UNIT LEARNING PACKS

FOCUS IN ACTION

Grade 7 Science in Action

Unit E - Planet Earth

EDQUEST
MIDDLE SCHOOL SCIENCE RESOURCES

http://www.edquest.ca

'Focus in Action' UNIT LEARNING PACKS

These booklets are designed to provide Grade 7 students with all the resources needed to review or reinforce concepts, covered in the Alberta Science Curriculum, and included in the Grade 7 Science Final Exam in June. There are circumstances in which **an entire unit** may be missed and covering the concepts from that unit (for the final exam) can be difficult. This can happen for a number of reasons:

- Students – new to the school – register throughout the year (from other provinces, school jurisdictions or countries)
- Students may be ill or have surgery and often can miss one or more units
- Students have extended holidays throughout the year
- Transfers from another school, who have completed the units in a different order

For additional support, students are directed to the **Edquest Middle School Science Website** or, Scienceman Resource (www.scienceman.com/scienceinaction/pgs/hot_7u5.html)

Unit 5 – Planet Earth

- **Section 1 Notes & Quiz**
- **Section 2 Notes & Quiz**
- **Section 3 Notes & Quiz**
- **Section 4 Notes & Quiz**
- **Unit Summary**
- **Review Booklet** (Covered in class, prior to the Final Achievement Exam)
- **Unit Test**
- **Answer Key for Section Quizzes and Unit Test**

Additional support will be provided, in the form of practice Achievement Test Questions, during the course review in June. Multiple Choice Questions and Numerical Response Questions will be reviewed, as these are the types that will make up the Science 7 Final Exam

Handouts and other activities, to reinforce the concepts covered in this Unit, will be made available based on need. If you require further information or resources, email Edquest directly: edquest@gmail.com.

Finding Solutions to Problems, instead of Making Excuses

Student Instructions for use of this Learning Pack

The purpose of this Learning Unit Pack is to provide you with the resources that will help you cover the material from the curriculum that will be tested on the Final Exam in June.
Follow these steps to successfully complete this Unit Learning Pack:

Step 1 – Read the **Topic Notes**

Step 2 – Use a **highlighter** to identify the key words or phrases in the Topic Notes and reread the material again paying close attention to those words that you highlighted. If necessary, modify your highlights to make sure you understand the material in the notes.

Step 3 – Complete the **Topic Quiz**

Step 4 – Correct the Topic Quiz by **checking the answers** in the back of this Learning Pack.

Step 5 – Using your **textbook** and the **completed quiz**, find the page where the question and correct answer can be found and write it next to the question number in your Learning Pack.

Step 6 – **Repeat Steps 1-5** for each of the other Topics in this Unit.

Step 7 – Look over the **Unit Outline** to review the **Key Concepts** once you have completed all of the Topics.

Step 8 – Complete the **Unit Review**, using your **Learning Pack** and **Textbook**.

Step 9 – **Highlight** those sections of the Review that you had difficulty with and review those sections with your teacher prior to taking the Unit Test.

Step 10 – Take the **Unit Test** and correct it using the answer key provided in the back of the Learning Pack.

Step 11 – You should now be ready to answer any questions on the **Final Exam** related to this Unit.

Anything you still do not understand should be discussed with your teacher. Congratulations on your **Independent Study**, and Good Luck on the Final Exam. I hope you have made good use of this resource. Please provide feedback to your teacher, so that this resource can be improved.

Additional support is available in the form of practice Achievement Test Questions. **Multiple Choice Questions** and **Numerical Response Questions** will be made available on request, as these are the types that will make up the **Science 7 Achievement Exam**.

Handouts and other activities, to reinforce the concepts covered in this Unit may be acquired by visiting the Edquest Middle School Science Resource Website

