/modelforests/en/ Accessed 16/8/2017
11. Washington State University, April 26, 2016_Model predicts how forests will respond to climate change - Accessed 16/8/2017 www.sciencedaily.com/releases/2016/04/160426162555.htm
12. CSIRO, Forests in the landscape - Accessed 16/8/2017 www.csiro.au/en/Research/LWF/Areas/Landscape-management/Forests
13. A Novel Modelling Approach for Predicting Forest Growth and Yield under Climate Change. M. Irfan Ashraf, Fan-Rui Meng, Charles P.-A. Bourque, David A. MacLean. PLoS ONE 10(7): e0132066.Published: July 14, 2015 www.journals.plos.org/plosone/article?id=10.1371/journal.pone.0132066_ Accessed 16/8/2017

Teacher

Sample Answers

Activity 1.1: Teacher introduction to models

All missing words provided on teacher resource

Activity 1.2: What models do you know?

1.2.1 Answers will vary depending on class experience and recall. Answers may include: body systems models, atomic models, earth models, water cycles, carbon cycles etc earths layers, predator prey simulations, wave machines etc

1.2.2 Answers will depend on individuals and class

1.2.3 NA

1.2.4 See below:

A. Why scientists use models • Explaining complex data to present as a hypothesis • To compare to other scientist's thoughts and ideas • Knowledge building about the idea as it is a dynamic process
B. Building a model • Start with data and build on it, • Likely to be mathematical
C. Using models for predicting • Try to predict things eg climate change • Use existing information to try to predict • E.g. forestry modelling is used to predict tree numbers and basal areas to assess when to harvest or thin the trees.
D. How do we know if a model works? • Used to make decisions • Can be related to unimaginable costs so need to ensure they are as correct as possible • Continually tested E. Ground truthing "comparing model with existing observable data"
F. Nature of science. • Often not accurate as we don't have all the data, but they will continue to improve as there is more data

Activity 1.3: Model Earth and/ or Universe

a) Model will depend on group research and choice

b) Answers to these questions will vary depending on group research but may include some of the following ideas:

   i) URL : https://prezi.com/ovkpeydkgoea/the-history-of-the-shape-of-the-earth/
   ii) Examples could include a flat level disc and then was reconceptualised as a very large sphere. It is now known not to be spherical but a little more pear shaped.
   iii) The site contains a number of images that students may encounter. https://en.wikipedia.org/wiki/Flat_Earth
   iv) Many ancient cultures subscribed to a flat Earth cosmography, including Greece until the classical period, the Bronze Age and Iron Age civilizations of the Near East until the Hellenistic period, India until the Gupta period (early centuries AD), and China until the 17th century. https://en.wikipedia.org/wiki/Flat_Earth

2. Evidence for the Theory of Plate Tectonics

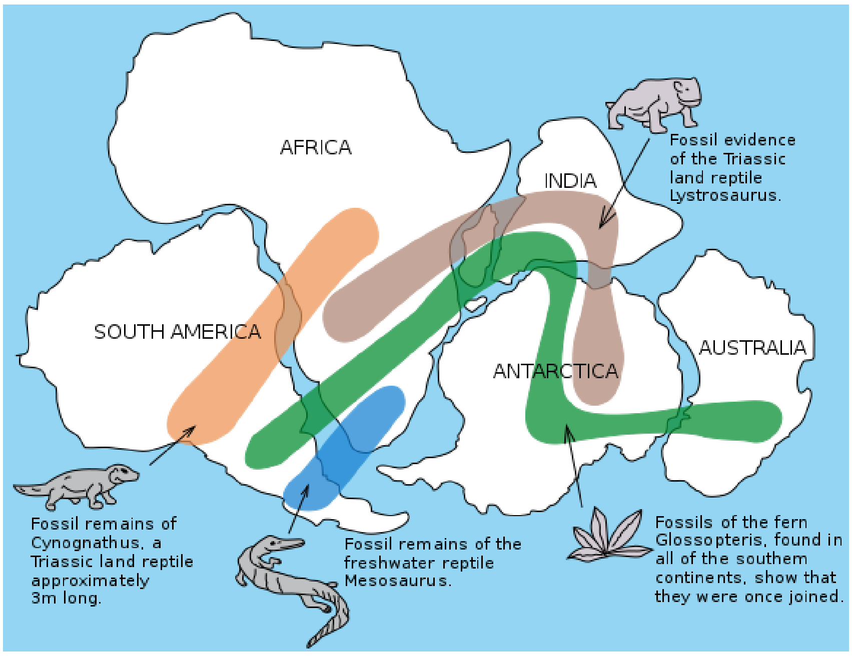
Activity 2.1 Continental Drift The 'Jigsaw' Fit of the Continental Shelves and Matching of Fossils

