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Photocopy Master Sheets

Years 9-10

Earth Science

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Topics Available

Year 7-8 General Science

Disk Filename	Topic Name
01.Energy	Energy
02.Forces	Forces
03.Matter	Solids, Liquids & Gases
04.Mixtures	Separating Mixtures
05.Elements	Elements & Compounds
06.Cells	Living Cells
07.Life	Living Things
08.LifeSystems	Plant & Animal Systems
09.Astronomy	Astronomy
10.Earth	The Earth
11.Ecosystems	Ecosystems

Year 9-10 General Science

Disk Filename	Topic Name
12.Waves	Wave Energy (inc. Light)
13.Motion	Forces & Motion
14.Electricity	Electricity
15.Atoms	Atoms & Elements
16.Reactions	Compounds & Reactions
17.DNA	Cell Division & DNA
18.Evolution	Evolution of Life
19.Health	Health & Reproduction
20.Universe	The Universe
21.EarthScience	Earth Science
22.Resources	Resources & Technology

Year 11-12 Science Courses

Biology

Preliminary Core
Local Ecosystem
Patterns in Nature
Life on Earth
Evolution Aust. Biota
HSC Core
Maintain. a Balance
Blueprint of Life
Search for Better Health
Options
Communication
Genetics:Code Broken?

Chemistry

Preliminary Core
Chemical Earth
Metals
Water
Energy
HSC Core
Production of Materials
Acidic Environment
Chem.Monit.&Mngment
Options
Shipwrecks, Corrosion...
Industrial Chemistry

Earth & Envir. Science

Preliminary Core
Planet Earth...
Local Environment
Water Issues
Dynamic Earth
HSC Core
Tectonic Impacts
Environs thru Time
Caring for the Country
Option
Introduced Species

Physics

Preliminary Core
World Communicates
Electrical Energy...
Moving About
Cosmic Engine
HSC Core
Space
Motors & Generators
Ideas to Implementation
Options
Quanta to Quarks
Astrophysics

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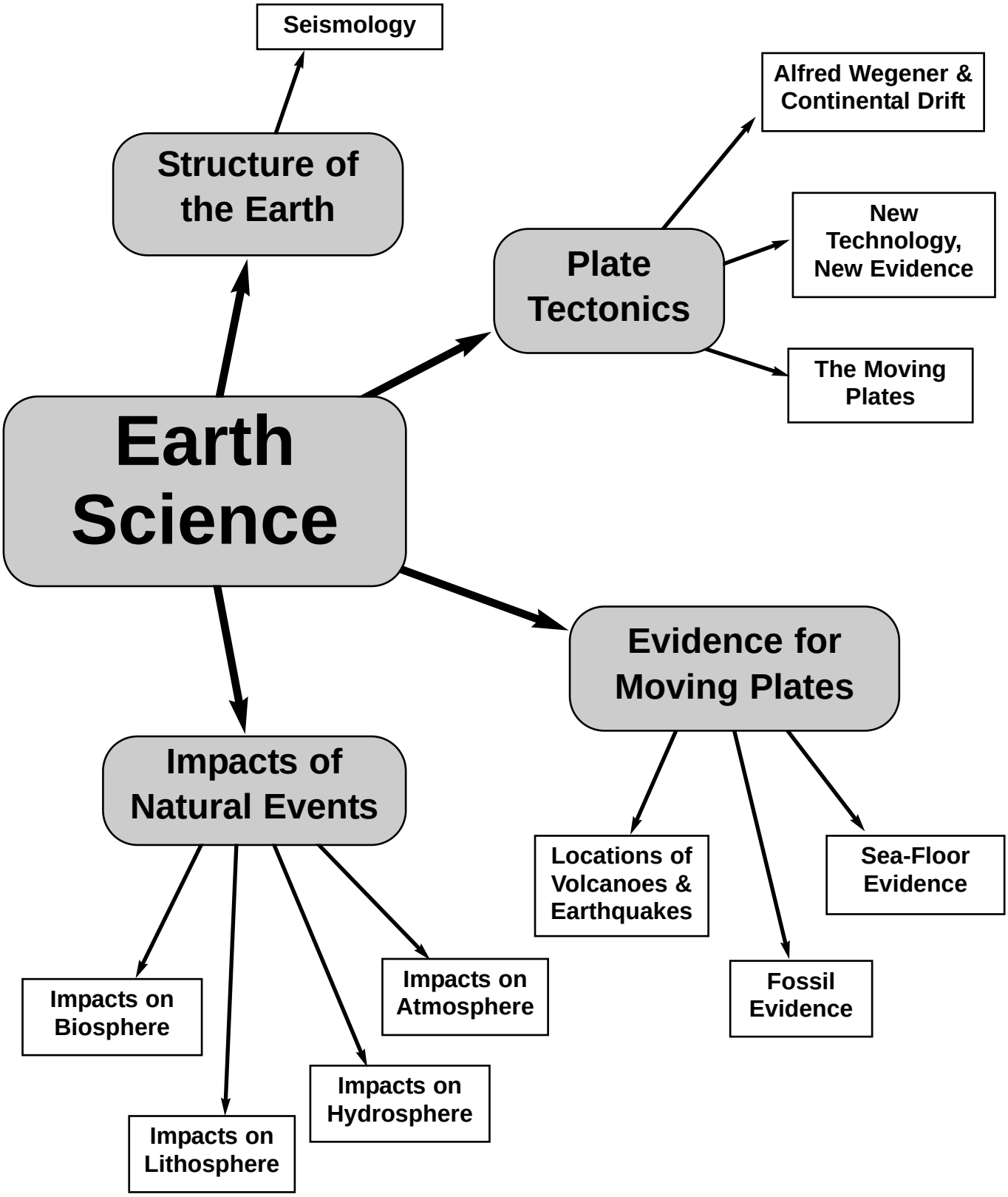
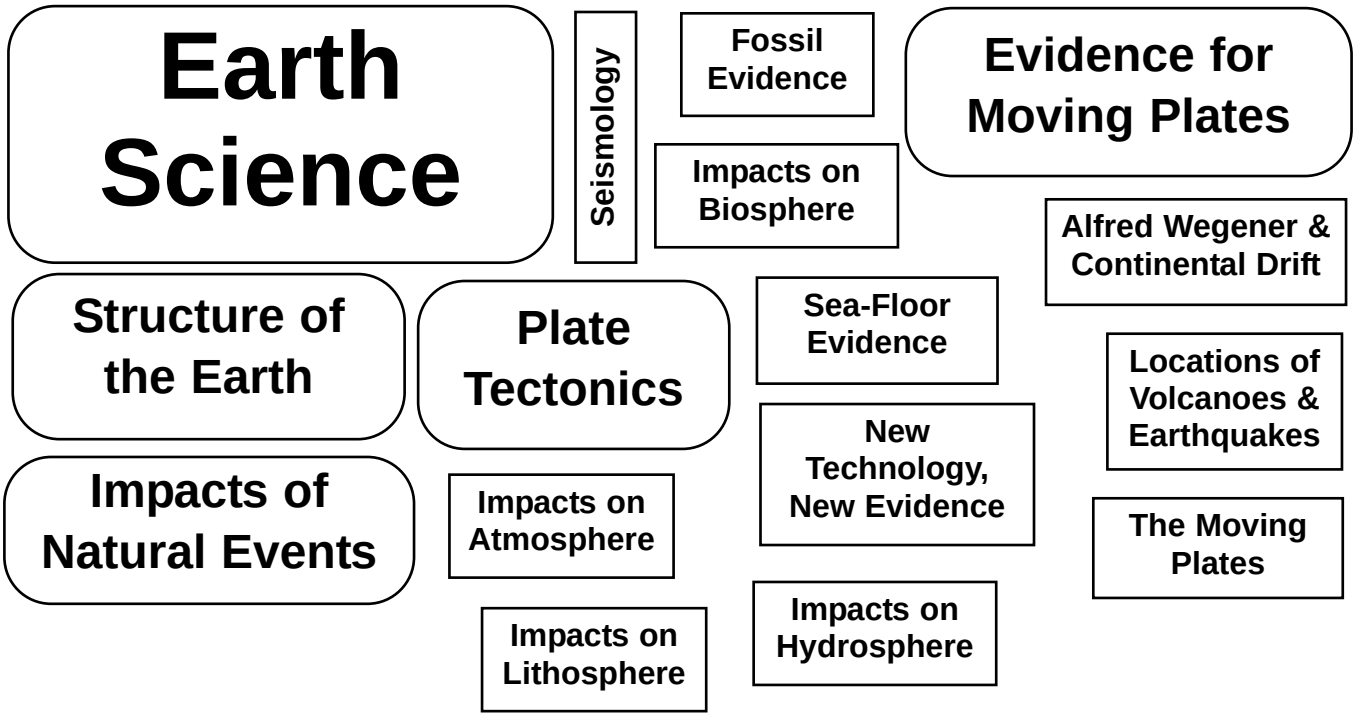
"Mind-Map" Outline of Topic

Modern Science is based on a handful of major theories.
In Biology it is Cell Theory and the Theory of Evolution.
Astronomy has the Big Bang. Chemistry is based on Atomic Theory.
In this topic, you will study the major theory that is the basis of Earth Science.