http://www.edquest.ca

1.0 Earth's surface undergoes gradual and sudden changes

1.1 A Model for Earth

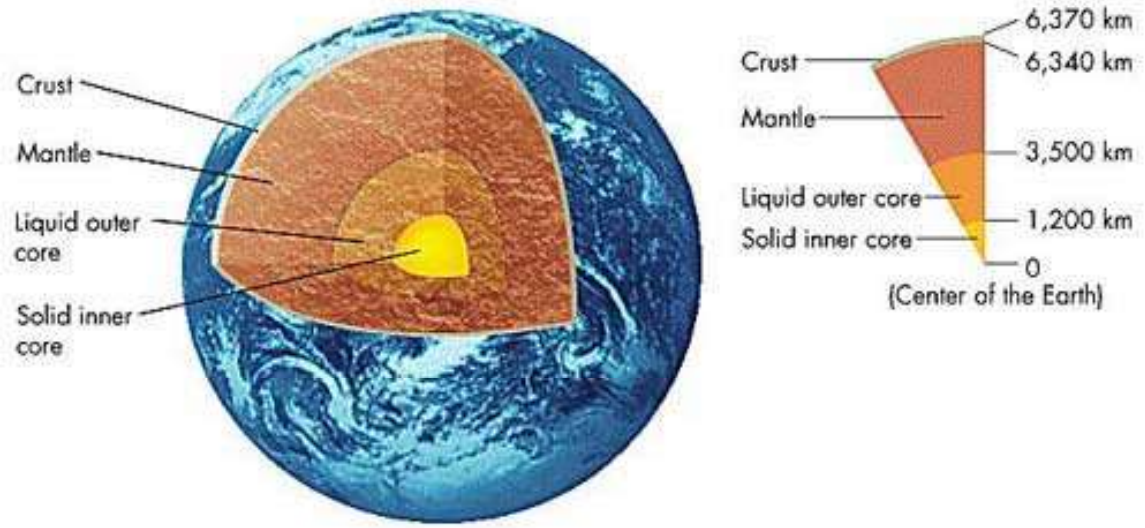
The story below the surface of the Earth is a mystery. The motion picture – **The Core** – tries to explain this mystery in a way that we can visualize it and understand it. Scientists make educated guesses based on data they collect from events that shape and reshape our planet every day. They try to understand this evidence so that they can explain how our planet began and what it is made of.

Developing A Model

A model is an idea of something that cannot be fully known or seen. It is a way of demonstrating an understanding based on evidence that is collected and interpreted, based on current knowledge. Models can take many forms: drawings, constructions, and comparisons to similar things.

What's Inside Earth

Geologists use a model to help them understand the inner structure of the Earth. This model is based on *indirect evidence*. The **crust** is the top layer of the Earth. Below it is the **mantle**, which is made of rock material (upper part is solid, lower part is partly melted. The upper mantle and crust are called the **lithosphere**. Below the mantle is the **core**. The **outer core** is made up of mainly liquid iron and nickel, while the **inner core** is solid.



The Crust

The crust is the layer of the Earth that we live on – the surface. It contains many minerals and fossil fuels, which help to supply much of our need for energy. It is also the thinnest part of the Earth. Because the inner part of the Earth is so hot, the crust radiates heat into the atmosphere. Despite the very thin film of soil and vegetation, the crust is primarily made of rock.

1.2 Sudden Earth Events

Few forces in nature are as devastating and Earth shattering as Earthquakes and Volcanoes. These are examples of sudden changes, that can transform a peaceful neighborhood into a shattered wasteland in a matter of minutes. **Kobe, Japan** – Earthquake killed 5000 people. **Mt. St. Helens** – Volcano killed 57 people and destroyed 560 square kilometers of land. Most recently, an undersea earthquake - in the Indian Ocean, caused the **Tsunami** which killed 150,000 or more people.

What Causes Earthquakes?

Earthquakes occur when tectonic plates break or move suddenly

Types of Rock Movement in Earthquakes

- where the plates meet, the rock is under great pressure, which can make it bend and stretch - when the pressure is too great, the rock breaks suddenly creating a **fault**
- there are three types of movement, of the tectonic plates, along a fault
- **Normal Faults**, (pulling action, which breaks rocks apart) - North Atlantic
- **Reverse Faults** (compression, where rocks are squeezed, causing them to bend and break) - Marianas Trench, near Japan
- **Strike-Slip** or **Transform Faults** (shear causes slipping, which makes the jagged edges break off) - Pacific Plate

The First Break

The **source** of an earthquake deep in the crust is called the **focus**, where the sudden breaking of the rock releases energy that spreads as waves through the Earth. These waves are called **seismic waves**.

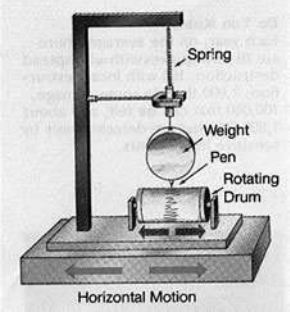
The **p waves** (primary waves) and **s waves** (secondary waves) originate at the focus.

it is possible to determine the location of an earthquake by the interval between the p waves and the s waves (the farther apart they are, the further away the earthquake is

- the surface waves come from the **epicentre** (the location on the surface directly above the focus)

Measuring The Strength Of Earthquakes

Scientists called **seismologists** use a **seismograph** to record the intensity of an earthquake.