Students will complete the passage below using the URL:
https://www.sciencelearn.org.nz/resources/952-continental-drift:

The Earth's continents have not always been where they are at present. If you look at a map of the world, you might notice what Alfred Wegner noticed – that the continents look as if they could fit together like a big jigsaw puzzle if you were able to move them around. Wegener published his theory in 1915. He tried to explain how the Earth drifted apart, but he was unable to give a scientific explanation. Many years later, though, this theory began to gain popularity, and now we understand more how it is possible that land masses can move. Continental drift is the concept that the Earth's continents move relative to each other, with the Earth's surface being broken into plates.

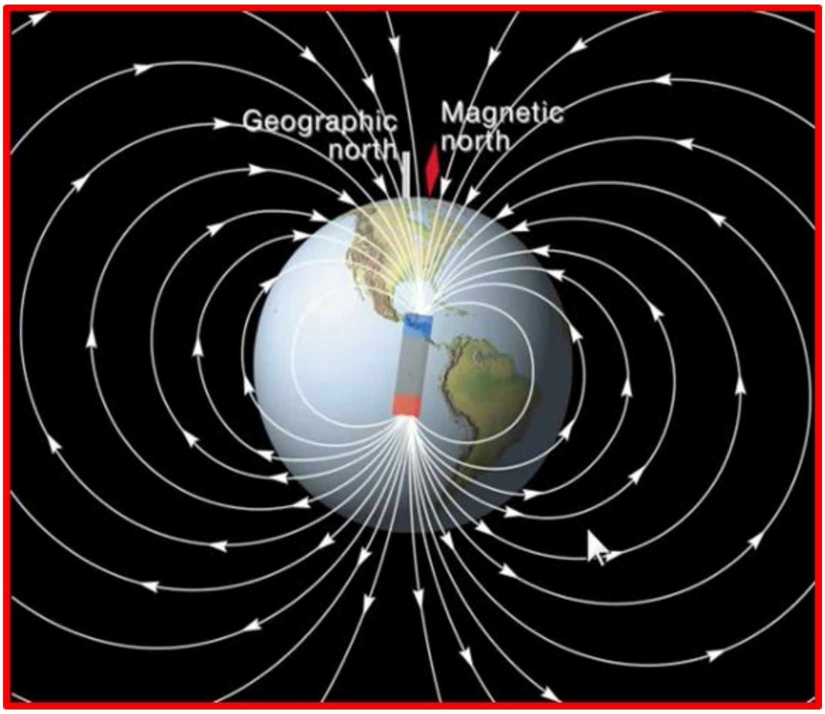
Activity 2.2: Evidence for Continetal Drift and Matching Fossils

Answers will vary depending on jigsaw supplied to the students. The result may be similar to this: Image: https://commons.wikimedia.org/wiki/File:Snider-Pellegrini_Wegener_fossil_map.svg#fil



Activity 2.3: Model of Seafloor

1. Draw the Earth and its invisible magnetic fields



2. Every few million years the earth's magnetic field reverses.

3. Explain what happens to the magnetic minerals in the lava when it cools to form rock.

   The magnetic minerals in the lava align themselves to the Earth's magnetic field at the time and preserves the direction of the magnetic field, either normal or reversed, in the rock (like a tape recorder).