Make your own "Mind-Map" TITLE PAGE.
Cut out the boxes. Sort them into an appropriate lay-out on a page of your workbook, then glue them down. Add connecting arrows and colour in.



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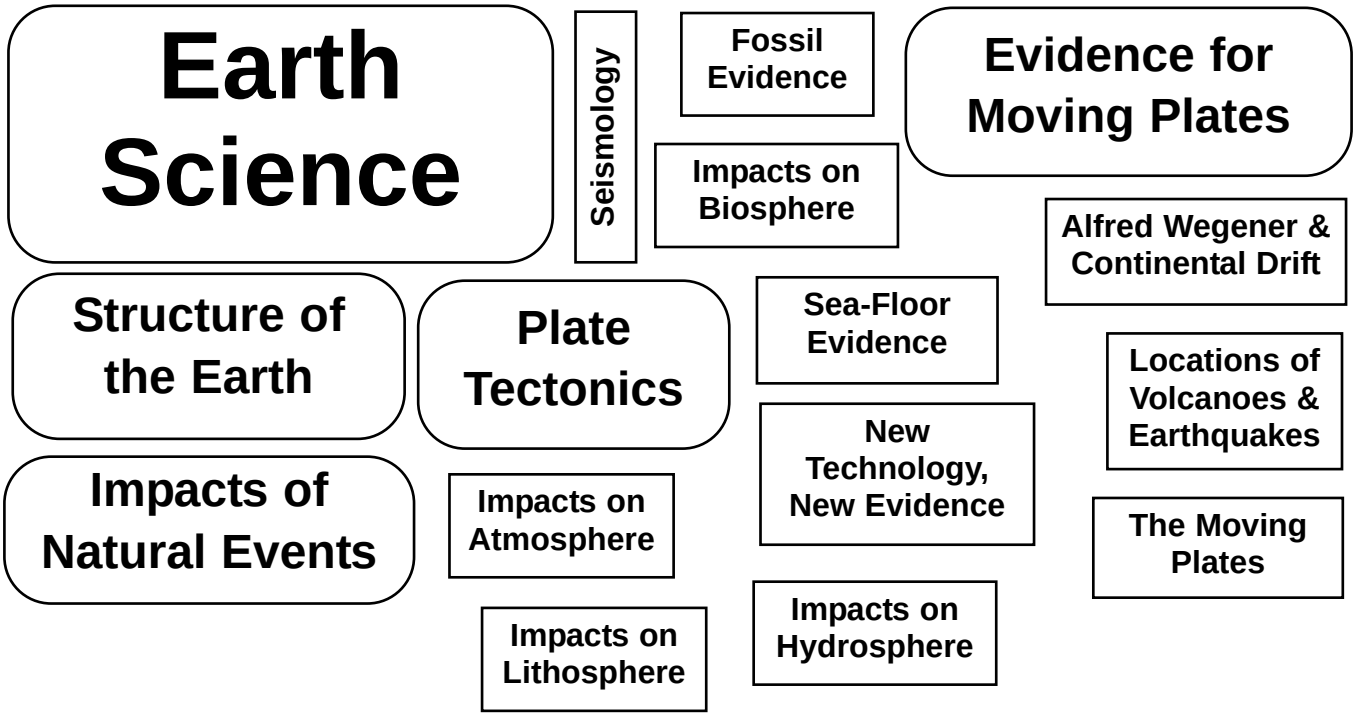

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The Structure of the Earth (Revision)

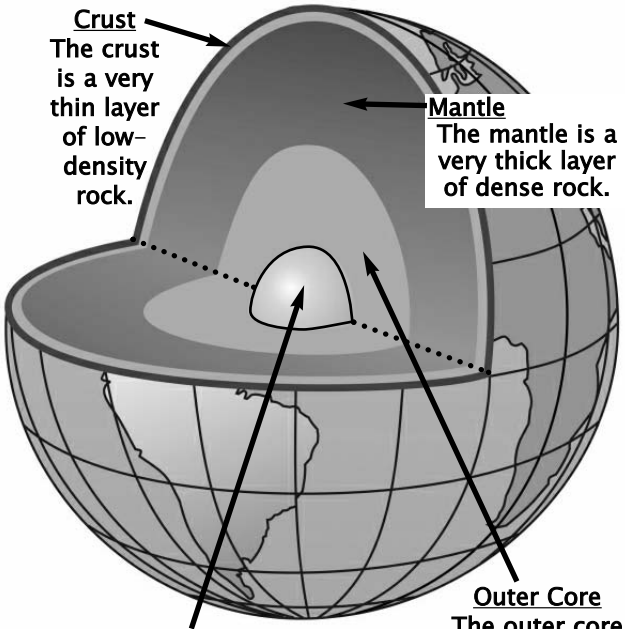
You already know that the Earth has a <u>layered</u> structure.

Inside the Solid Earth

Scientists have always been interested in earthquakes. By learning about earthquakes it was hoped that we might learn to predict them, and so avoid some of the deaths and destruction that they cause.

About 100 years ago, the study of earthquakes (called "<u>Seismology</u>") became advanced enough that scientists began studying the way that earthquake shockwaves travel through the Earth.

From this, it became clear that the solid Earth is not totally solid, and has a layer structure, as shown.

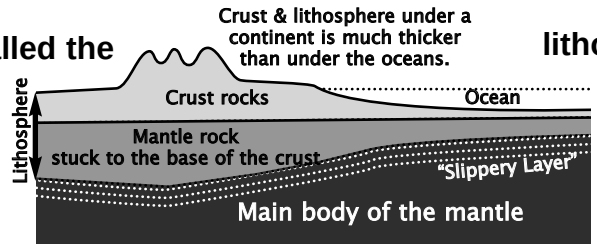


The Lithosphere

Although the Crust and Mantle are separate layers in terms of their density and composition, the boundary between them is not so simple and clear-cut.

Attached to the bottom of the crust is a layer of mantle rock which has "welded" itself to the crust rocks above.

This 2-part layer is called the <u>lithosphere</u>.



The thickness of the lithosphere varies. Under the oceans, it can be about 5 km thick and is mostly crust rocks with very little mantle rock attached. Under the continents the lithosphere is over 100km thick.

Compared to the 6,400 km radius of the Earth the lithosphere layer is an extremely thin shell on the outside.

Below the lithosphere is a "slippery layer" of the mantle.

We now know that the lithosphere "floats" on the main body of the mantle, and is broken up into large chunks of lithosphere, called <u>tectonic plates</u>.

The plates slowly move around, sliding across the "slippery layer" of mantle rock.

In this topic you will learn more about the tectonic plates and how they slowly move around and change the continents, oceans and mountain ranges of the Earth.

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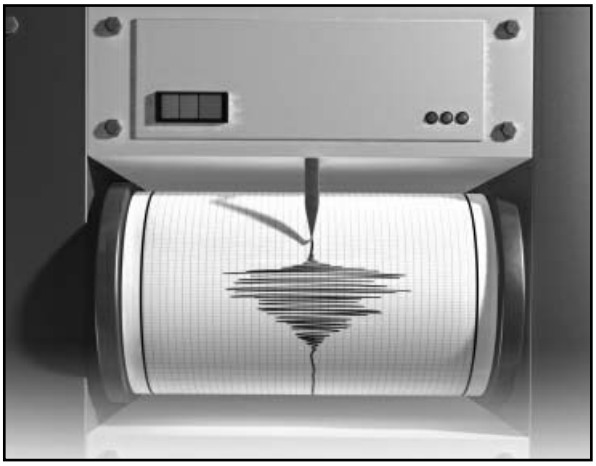
Seismology

Seismology is the study of earthquakes and their shock waves.
(Greek, "seismo"= shaking)

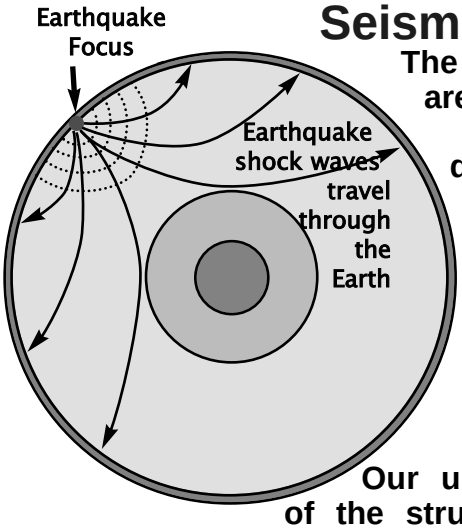
Earthquakes

Earthquakes are caused by sudden movements in the Earth's crust. The sudden release of enormous energies sends out shock waves which radiate out from the "focus" of the 'quake.