- the seismograph must be attached to **bedrock** (the solid rock that lies beneath the soil and looser rocks) to feel the vibrations on the plate
- a marking pen, inside the seismograph, records the vibrations on a rotating drum (modern seismographs are electronic)
- the measurement scale used is called the **Richter scale**

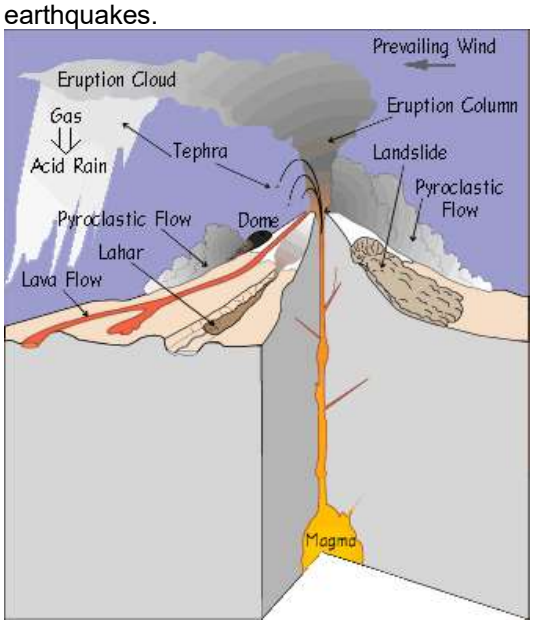
An Ancient Chinese Device to detect Earthquakes

Invented around 132 A.D., it consisted of a wine jar with eight dragon's head spouts which pointed in the compass rose directions.. A ceramic frog sat below each spout, which had a ball. With its open mouth, each frog was ready to catch any ball dislodged by an earthquake. The direction of the earthquake could be determined by which frogs caught balls.

http://volcano.und.nodak.edu/volcanoes.html (Volcano World)

Volcanoes

A **volcano** is an opening in the Earth's crust that releases lava, steam and ash when it **erupts** (becomes active). The openings are called **vents**. When volcanoes are not active, they are called **dormant**. Scientists are better equipped to predict volcano eruptions than they are at predicting earthquakes.



Famous Volcanoes

- the eruption of **Mt. Etna** in Italy this past summer shows that volcanoes cannot be predicted and don't always behave in ways scientists think they will behave. They can be rather spectacular (as the video link shows).
- the most active volcano on the Earth is **Kilauea** in Hawaii (**Loihi** is a new volcano forming beside the main island in Hawaii - creating a new island)
- **Krakatau**, in Indonesia (blast was heard 4800km away and tsunamis waves were 30 m high)
- **Mount St. Helens**, in Washington (sideways and vertical eruptions)
- **Mount Vesuvius**, in southern Italy (**City of Pompeii** was buried - it is due for another large eruption because it is sealed with a 'rock plug' that could blast 1.5 km upwards)
- **Mount Pinatubo**, in the Philippines (ash circled the globe and cooled temperatures around the world)
- Volcanoes on **Lo**, one of **Jupiter's moons** have been photographed using Vidicon - a type of TV camera mounted on the Voyager spacecraft, using an electron gun and photoconductor
- those on **Mars** and our **moon** have been extinct for millions of years, while those on **Venus** may still be erupting
- the largest volcano found in our universe is the extinct **Olympus Mons** on Mars

Current Volcano update: http://volcano.und.nodak.edu/vwdocs/current_volcs/current.html

- volcanoes that form a circle around the Pacific Ocean are called the **Ring of Fire** (derived from the circle of volcanoes that pour out red hot lava, fire and steam)

Tools and Techniques For Studying Earth

Volcanologists, Geologists and Seismologists take risks whenever they explore the world of Earthquakes and Volcanoes. Their efforts to learn more about these sudden Earth events may one day enable us to predict with more accuracy when they will occur.

Tools of the Trade

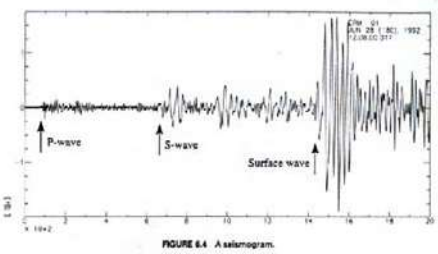
Silver Fire Suit

Reflects extreme temperatures

Surveyor's level

Detects changes in the slope of the ground

Seismogram



Determines the strength and location of an earthquake

1.3 Incremental Changes: Wind, Water and Ice

Weathering (3 types) breaks down and wears away rock, creating sediment. Erosion is the movement of rock and mineral grains from one place to another. Deposition is the process of placing the materials that are carried by water, wind and ice.

Mechanical Weathering
- the physical break-up or disintegration of rocks, caused by gravity, temperature change and frost wedging
- mechanical weathering 'wears away'
- sedimentation 'builds-up'

Chemical Weathering
- chemicals, present in the earth's surface or atmosphere, can be dissolved in water and react in the chemical decomposition of rocks and minerals (acid rain)

Biological Weathering
- living organisms (plants, animals, bacteria and fungi) can breakdown rock
- plant roots, acidic fluids produced by roots, bacteria, fungi and some insects and small animals can cause chemical reactions

The Effects of Moving Water

Water is one of the most powerful causes of erosion. Sudden or incremental changes occur due to the movement of water - rivers, rain, ocean waves. As rivers flow they carry a load of silt, sand, mud and gravel, called **sediment**.