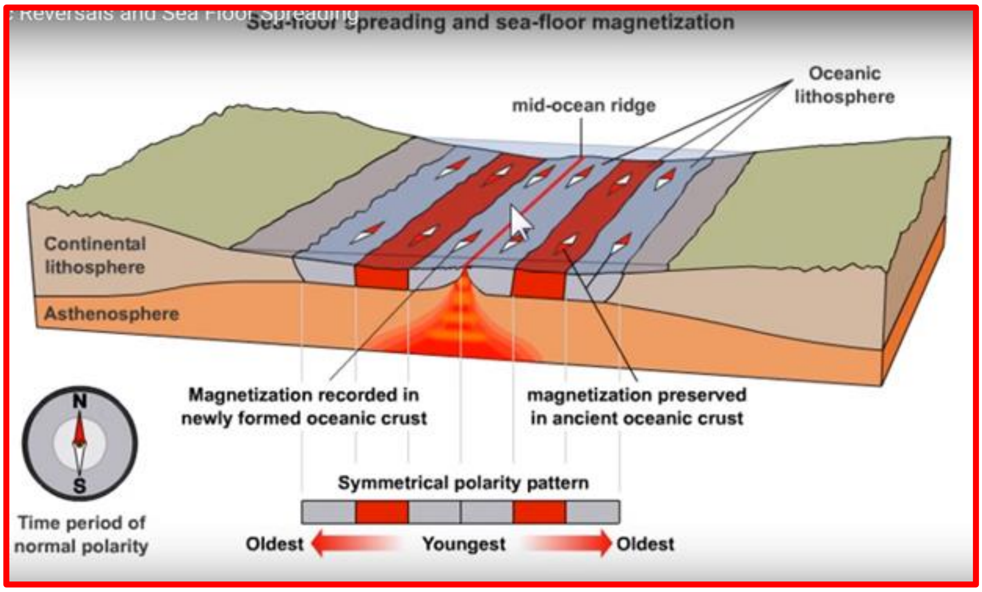
4. Outline the differences in magnetic field of the lava layers over time

   Looking at lava layers over time there are patterns of normal and reversed magnetic fields 0.4 mya normal, 0.8 mya reversed and 1.2 mya normal.

5. What are magnetic polarity reversals?

   These are times when the Earth's magnetic field flips backward and forward

6. Draw a labelled diagram of the seafloor spreading and magnetic reversals from the video at 2.48 minutes



7. On the diagram above where is the youngest and oldest rock?

   The youngest rocks are found in areas where the mid ocean ridge is located/where the seafloor is currently spreading and the oldest rocks are closest to the continents

8. From the video and your reading knowledge, write a summary of patterns in the age of rocks and magnetic reversals on the seafloor

The youngest rocks are found closest to the active mid ocean ridge and become older as you move toward the continents. The patterns in magnetic reversals on the seafloor show a mirror image of normal and reversed polarity on either side of the mid ocean ridge.

Activity 2.4: Making a model of the seafloor

Photos in teacher activity demonstrate how this model works

Answers to Questions

1. Name a tectonic boundary where this process is occurring: Mid Atlantic Ridge
2. Describe the process that occurs at a spreading centre

Convection currents in the asthenosphere cause magma to push apart tectonic plates at mid ocean ridges. As the lava erupts from a spreading centre it spreads horizontally and cools to form rock

- Outline the pattern observed in the age of the rocks as the continents are moved apart

The rocks are youngest at the spreading centre and become older towards the continents

- What do you notice about the patterns of magnetic reversal in the rocks as the continents are moved apart?

The patterns of normal and reversed polarity show a mirror image on either side of the spreading centre

- Explain how magnetic reversals are preserved in the rock on the ocean floor.