The shock waves are detected and recorded by a seismometer. The photo shows an old-fashioned seismometer recording the waves on paper. Modern seismometers use electronic detectors and record digitally for computer analysis.



Seismic Waves



The shock waves are refracted by different density rocks, and some types of waves cannot pass through the liquid Outer Core.

Our understanding of the structure of the Earth is based on studying the seismic waves and how they behave as they pass through the different layers.

There are thousands of seismometers all over the world, including the ocean floor. Most are automatic stations sending data to central computers by radio or phone links. Many are deployed as part of warning systems to alert people to possible volcanic eruptions or tsunami waves in the oceans.

Locating an Earthquake

Within minutes of an earthquake occurring, modern seismometers can tell you exactly where it occurred. Here is a simplified explanation of how.

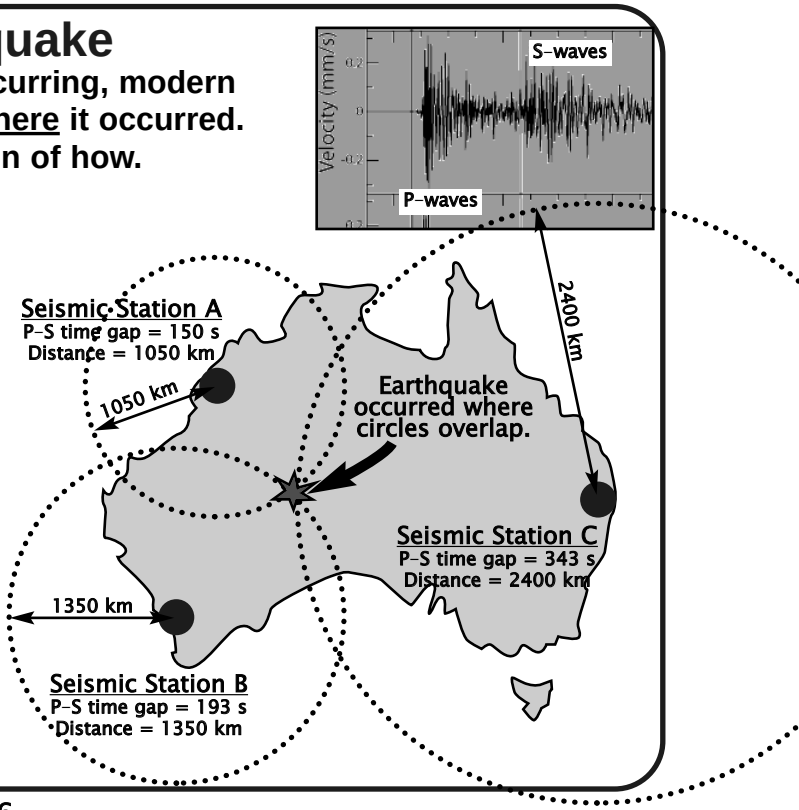
P and S Waves

Earthquakes give off several types of shock wave which have different properties and travel at different speeds.

The fastest waves, called "Primary" (P) waves always arrive at a seismometer first, followed by "Secondary" (S) waves.

The time-gap between them gives the distance from seismometer to earthquake. Each 1.0 second P-S gap equates to a distance = 7 km.

If 3 or more seismometers record the earthquake, it can be located by triangulation. Study the diagram.



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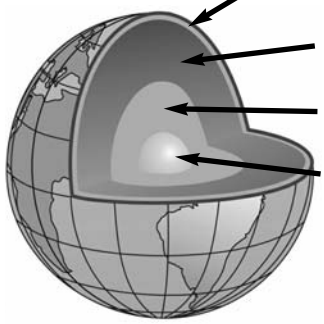
Worksheet 1
Earth & Lithosphere

Student Name.....

1. Label this diagram to identify the layers of the Earth.



a).....

b).....

c).....

d).....

e) What is the "lithosphere" made of?

2. What is the major difference between lithosphere under a continent compared to under the ocean floor?

3. Give an outline of how we know about the layer structure of the Earth.

4.

a) What does a "seismometer" measure?

b) What are "P" & "S" waves, and how can they be used to find the distance to an earthquake?

c) Apart from learning about the Earth itself, what is a practical reason for seismology?

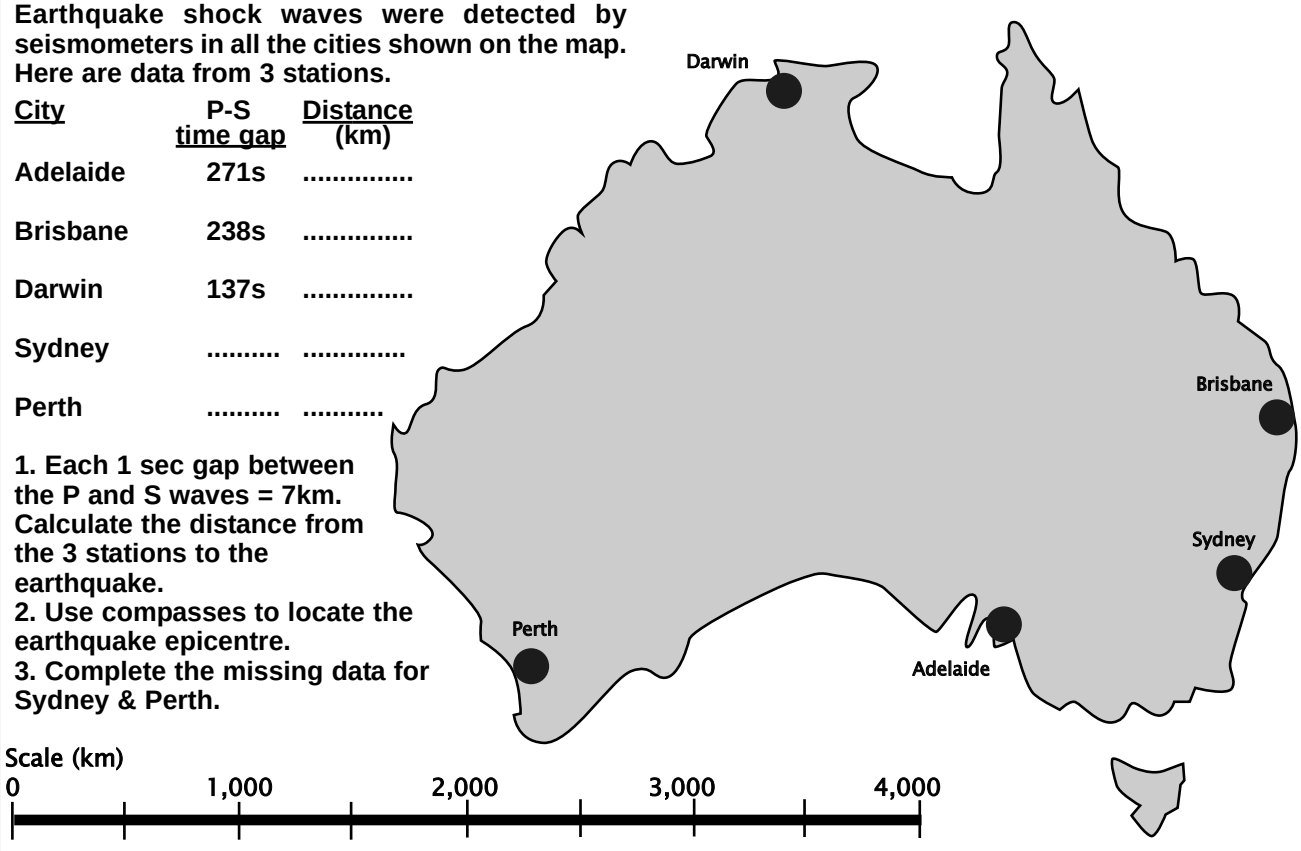
Worksheet 2
Locating an Earthquake

Student Name.....

Earthquake shock waves were detected by seismometers in all the cities shown on the map. Here are data from 3 stations.

City	P-S time gap	Distance (km)
Adelaide	271s	.....
Brisbane	238s	.....
Darwin	137s	.....
Sydney	.....	.....
Perth	.....	.....