When a river becomes mature it begins to meander (curving its bed from side to side). As it slows the sediment begins to fall to the bottom. **Sedimentation** is the process of sediments being deposited, usually at the bottom of oceans, lakes and rivers.

Landforms created by flowing water are called **fluvial landforms**.

The powerful forces of erosion caused by moving water wear away rock and soil and transport them to other locations.

Eroding Away

Agents of erosion include: glaciers, gravity, wind, and water. Changes can occur **gradually** (glaciers) or **suddenly** (flash floods, landslides, rock slides). **G**ravity causes landslides and rock slides – eg. Frank Slide (a **retaining wall** can often be used to hold back unstable material – but this is not always the best protection). **W**ind carries rock particles across the landscape, eroding the land by **abrasion** (planting vegetation, contour farming and reduced tillage can reduce the effects of wind erosion).

Glaciers – Rivers of Ice

Large rocks caught up in a glacier and then left behind when the glacier recedes are called **erratics**. Sediment that is push away, as the glacier moves forward, are called **moraines**. Scratches, made in the bedrock, by glaciers carrying rocks are called **striations**. As the glacier melts (or, retreats) it leaves behind sediment in the form of small hills, called **drumlins** and and snake-like hills called **eskers**.

Section 1 – Earth's surface undergoes gradual and sudden changes - Quiz

1.1 A Model For Earth

1. Scientists estimate the age of the Earth to be about 4.6 billion years old, using evidence and theories. Then they construct a model of what the Earth is composed of. A model is based on what is …
   A. known
   B. inferred
   C. observed
   D. proven

2. A scientist who studies the Earth is called a ….
   A. geologist
   B. meteorologist
   C. paleontologist
   D. environmentalist

3. Compared to the other layers of the Earth, the crust, at a temperature of 5^{o}C is ...
   A. thicker than the upper mantle
   B. thinner than all the layers
   C. thicker than the lower mantle
   D. thicker than any other layer

4. In order for scientists to study - first hand - the composition of the core of the Earth, they would have to travel 1700 times the depth of the deepest mine in the world. The deepest mine is in South Africa and it reaches a depth of 3.8 kms. What is mined there?
   A. coal
   B. gold
   C. silver
   D. diamonds

5. The temperature in the deepest parts of these types of mines protects miners from cold. This is because the deeper the mine gets the closer to the core it is. The normal temperature in these deep mines is …
   A. 15^{o}C
   B. 19^{o}C
   C. 29^{o}C
   D. 35^{o}C

6. The core of the Earth is made up of two layers. The inner core, which is made up of nickel and iron reaching temperatures of **7000^{o}C**, because of the pressure of the other layers on this inner core, it is …
   A. molten
   B. liquid
   C. solid
   D. crystal

7. Which of the following foods would you use to model what the Earth is made of …
   A. pear
   B. apple
   C. peach
   D. banana

1.2 Sudden Earth Events

1. The largest earthquake recorded in Canada was off the coast of British Columbia. It was ~9 in magnitude. The reason this is just an estimation is because …
   A. the seismograph was turned off
   B. there was nobody around to read the seismogram
   C. seismographs were not invented yet
   D. the earthquake destroyed the seismic equipment

2. It is likely that San Diego would be able to get early warnings of possible earthquakes in the area because of this attraction ...
   A. San Diego Zoo
   B. San Diego Emergency Center
   C. San Diego Observatory
   D. Pacific Climatology Center

3. The pressure under the earth's crust can cause it to move in different ways. A fault that is caused by a compression force is called a ...
   A. normal fault
   B. reverse fault
   C. strike-slip fault
   D. transform fault

4. The source of an earthquake can be determined by recording the interval time between the p waves and s waves. The first place that rocks break below the surface in an earthquake is called the ...
   A. focus
   B. fault line
   C. epicenter
   D. shadow zone

5. Scientists study the effect of an earthquake by locating this point , which is the place on the surface that is directly above where the earthquake first began, called the …
   A. focus
   B. fault line
   C. epicenter
   D. shadow zone

6. An earthquake in Japan registers on a seismograph in Winnipeg, Manitoba. This occurs because ...
   A. seismographs anywhere will record all earthquakes
   B. the earth's crust is solid, allowing the surface waves to be recorded anywhere
   C. seismic waves travel through all the layers of the Earth
   D. the core of the earth is liquid

7. Seismologists use a special machine that measures earthquakes. It is called the …
   A. Richter Scale
   B. Seismogram
   C. Seismologist
   D. Seismograph