The magnetic minerals in the lava aligns itself to the Earth's magnetic field at the time and preserves the direction of the magnetic field, either normal or reversed, in the rock (like a tape recorder)

Activity 2.5: Model of A profile of the Ocean Floor

Introduction

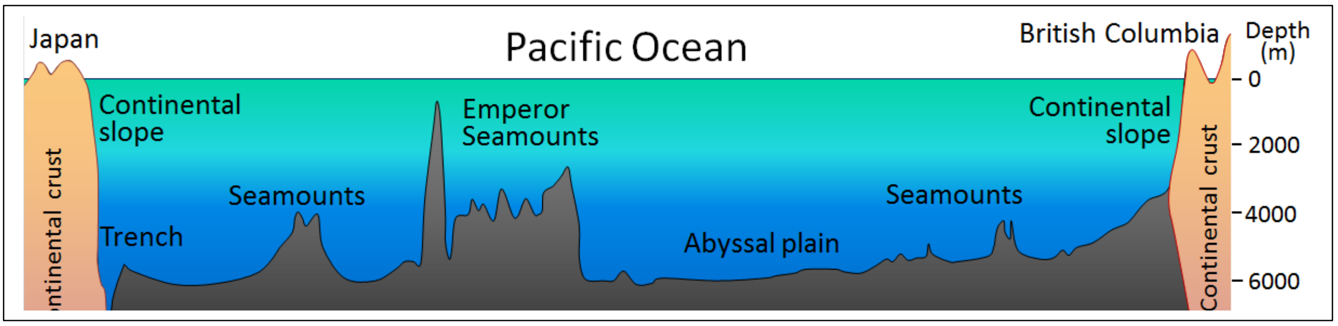
In the space below recall 5 points on mapping of the ocean floor from the readings given to you by your teacher and your own knowledge on features found on the ocean floor.

- Answers will depend on student knowledge and recall

Activity 2.5: Part One - Build a Model of the Ocean Floor

Method:

13. In the space below sketch a plan of the side of the ocean floor you will be modelling. Brainstorm some features with your group that could be included in the model before starting. Below some ideas of features that could be included.



Activity 2.5: Part Two

These will depend on group seafloor profiles

Questions

1. Describe some of the benefits of using this model

Answers could include but are not limited to:
- Shows how the seafloor could be mapped without being seen
- Shows some features that could be found on the seafloor

2. Outline any limitations to the model

Answers could include but are not limited to:
- Does not show all the features found on the sea floor
- Accuracy is lost due to how simple the model is

3. If you were to make this model again, identify some changes you might make

Answer will depend on the models made by the groups

Teacher

3. Assessment of understanding theory via text or models.

Activity 3.1: Reflections of text versus models

Answers will vary depending on the individual student.

4. The Use of Models in the Forestry Industry

Activity 4.1: Models in the forestry industry cloze passage

All missing cloze words are contained on teacher resource above, page 28.

Examples of the Models:

Source	The use of the model	Why it is needed?
1	Designed to demonstrate sustainable forest management in practice and promote implementation.	- To develop, test and demonstrate innovative approaches to forest management to provide feedback. - To promote partnerships of stakeholders
2	- Models predict how forests will respond to climate change. - The models project that current types of plantations will be ill-suited for drought conditions that are predicted.	Without the model it is not possible to identify forests that are in the greatest risk from environmental stressors. Managers can then take steps to planting drought tolerant seedlings and saplings to prepare
3	• Native forests are at risk from drought, heatwaves and fires and there is growing pressure from consumers for sustainable products. • The models are modelling how trees growth and function to that they can be managed. • Models look at; impacts of climate change on growth, water uptake and management, carbon accounting, growing forests in	Aims to keep Australia's forests productive and healthy into the future so they can provide the range of products and services.

	developing countries, predicting risk	
4	Predicts individual tree growth under current and projected future climatic conditions	Forest managers need growth and yield models that can predict future forest dynamics

Notes: Importance of Models in the Forestry Industry

Answers could include but are not limited to:

- Continuing supply of produce in predicted climatic changes in the future i.e. will still need wood products for a growing population.
- Importance of maintaining profits and predicting profits
- Predicting how to increase supply of products
- Modelling and knowing impacts on the environment that may be caused by forestry and how to mitigate them
- Modelling if carbon can be reduced by the industry in the future as a means of combating climate change.
- Creating models that may indicate where there may be improved resource allocation, time efficiency etc.

ForestLearning is an initiative of Forest and Wood Products Limited and these resources have been developed by qualified educators and designed to assist teachers deliver the Australian Curriculum.