1. Each 1 sec gap between the P and S waves = 7km. Calculate the distance from the 3 stations to the earthquake.
2. Use compasses to locate the earthquake epicentre.
3. Complete the missing data for Sydney & Perth.



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A Little History: "Continental Drift"

As soon as accurate maps of the World appeared, some people noticed that the shapes of some of the continents fit together like jig-saw pieces. One man took this idea further.

Alfred Wegener (German, 1880-1930)

(pron: "vague-ner")

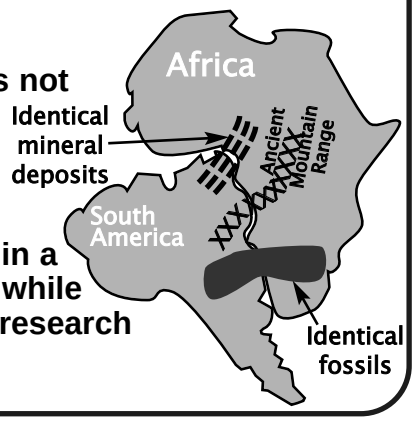
Wegener was trained in astronomy, but became interested in Earth Science.

Intrigued by the shapes of the continents, he studied the rocks and fossils on either side of the Atlantic Ocean.

He found many examples of identical, same-age minerals, fossils and geological features which are on separate continents, but in exactly the locations which fit the "jig-saw" idea.

In 1915, he published a theory of "Continental Drift" which proposed that the continents had once been joined together and had moved to their current locations. He put forward a lot of geological evidence, but could not suggest how the continents could move, or what force might be pushing them.

His theory was not accepted by many other scientists.



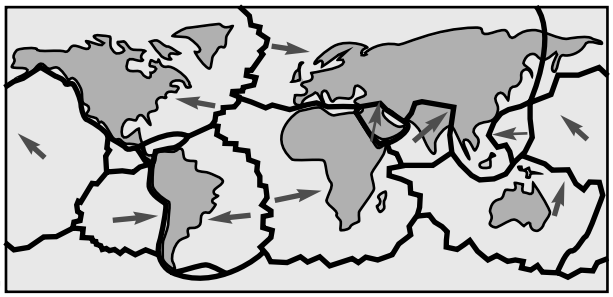
Wegener died in a snow blizzard while doing climate research in Greenland.

New Technologies, New Evidence, New Theory

During World War II, sonar was developed for submarine warfare. In the 1950's it was used to accurately map the deep ocean floor for the first time. The demand for petroleum led to new techniques for deep-sea drilling from ships into the rocks under the sea. Sensitive "magnetometers" could be towed by a ship to map the magnetism in the rocks under the deep oceans.

Plate Tectonics

During the 1950's through 1970's a huge amount was learnt about the crust of the Earth, especially under the deep oceans.



The ocean-floor maps, magnetic data and rock samples from deep-sea drilling built up a body of evidence which showed that Wegener was right... continents move!

Additional evidence came from seismology and studies of volcanoes. Details of the evidence will be presented later in this topic.

This led to a new theory called "Plate Tectonics".

According to this theory, the lithosphere is not a simple "skin" like an egg shell, but is broken up into about a dozen pieces, or "plates".

The plates slowly move around, sliding on the mantle layer below. Adjoining plates must either move apart, or crash together, or slide sideways past each other.

These movements cause earthquakes and volcanoes, create mountain ranges and volcanic islands and enlarge or destroy the oceans themselves.

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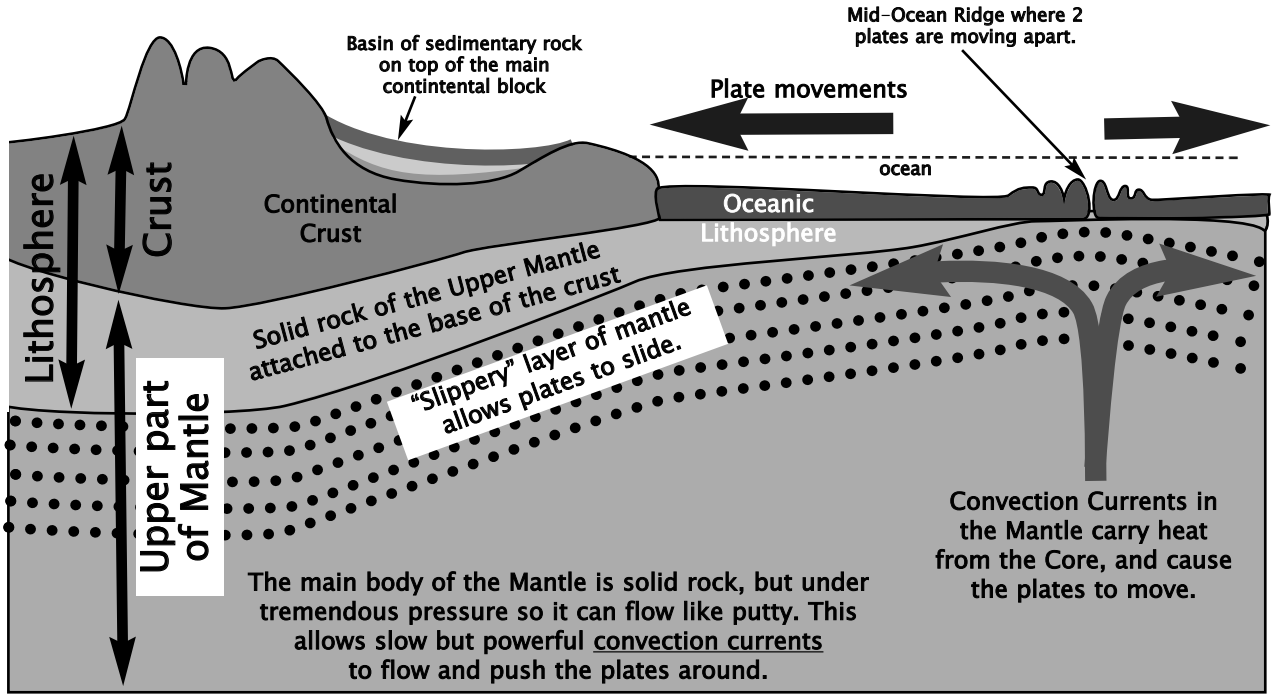
The Structure of a Tectonic Plate

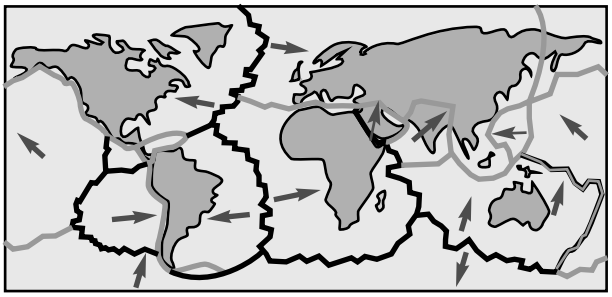
Most of the major Tectonic Plates carry a thick "block" of a continent plus a thin layer of lithosphere under the ocean.



Each plate can slide sideways on a "slippery" layer of the Mantle. The movement is caused mainly by huge, slow convection currents which carry heat out from the Earth's core. The average rate of movement is about 5 cm per year, but movements are not slow and steady. Instead, the plate might not move at all for many years, then suddenly lurch forward by several metres.
It is these sudden movements which cause earthquakes.

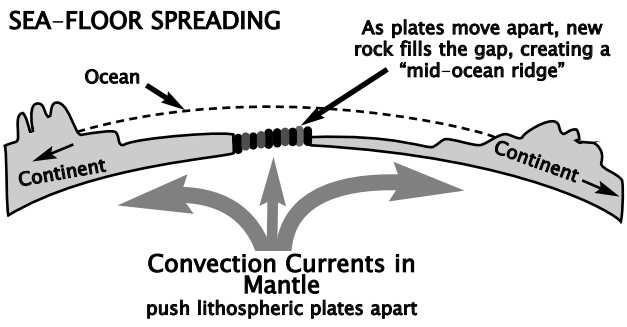
When Plates Move Apart

When plates move away from each other, molten rock immediately billows up from underneath to fill the gap and create a new, thin layer of crust.
This is occurring mainly on the floor of the oceans. Hidden deep underwater there are about 70,000 km of plate boundaries which frequently move (creating many small earthquakes) and erupt new oceanic crust.



The "Mid-Ocean Ridges" are chains of underwater mountains with a central "rift valley" where the plate edges are. In some places, such as Iceland, the eruption of new crust has built up high enough to reach the ocean surface, forming islands.

About 250 million years ago, the American continents were joined to Europe and Africa. As they have moved apart, the Atlantic Ocean has grown wider and wider by "sea-floor spreading".