8. In 1935 Charles Richter developed a scale that helped geologists understand about the strength or magnitude (intensity) of an earthquake. The scale he developed starts at 0 and each increase of 1 indicates an increase of 10 times the amount of …
   A. damage
   B. seismic waves
   C. ground motion
   D. fault movement

9. Volcanoes erupt when they become active. Until an eruption occurs, volcanoes are described as ...
   A. stagnant
   B. dormant
   C. extinct
   D. plugged

10. There are a number of volcanoes that border the pacific ocean. These volcanoes are known as the ***Ring of Fire.*** The name comes from the fact that these volcanoes erupt with red-hot lava, fire and steam. Most volcanoes in the Ring of fire occur at ...
   A. subduction zones
   B. abduction zones
   C. conduction zones
   D. compression zones

11. One of the most dangerous side effects of an erupting volcano is a ...
   A. hurricane
   B. tornado
   C. earthquake
   D. tsunami

12. Mt. St. Helens volcano in Washington was thought to be dormant, until it erupted suddenly and caused widespread damage. After the eruption, people who lived in Ontario and Quebec had to clean this off their cars because the prevailing wind carried it that far ...
   A. lava
   B. ash
   C. smoke
   D. volcanic rock

13. Volcanoes can cool temperatures around the world. Despite the hot temperatures and the destruction they can create at the source, the lowering of world temperatures following a volcanic eruption can be caused by ...
   A. a rapid lava flow into the ocean
   B. an ash plume causing mudflows
   C. an ash layer in the atmosphere
   D. a large number of tsunamis

14. A device that geologists use to measure minute changes in the angle of the ground's slope is called a …
   A. seismograph
   B. seismogram
   C. surveyor's level
   D. magmascope

15. Not very many volcanologists use this special suit to study molten lava up close, but those who do are able to get close enough to the magma flow to make observations, take measurements, or collect gas and lava samples. This special suit is coated with …
   A. reflective plastic
   B. fireproof insulation
   C. reflective metal
   D. flammable liquid

1.3 Incremental Changes: Wind, Water and Ice

1. Weathering is the process by which rocks are broken down by means of water, glacial ice, wind and waves. This process can in three ways. Which way described below is incorrect? …
   A. chemically
   B. mechanically
   C. gravitationally
   D. biologically

2. Tony found that when he poured water into a crack in a rock sample and froze it, then allowed it to thaw, the crack was actually wider. The type of weathering he investigated was classified as ...
   A. chemical
   B. biological
   C. mechanical
   D. gravitational

3. André tested the effects of water on the natural rock samples found in his schoolyard. He tested the rock samples with pure water (pH 6.8), rainwater (pH 4.5) and tap water (pH 6.7). The type of weathering he investigated was classified as ...
   A. chemical
   B. biological
   C. mechanical
   D. gravitational

4. On a field trip to the foothills, the class was amazed, when their teacher pointed out a tree growing in a rock. The roots of the tree had worked their way into the cracks and split the rock in many places. The type of weathering they observed was classified as ...
   A. chemical
   B. biological
   C. mechanical
   D. gravitational

5. The movement of materials from place to place is called …
   A. weathering
   B. deposition
   C. glaciation
   D. erosion

5. Landslides and rock slides can have devastating effects on the landscape. The Frank Slide is one such example. To study these, scientists are using new technology and sound waves. One of the major forces besides an earthquake responsible for these types of sudden changes is ...
   A. chinook winds
   B. frost wedging
   C. gravitational pull
   D. acidic rainwater

6. A science field trip included a stop at the 'Big Rock' in Okotoks. A receding glacier left behind this rock. It is called ...
   A. an erratic
   B. a moraine
   C. a striation
   D. an abrasion

7. Allison and Rachel were investigating the effects of landforms that have been created by the action of running water. They were told that the Alberta badlands are an example of this type of landform, called ...
   A. sediment
   B. fluvial
   C. bedrock
   D. striation

2.0 The Rock Cycle describes how rocks form and change over time

2.1 What are Rocks and Minerals?

Minerals In Rocks

The building blocks of rocks are naturally occurring materials, called minerals. Rocks contain naturally occurring, non-living minerals. Most minerals are rare and can be elements (pure substances) or compounds (combinations of pure substances). Minerals are not only found in rocks, but they are also found in your body.

- Iron and pyrite help the blood carry oxygen
- Kidneys produce crystals, called kidney stones
- Calcium and dolomite help regulate water in body cells
- Diamonds are used in surgery, razor blades, computers, dentistry, oil drilling and a glass-cutter's wheel has diamonds embedded in it.

Some rocks are made up of only one mineral, like limestone, while other have many different minerals like granite. There are more than 3500 different minerals. Five minerals combine in different ways to form the majority of rocks.

They are:

Prospecting For Wealth

Identifying rocks, besides being a hobby, is also big business. Canada is one of the world's leading producers of gold, copper, nickel, zinc, lead, silver, iron ore, asbestos, potash, sand gravel, and clay.
There are also diamonds mined in Canada.