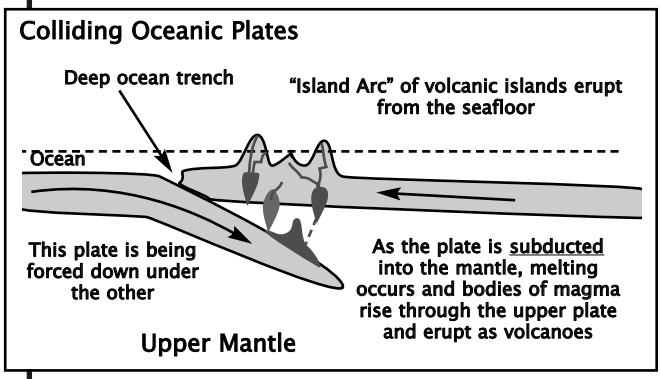


When Plates Collide

The tectonic plates cover the surface of a sphere. If they are moving apart in some places, then they have to be colliding somewhere else. Exactly what happens in a collision zone depends on what type of lithosphere is involved.

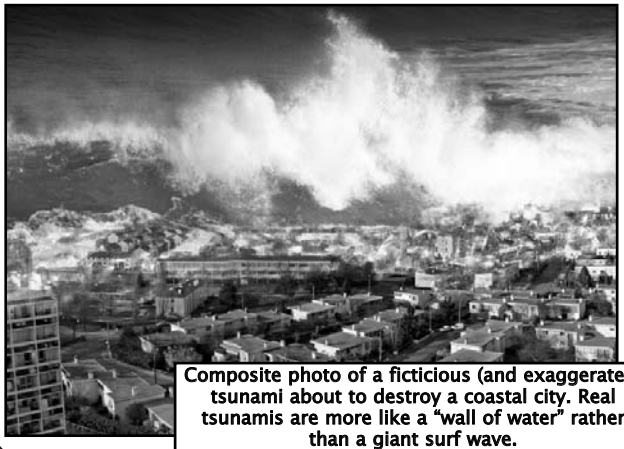
Subduction

If one of the colliding plates is made of oceanic lithosphere it will be pushed down under the other plate and destroyed by being re-melted into the Mantle. This is called "Subduction".

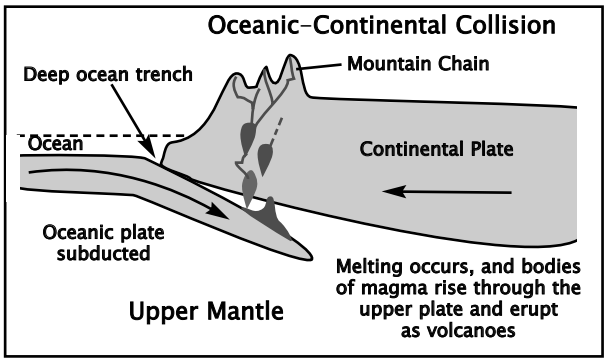


This type of collision is occurring north of Australia where the plate under the Pacific Ocean is being destroyed. The many volcanic islands of the western Pacific have formed in chains along the subduction zones. Deep ocean trenches occur where the plate is bent sharply downwards.

Each time a plate lurches forward, an earthquake occurs. Large under-sea 'quakes can set off a tsunami, or seismic water wave, in the ocean. The Boxing-Day tsunami of 2004, which killed over 200,000 people, was caused by a 'quake in the subduction zone north-west of Australia.



Composite photo of a ficticious (and exaggerated) tsunami about to destroy a coastal city. Real tsunamis are more like a "wall of water" rather than a giant surf wave.

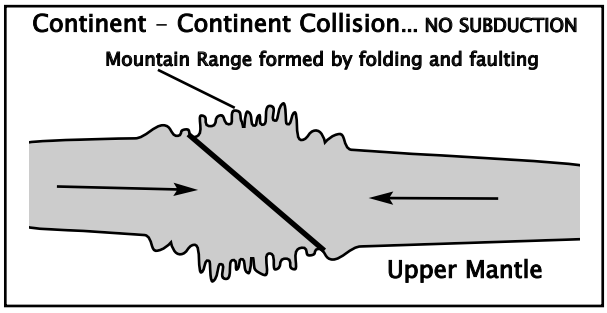


The South American plate is colliding with the plate under the eastern Pacific Ocean. There are deep ocean trenches just off the coast and a massive mountain range (the Andes) along the western edge of the continent.

The mountains are formed by the "crumpling" of the continent's crust in the collision. There are also many volcanoes and earthquakes.

Mountain Building

If both colliding plates carry the thick lithosphere of a continent, neither plate is subducted. Instead, the continents are crumpled by the collision.



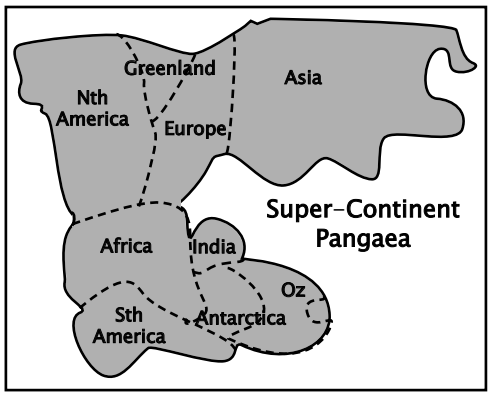
The crumpling effect folds and fractures the crust rocks and pushes them up to form a chain of mountains.

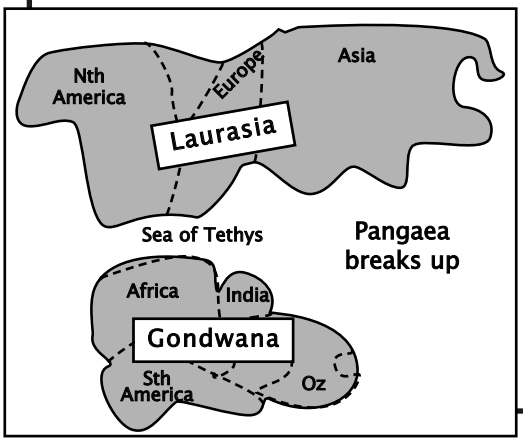
The Himalaya mountains formed this way as the plate carrying India has collided with Asia. Rocks which were once under the sea are now almost 9 km high.

The Changing Map of the World

Supercontinent Pangaea

The evidence indicates that 200 million years ago, all the continents were joined together in one "supercontinent" called Pangaea, which means "whole Earth".

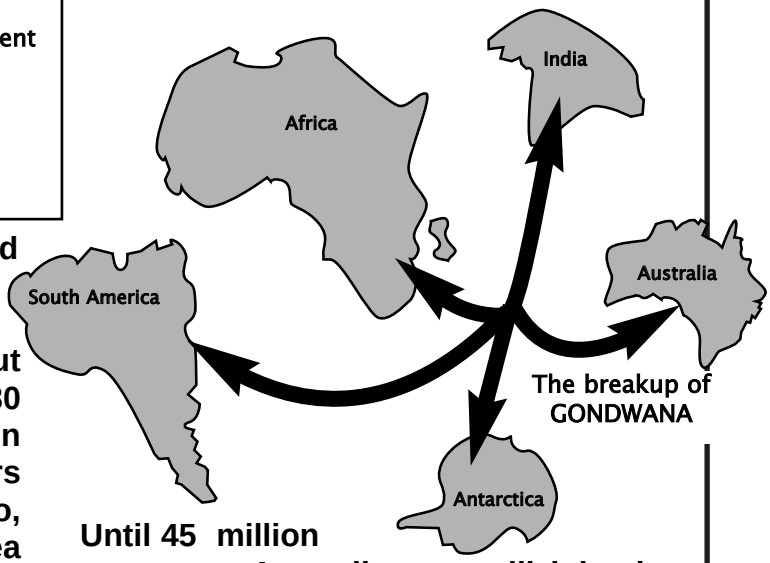




About 180 million years ago, Pangaea split into 2 parts as shown.

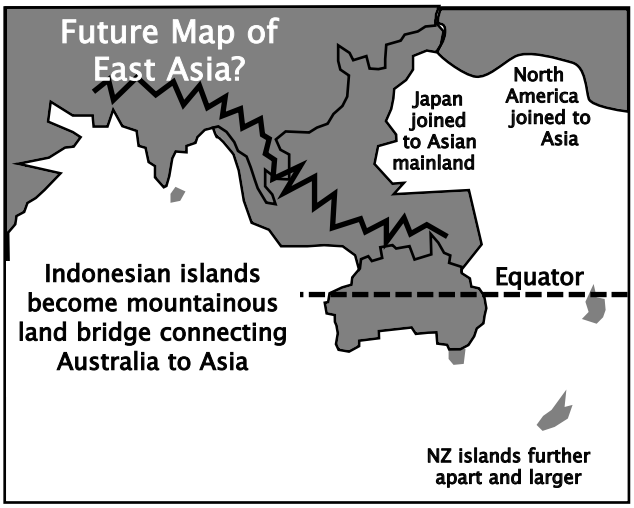
Later, North America separated from Europe, creating the Atlantic Ocean as it moved away.

In the south, the ancient continent we call Gondwana also began breaking up.



Until 45 million years ago Australia was still joined to Antarctica. Today Australia is connected to India by the plate under the Indian Ocean and we are slowly moving north.

The Future?



If all the tectonic plates keep moving the way they are now (no guarantees!) we can predict what the world might look like in 100 million years time:

- Africa will join completely onto Europe, destroying the Mediterranean Sea.
- The eastern one-third of Africa will split-off to form a separate continent.
- North America will connect to Asia and the north Pacific Ocean will shrink.

Eventually, all the continents may collide and join together to form a new "supercontinent" like Pangaea, but with all the pieces in different places. The new supercontinent might then crack up into new fragments. This cycle has occurred over and over in the past. Western Australia was once joined to Canada in a previous supercontinent long before Pangaea was formed.

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Worksheet 3
Plate Tectonics

Student Name.....

Fill in the blank spaces.

The theory of "a)..... Drift" was proposed by Alfred b)..... in 1915. He thought that the continents had once been joined together and had moved apart. His evidence included identical c)..... and rock formations which are now separated by oceans.
His theory was <u>not</u> well accepted, mainly because he could not explain d).....

During 1950-1970's new technologies produced new evidence. e)..... allowed mapping of the f)..... .....

Deep-sea drilling allowed g)..... ..... to be collected, and the h)..... in the rocks could be measured by magnetometers.

From the accumulation of evidence we now believe that the lithosphere is made up of a number of separate i)..... which slide across the j)..... being pushed by slow-moving k)..... which carry heat from the earth's l).....

Two adjoining plates must either m)..... ....., or n)....., or slide sideways past each other.

It is the sudden movement of a plate which causes most o).....

Worksheet 4
When Plates Move

Student Name.....

Fill in the blank spaces.

If 2 plates move apart, a)..... immediately erupts to fill the gap and create new b).....

This occurs mainly along the "c).....-..... ridges on the ocean floors. Many small d)..... occur as the plates move apart. In a few places the erupting material builds up enough to form an e).....

Where plates collide, different things can occur depending on the plate types. When "oceanic plates" collide, one of them will be pushed down into the mantle, or "f)....". When the plate bends down sharply there is a g)..... trench. As rock melts and moves upwards, a chain of volcanic h)..... may form.

The plate movements may be irregular and sometimes produce huge i)..... Since these occur under water, they may set off a j).....

Subduction also occurs if the collision is between an oceanic plate and one carrying a k)..... The continent edge is l)..... forming a m).....

If 2 continents collide neither one can be n)..... Both are o)..... and ....., creating a mountain range such as the p)..... range.

We believe that 200 mya, all the continents were joined together in a "supercontinent" called "q)....."

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The Evidence for Moving Plates

The Tectonic Plate Theory explains many things such as earthquakes & volcanoes, mountain ranges, island chains & deep ocean trenches. But is it really true?

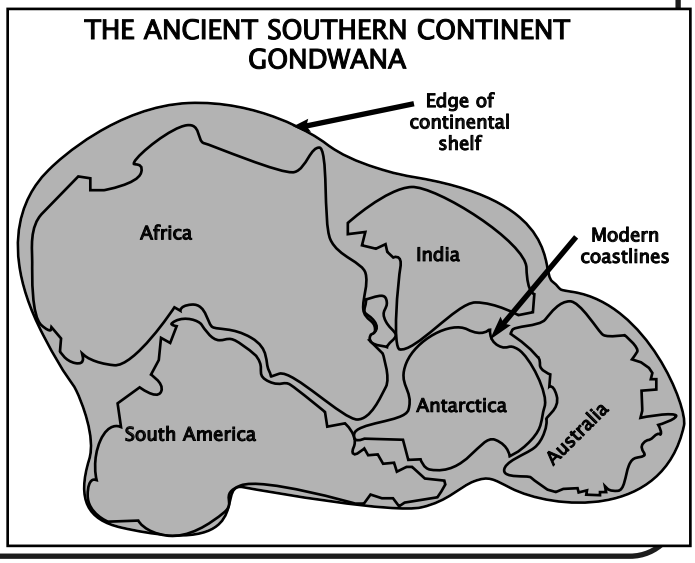
We believe it is true because there is a huge body of evidence to say so. Some evidence was noted by Alfred Wegener almost 100 years ago, but a lot was only discovered after the 1950's when new technologies allowed us to study the ocean floor, accurately measure the age of rocks and so on.

The Shape of the Continents

The continents of the Earth are like jig-saw puzzle pieces... they fit together quite well, especially along the lines of the "continental shelf" rather than the actual coastline.

The continental shelf is the true edge of each continent. In most cases it is under water today, but has been mapped using sonar.

When the continents are fitted together along their continental shelf margins, the fit is almost perfect.



The Fossil & Mineral Evidence

Alfred Wegener discovered some of this evidence and used it to support his "Continental Drift" idea. Since his time, many more discoveries have been made of this same type of evidence.

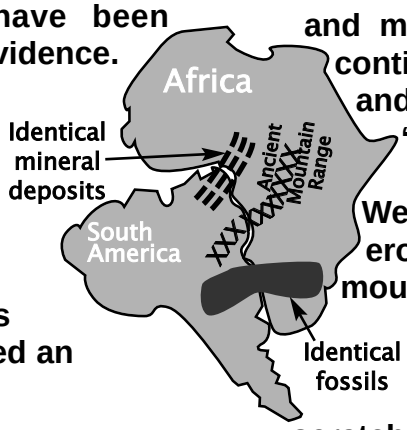
Fossils

There are many examples of fossil plants and animals that are found on separate continents. These were land plants, or freshwater animals which could not have crossed an ocean.

The fossils are the same age, and identical specimens are found across (for example) Africa, South America, India, Australia and Antarctica. They must have evolved and lived right across an ancient continent. The moving plates later separated the fossil deposits.

Geological Evidence

There are many examples of rock layers and mineral deposits on different continents which are very similar and are in locations which fit the "jig-saw" pattern.



Wegener noted evidence of the eroded "stump" of an ancient mountain range which is present in South America and Africa.

Scientists have even found scratch marks on rocks caused by ancient glaciers which gouged the rocks. The pattern of the scratches line up perfectly across what are now different continents. Of course, when the glaciers were doing the scratching, the continents were joined together.

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Evidence From the Ocean Floor

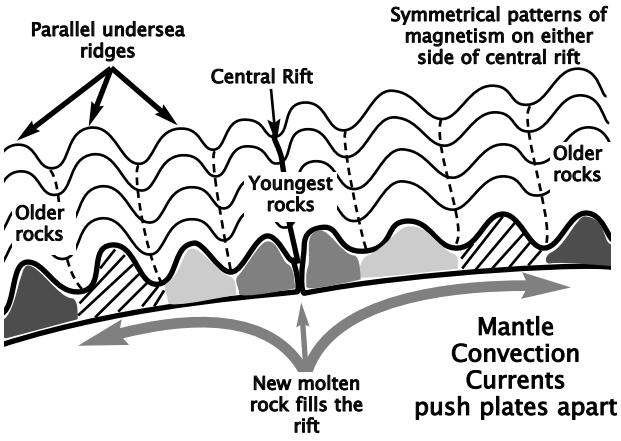
When scientists began mapping the ocean floor with sonar, they quickly discovered that there is a "Mid-Ocean Ridge" of underwater mountains running for 70,000 km through the world's oceans.
New deep-water drilling equipment allowed rock samples to be collected, and new methods involving radio-activity allowed the age of rocks and sediments to be measured. New magnetic equipment allowed the magnetism in the rocks to be measured accurately.

Mid-Ocean Ridges

The rocks of the parallel ridges are youngest in the middle and get progressively older as you move outward. The sediments which settle on top of the rock are thinnest at the mid-ocean ridge and get thicker as you move away from it.

The "residual magnetism" in the rocks (which was aligned as the rock hardened from molten lava) shows a symmetry on either side of the central ridge. Each matching band of magnetism represents a line of new rock formed as the crust plates moved apart.

Later, these bands were split and separated by even newer rock injected in the middle as the crust plates continued to be pushed apart.