Using Properties To Identify Rocks

The properties that can be used to identify minerals are:

- **Lustre:** this refers to the 'shininess' of the mineral (how light is reflected off the surface)
- **Colour:** colour can vary even within the same mineral, like corundum (it can be white, blue or red), depending on what other elements are present.
- **Streak:** a streak is the color, of the powdered form, of the mineral. (it can be made by scratching a porcelain tile)
- **Cleavage and Fracture:** is the way a mineral breaks apart. If it breaks along smooth, flat surfaces or planes, it has cleavage. If it breaks with rough or jagged edges, it has fracture.
- **Transparency:** it can be **transparent** (see through), **translucent** (shadowy), **opaque** (non-see through).
- Type of mineral/s present (viewed through a microscope)

Moh's Hardness Scale

The hardness of a mineral is measured by how easily it can be scratched. A harder mineral will leave a scratch on a softer mineral.

- Friedrich Mohs developed a scale of hardness with **10 values** in 1812 (see Figure 2.5 p. 372)
- Diamond is the hardest and talc is the softest (check the table to find out how hard common objects, like your fingernail)

2.2 Three classes of Rocks: Igneous, Sedimentary, and Metamorphic

Types of Rock
Rocks are classified into 3 major groups

Igneous Rock
Magma is melted rock found below the Earth's crust. When it flows onto the Earth's surface it is called **lava.** Igneous rock forms when hot **magma** cools and solidifies.
There are two different types of Igneous rock:

Intrusive
(cooled and hardened magma below the Earth's surface)

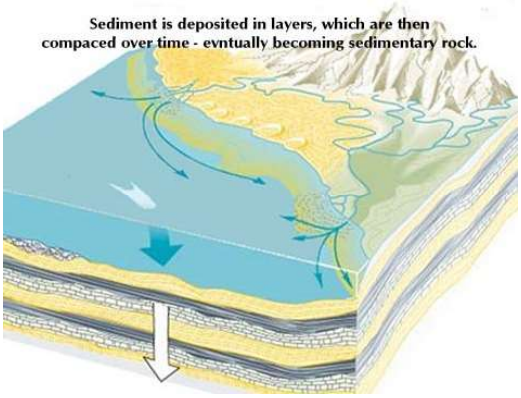

Pegmatite

Extrusive
(rock that forms when lava - magma released during a volcanic eruption - cools on the surface)


Basalt

Magma can contain crystals, their size depending on how quickly or slowly the rock cools (large crystals form when the rock cools slowly).

Sedimentary Rock
Sedimentary rock is formed from sediment (loose material - rock, minerals, plant and animal remains - that is layered and compacted together by the pressure of the material above it.
- stratification is the visible evidence of the layers
- cementation - some of the minerals that dissolve with the addition of water, makes a natural cement that glues the pieces of sediment together.



Types of sedimentary rock include:
-shale (formed from fine clay or mud)
-sandstone (sand, made of quartz)
-conglomerate (pebbles and small stones cemented together)
-limestone (organic sedimentary rock, containing fossils - plant and animal remains)
-organic sedimentary rock forms from living material that has been buried and is under pressure over thousands of years. (Coal is an example)

Metamorphic Rock
This type of rock has changed its form from what it was originally. It is formed below the Earth's surface by extreme pressure and heat
- the parent rock will become another type of rock depending on how much pressure and heat is used to change it. (example: shale → slate → schist)

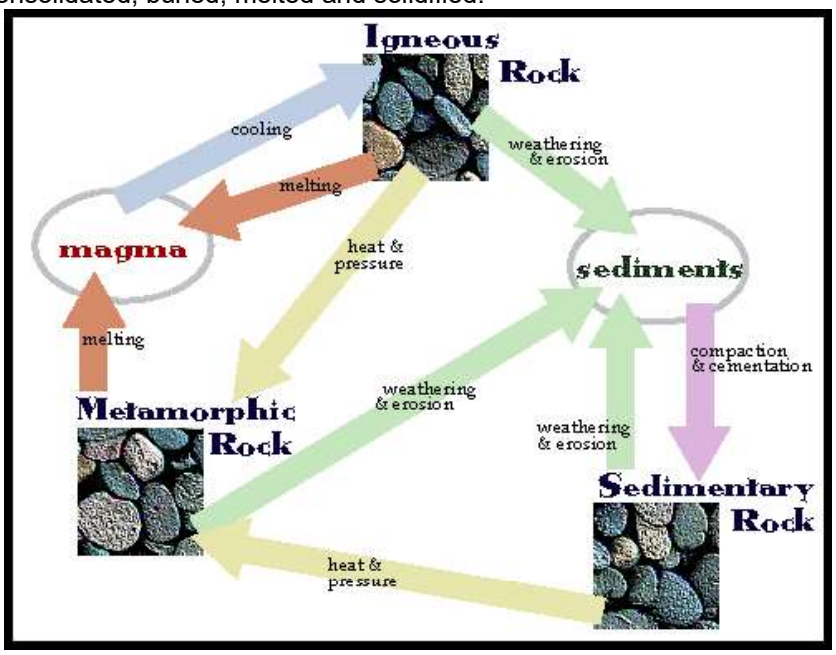
Identifying Classes of Rock
Scientists classify rocks into categories which have shared characteristics.