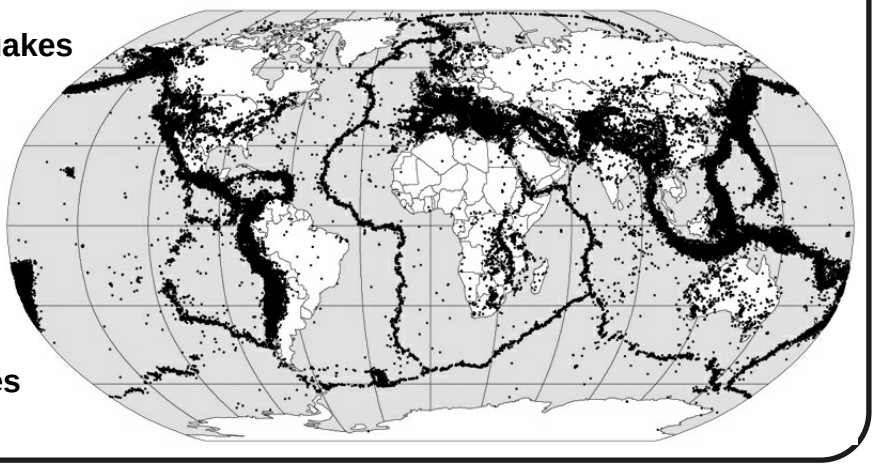
While some rocks on the continents are billions of years old, the rocks of the oceanic crust are all relatively young. This is because oceanic crust is created where plates move apart, and then destroyed again by subduction within a few hundred million years. There is no really ancient rock under the oceans.

Evidence From Seismology

Even several hundred years ago, it was realised that earthquakes and volcanic eruptions occur most often in certain "active zones", such as the edge of the Pacific Ocean which is called the "Ring of Fire".

When data from modern seismology is analysed a clear pattern emerges.

Each dot on the map is the focus of one of the 350,000 earthquakes that occurred 1963–1998.



The vast majority of earthquakes (and volcanoes) are located along the boundaries of the tectonic plates.

On this map you can clearly see the line of the mid-ocean ridges and the heavy concentration of earthquakes where the plates are colliding.

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Worksheet 5
Evidence of Moving Plates

Student Name.....

Fill in the blank spaces.

The most obvious evidence is the a)..... of some continents which seem to fit together like a jig-saw. This is especially true along the "b)..... .....", rather than the coastlines.

There are many examples of identical c)..... of plants and animals found on different continents. Similarly, there are identical d)..... and mineral deposits now on separate continents.

Many pieces of evidence have come from studies of the deep ocean floor, especially along the "e)..... Ridges".

There are a series of parallel ridges, with a central f)..... The rocks in the centre are the g)..... (age) and they get progressively h)..... as you move further from the ridge.

The ocean sediments are very i)..... at the ridge and get j)..... as you move outwards.

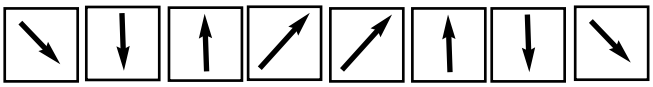
There are a series of matching "bands" of k)..... in the rocks on either side of the rift. All these facts point to the oceanic crust being created and spreading from the central rift.

Seismology patterns give more evidence. The vast majority of l)..... and ..... occur along the plate m).....

Worksheet 6
Questions: Plate Tectonics

Student Name.....

1. This data was collected from rocks on either side of a mid-ocean ridge. The arrows show the magnetic field direction of each sample and the numbers are the approximate age of the rock sample in millions of years.



a) How would you explain the patterns in this data?

b) Where, in this sequence of samples, would you expect to find the thickest layers of sediments on top of the rock? Explain.

2. Fossils of a plant called Glossopteris have been discovered in Sth America, Africa, India, Australia and Antarctica. This plant lived about 180 million years ago. It had soft seeds without a seed case, so it is unlikely that seeds could survive drifting across an ocean. Explain the distribution of the fossils.

3. Most of the active volcanoes in the world occur in the "Ring of Fire" around the perimeter of the Pacific Ocean. Why?

4. Australia has no active volcanoes and experiences few earthquakes. Why is that?

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Impacts of Natural Events

What effects do the movements of Tectonic Plates have on the air, the oceans, the lithosphere itself and on living things?

Impacts on the Atmosphere

Of the tectonic events, it is volcanoes that are likely to have the greatest impact on the atmosphere.

Volcanic Eruptions

release huge quantities of gases, ash and dust. Most of the solid particles fall quickly and blanket the surrounding area, but some fine particles can be injected into the high atmosphere and remain there for years.

These fine particles reflect light & heat from the Sun and can have a cooling effect which lasts several years.

Volcanoes release a lot of <u>acidic</u> gases such as sulfur dioxide. This can cause "acid rain" which damages the biosphere ecosystems.

CO_2 and Greenhouse

Although fine dust particles can have a short-term cooling effect, the longer-term effect of volcanoes can be the opposite.

Volcanic eruptions release huge amounts of CO_2. CO_2 is a "greenhouse gas" which traps heat which would otherwise radiate back into space. This has the effect of raising global temperatures.

One volcano has little impact, but there have been times in the Earth's history when widespread activity caused major climate changes. We believe that, about 250 million years ago, 95% of all life on Earth became extinct. The cause seems to have been climate changes due to huge volcanic eruptions which first cooled, then heated the Earth.

Impacts on the Hydrosphere

Tsunamis & Sea-Levels

An undersea earthquake can cause a seismic water wave, or tsunami. These have little effect on the ocean itself, but are devastating when they hit the coast.

Aftermath of the 2004 Asian tsunami in Indonesia. This photo was taken from a rescue helicopter.

A tourist took this photo as the 2004 Asian Tsunami hit the coast of Thailand. Moments later, some of these people died .

Longer term, the movement of continents changes the ocean basins completely.

Ocean levels rise and fall as climates change due to volcanic activity and changing ocean currents.

In an "ice age", so much water is frozen at the poles that sea levels fall by hundreds of metres. When the Earth goes "greenhouse-hot", the ice-caps melt and sea-levels rise over 100m higher than today. Look up at a 30-storey building at the beach to get the idea!

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Impact on the Lithosphere

Plate Tectonics is all about changes to the lithosphere. Volcanic eruptions and earthquakes are the results of plate movements, and are the major causes of change to the surface of the Earth.

Sea-Floor Spreading

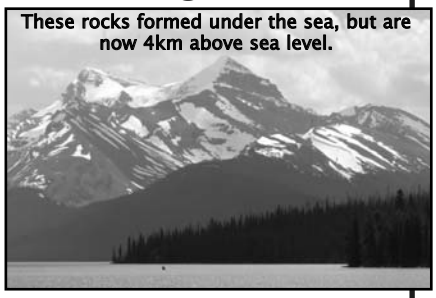
Where plates move apart, new crust is created at the mid-ocean ridges. This widens the ocean basins.

200 million years ago, the Atlantic Ocean did not exist because North America was joined to Europe. As the lithosphere fractured into separate plates which moved apart, the Atlantic Ocean was created, and is still growing wider.

Subduction

destroys oceanic lithosphere and shrinks oceans. Near subduction zones, volcanic islands grow from the ocean floor.

Mountain Building



Mountain chains are formed where plates collide.

The crust is buckled, folded and faulted. Earthquakes thrust the crust upwards to form the great mountain chains of the world. Erosion then forms valleys and plains. All our landscapes result.

Metamorphism

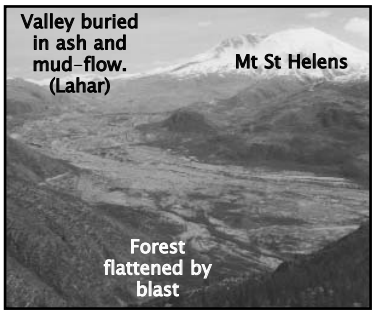
The high temperatures and pressures caused by tectonic forces changes the rocks themselves. Shale turns to slate, limestone becomes marble.

Impacts on the Biosphere

We tend to think that earthquakes and volcanic eruptions always cause destruction of ecosystems and death of living things. However, there is a positive side as well.

Mass Extinctions

At a local level, a tsunami can destroy coral reefs or coastal mangrove ecosystems. A volcano can destroy forests, or bury entire ecosystems under hot ash. Locally, the living communities can be devasted by a tectonic event.



It can also be global. It was already mentioned that volcanic activity almost completely wiped out life on Earth by causing huge climate changes about 250 mya.

However, we know from the fossil record that after every mass extinction, life always "bounces back" with greater variety and numbers than before.

New Habitats

Tectonic events create new places to live. For example, coral reefs thrive around volcanic islands created by subduction zones. Many new species evolve on the islands themselves.