Geology Tools and Techniques
Remote Sensing – satellite mapping of the Earth's surface
Geophysical prospecting – sensitive instruments like the magnetometer detect minerals hidden deep beneath the surface of the Earth.
Geochemical prospecting – chemical analysis of core samples
Exploration – drilling with diamond-tipped drill bits

2.3 The Rock Cycle

http://www.cotf.edu/ete/modules/msese/earthsysflr/rock.html

Rocks are constantly changing. The Rock Cycle does not have a set order as they are weathered, consolidated, buried, melted and solidified.



Investigating The Rock Cycle

Soil formation is determined by climate, type of rock present, amount of water, organic material, air spaces, living organisms in the soil. It takes nearly 1000 years for 5mm of soil to form.

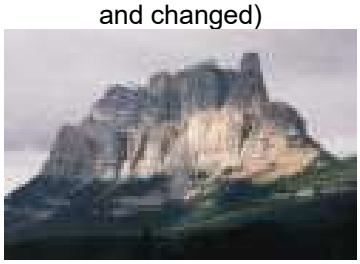
The Alberta Story: Investigating The Changing Earth

The rocks that make up Alberta were laid down in layers over hundreds of millions of years ago. The oldest layer, the **Precambrian Shield**, is at the bottom. This layer is made up of igneous and metamorphic rocks that were formed between 544 and 4500 million years ago. This layer of rock covers all of Alberta, but is only exposed in the upper northeastern part of the province. 87% of the Alberta landscape lies over the **Interior Plain**, which is sandwiched between the **Canadian Shield** and the **Rocky Mountains**. The Interior Plain has various layers of sedimentary rock that are between 544 million and 1.5 million years old.

Pelican Rapids
(where metamorphic rock is exposed)

Dinosaur Provincial Park
(where you can see sedimentary rock layers)

Rocky Mountains
(rocks that have been formed and changed)



Section 2 – The Rock Cycle describes how rocks form and change over time - Quiz

2.1 What are Rocks and Minerals

1. The building blocks of rocks are naturally occurring solid materials called …
   A. granules
   B. grains
   C. minerals
   D. crystals

2. Specific patterns such as cubic, tetragonal, hexagonal, orthohombic, monoclinic and triclinic describe how minerals line up in a regular pattern creating smooth surfaces and sharp edges, making systems of ...
   A. mineral hardness
   B. crystal structure
   C. cleavage types
   D. synthetic models

3. Minerals can be identified by certain clues. The clue that identifies the color of the powdered form of the mineral left behind when it is rubbed against a rough surface is called its ...
   A. streak
   B. lustre
   C. color
   D. cleavage

4. The way a mineral reflects light describes its …
   A. streak
   B. lustre
   C. color
   D. cleavage

5. The relative hardness of a mineral is measured with a scale. The scale is used to help identify different minerals, because each mineral will scratch all the minerals with a lower scale ranking than its own. Named after a German scientist, the scale is called...
   A. Newton's Force Scale
   B. Fahrenheit's Scale
   C. Mohs Hardness Scale
   D. Richter's Seismic Scale

6. On the scale of hardness, this mineral is the softest and can be scratched with a soft pencil point ...
   A. talc
   B. gypsum
   C. quartz
   D. diamond

7. There are over 500 mines and quarries scattered across Canada, with mining operations taking place in every province and territory. Canada is the world's largest exporter of minerals. The Ekati mine in Lac de Gras, Northwest Territories began operations in 1998. It was the first mine in Canada to recover this mineral …
   A. copper
   B. molybdenum
   C. silver
   D. diamond

2.2 Three Classes of Rocks: Igneous, Sedimentary and Metamorphic

1. Igneous rock, can be intrusive rock and extrusive rock. These rocks are all formed from ...
   A. crystals
   B. sediments
   C. magma or lava
   D. earth's crust

2. Igneous rock can be classified by how it is formed. If it has formed beneath the surface, cooling slowly, it has larger grains and is called …
   A. interior
   B. intrusive
   C. exterior
   D. extrusive

3. Allison and Rachel were investigating the banks of the river and discovered a large section had been eroded away. They could see layers of different soil types. These visible layers are called ...
   A. cementation
   B. sedimentation
   C. calcification
   D. stratification