Mountain ranges and the rivers, valleys and plains that form from them, all become habitats for living things.

Recycling Chemicals

Ancient farmers knew that volcanoes create fertile soil. An eruption can destroy, but fresh lava brings minerals which fertilise the soil.

Globally, plate tectonics is essential for cycling vital chemicals, such as carbon, calcium and phosphorus. Scientists now realise that without tectonic activity, the Earth's biosphere could not evolve and thrive as it has done.

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Impacts on Humans

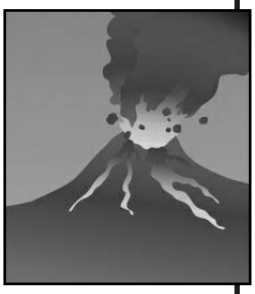
Earthquakes

The biggest threat to humans in an earthquake is collapsing buildings, landslides and fires started by broken gas mains, fuel tanks etc.

Underwater earthquakes can also set off a Tsunami. These can be devastating and cause great loss of life, as happened in 2004. However, it often only requires 15-30 minutes warning to get most people to safety. Warning system are now in place, or being installed in every ocean basin.

Volcanoes

Although a lava flow can destroy property, it is seldom a danger to people. The big killers are "Pyroclastic Flows" and "Lahars".



Pyroclastic Flow **is a cloud of red-hot ash and poisonous gases which can pour down a volcano at 100km/hr. Nothing can survive.**

Lahar **is a flow of mud, ash, water and debris from a melted glacier or burst lake on a volano. Lahars simply bury everything in their path.**

Casts of people killed by pyroclastic flow at Pompeii, 79AD

Worksheet 7

Tectonic Impacts

Student Name.....

Volcanoes can have major effects on the atmosphere. Some eruptions can inject a)..... into the high atmosphere. This b)..... sun-light and can c)..... the Earth for several years.

Gases released also have effects. Sulfur dioxide can cause d).....-rain. Huge amounts of e)..... gas are released and this can cause "f)..... warming".

Effects on the hydrosphere include g)....., caused by underwater earthquakes. Long-term changes to the ocean basins and positions of the continents cause h)..... changes. In an "ice-age" the sea-level i)..... If ice-caps totally melt, the sea-levels rise by over j)..... metres.

There are many impacts on the lithosphere as the plates move around. k).....-..... spreading widens the oceans. At a l)..... zone, m)..... islands grow from the ocean floor, and n)..... ranges are created along the edge of a continent.

The biosphere can be affected both negatively and positively.

Volcanic eruptions can destroy a local ecosystem, but global climate change can cause a o)..... ....., such as when 95% of living things died out about 250 mya.

Tectonic events also create new p)....., such as q)..... ..... around volcanic islands. Many important chemicals are r)..... by the creation and subduction of the tectonic plates.

Topic Test
Earth Science

Student Name .....

Score = /22

Answer all questions in the spaces provided.

1. (6 marks)
Match each description to an item from the list. To answer, write the letter (A,B,C, etc) of the list item beside the description.

Description matches with	List Item
a) Layer of crust with mantle rock attached.	.....
b) Study of earthquakes and their shock waves.	.....
c) Scientist who first proposed "Continental Drift".	.....
d) Zone where a tectonic plate is destroyed.	.....
e) Result of 2 continental plates colliding.	.....
f) Seismic water wave created by underwater earthquake.	.....

List Items Not all will be used. Some may be used more than once.

A. subduction	E. Wegener
B. island chain	F. mountain range
C. lithosphere	G. seismology
D. tsunami	H. Einstein

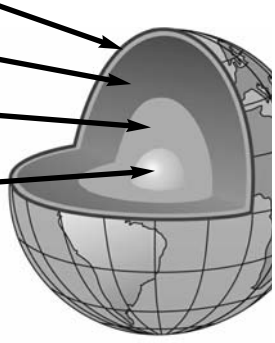
2. (6 marks)
a) Label the layers of the Earth

i).....

ii).....

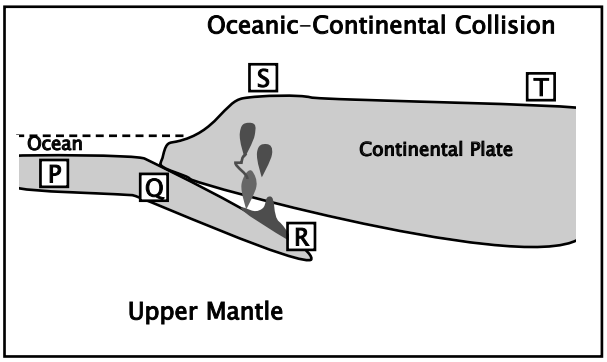
iii).....

iv).....



b) Give a brief outline to explain how we know about this layer structure.

3. (5 marks)
This diagram shows a collision between 2 tectonic plates. Answer the following questions by using the positions P,Q,R,S & T. (may be used more than once, or not at all)



In which position:
a) would there probably be a mountain range? .....
b) would there be a deep-ocean trench? .....
c) might there be a volcano? .....
d) would be the focus of an earthquake? .....

e) Name a place on Earth where a collision like this is occurring.

.....

4. (5 marks)
a) Describe a piece of evidence from sea-floor studies which supports the theory of Plate Tectonics.

b) Describe some fossil evidence which supports the theory.

c) Describe the pattern of earthquakes which helps us locate plate boundaries.

Answer Section

Worksheet 1

1.

a) crust **b) mantle**
c) outer core **d) inner core**

2.

Thickness. Very thick under a continent, much thinner under the ocean floor.

3.

Knowledge has come from seismology, from studying the way that earthquake shock waves behave as they pass through the Earth.

4.

a) Earthquake shock waves.
b) They are different types of shock waves which travel at different speeds. P waves always arrive before S waves. The time difference allows measurement of distance to the 'quake.
c) To predict possible tsunamis or volcanic eruptions and allow evacuation of danger areas.

Worksheet 2

1. Distances (nearest 10km)

Adelaide	**1900 km**
Brisbane	**1670 km**
Darwin	**960 km**

2. Epicentre is on southern coast of Gulf of Carpentaria.

3. Missing data (approx)

Sydney	**295 s**	**2060 km**
Perth	**410 s**	**2860 km**

Worksheet 3

a) Continental **b) Wegener**
c) fossils
d) what could make the continents move.
e) Sonar **f) ocean floor**
g) rock samples **h) magnetism**
i) plates **j) mantle**
k) convection currents
l) core **m) move apart**
n) collide **o) earthquakes**

Worksheet 4

a) molten rock **b) crust**
c) mid-ocean **d) earthquakes**
e) island **f) subducted**
g) deep ocean **h) islands**
i) earthquakes **j) tsunami**
k) continent **l) buckled/folded**
m) mountain range **n) subducted**
o) folded & faulted **p) Himalaya**
q) Pangaea

Worksheet 5

a) shape **b) continental shelf**
c) fossils **d) rocks**
e) mid-ocean **f) rift valley**
g) youngest **h) older**
i) thin **j) thicker**
k) magnetism
l) earthquakes & volcanoes
m) boundaries

Worksheet 6

1.

a) The crust keeps splitting open in the middle and new crust rock forms in the gap. This is why the rock is youngest in the middle and gets older outwards. This also explains the symmetrical pattern of magnetism on either side of middle.

b) Furthest away from the centre, because the oldest rocks have had more time for sediments to settle.

2. The plant grew all across the super-continent and fossils formed. Later, the fossil deposits have been separated by movements of the plates.

3.
There are plate boundaries all around the ocean perimeter. Volcanoes occur (mostly) near the edges of plates.

4.
Australia is not near the edge of a plate, so no volcanoes.

Worksheet 7

a) fine dust particles

b) reflects	**c) cool**
d) acid	**e) carbon dioxide**
f) greenhouse	**g) tsunamis**
h) climate	**i) falls.**
j) 100	**k) sea-floor**
l) subduction	**m) volcanic**
n) mountain	**o) mass extinction**
p) habitats	**q) coral reefs**

r) recycled

Topic Test

1.

a) C b) G c) E d) A e) F f) D

2.

a) i) crust
ii) mantle
iii) outer core
iv) inner core

b) Seismology studies.
Layer structure figured out from the way earthquake waves behave as they travel through the Earth.

3.

a) S b) Q c) S d) Q or R
e) Pacific coast of Sth america. (Andes Mtns)

4.

a) Rocks are youngest at the mid-ocean ridges and get older as you move away in each direction. This is evidence for "sea-floor spreading".

b) Fossils are found on different continents which match the "jig-saw" idea. The plant/animal lived all over an ancient super-continent, and fossils have been separated by plate movements.

c) Most earthquakes occur along the plate boundaries.