4. Soil that has organic, living material, gets covered over and each layer puts pressure on the organic debris – compressing it into peat, lignite, bituminous and anthracite. The hardest type of coal …
   A. peat
   B. anthracite
   C. lignite
   D. bituminous

5. Metamorphic rock is rock that has changed form. It is usually formed ...
   A. below the earth's surface
   B. on the earth's surface
   C. when rock is heated
   D. when rock is cooled

6. Shale changes to slate and then changes to schist. To change these rocks into other types requires …
   A. time and technology
   B. time and sediments
   C. heat and pressure
   D. heat and temperature

7. Geologists identify mineral ores locations, which are hidden below the surface of the Earth, using different tools and technologies. Using sensitive instruments, such as a magnetometer, geologists are using this technique ...
   A. remote sensing
   B. geophysical prospecting
   C. geochemical prospecting
   D. exploration

2.3 The Rock Cycle

1. The formation of different types of rocks is described in the Rock Cycle. An important feature of this cycle is that it ...
   A. always forms rocks the same way
   B. cannot be reversed
   C. does not have a set order
   D. doesn't have any shortcuts or detours

2. The rocks and minerals that cover the first 50 meters or so of the Earth's surface include sand, gravel, stones, and boulders. This material is called …
   A. underburden
   B. overburden
   C. shield cover
   D. common rock cover

3. Pelican rapids in the northeastern part of Alberta reveal rocks that are from the oldest rock layer (hundreds of millions of years) that make up Alberta. Most of these types of rocks are hidden beneath the surface in Alberta, however, they are revealed in Pelican Rapids …
   A. igneous
   B. magma
   C. sedimentary
   D. metamorphic

4. You will likely find dramatic examples of these types of rocks in *The Badlands* of Dinosaur Provincial Park, around Drumheller. The erosion and exposure of this type of rock took many years to complete.
   A. igneous
   B. magma
   C. sedimentary
   D. metamorphic

3.0 Landforms provide evidence of change

3.1 Continental Drift

Continents On The Move

Alfred Wegener collected evidence to explain the various shapes of the continents and how they were all together at one time. Along with the fossils, climate similarities, and the interlocking shapes of the continents, Wegener concluded that the continents were joined together as one supercontinent – **PANGAEA**. His explanation is called the **Theory of Continental Drift.**

Pangaea: The supercontinent 200 million years ago

The land masses after 65 million years of drift

The continents today and 50 million years from now

Biological Evidence

- fossil evidence was found on different continents, like Mesosaurus, Kannemeyerid, Lystrosaurus and Glossopteris.

Evidence from Rocks

Mountain ranges were also compared:

- the Appalacian in North America and the range in Britain and Norway were made of the same kind and age of rock
- Trilobites in the Himalayas suggested that India was once part of Antarctica, which broke off and collided with Eurasia, putting the fossils of trilobites, from the bottom of the sea, high into the Himalayans.

Geological Evidence of Climate

- coal provided more evidence, because in order for it to form, a rich tropical plant environment must have been present - coal is found in moderate to cold climates
- evidence of even greater climatic changes were found in places likely covered by glaciers (these places are now far too warm to support the presence of glaciers), this suggested that the continents may have once been part of the south pole.

Response to Wegener

After his findings were published, in a book called **The Origin of the Continents and Oceans**, Wegener's ideas were rejected. The scientific community did not agree with his assumptions and explanation that the moon might be responsible for the movement of the continents. After his death, advances in new technology and the work of a Canadian Scientist led to a new theory that explained Wegener's observations.

3.2 Plate Tectonics

Developing A New Theory

A unifying theory is one which explains several different natural events and landforms (volcanoes, earthquakes and mountains). Advances in New Technology helped explain Wegener's observations;

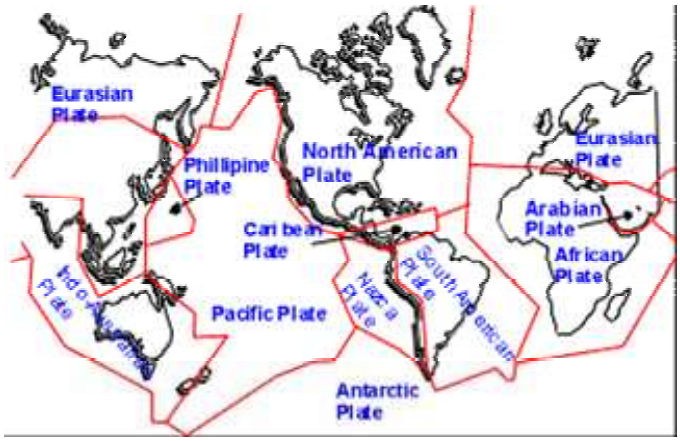
- *sonar* (sound wave technology) identified the **Mid-Atlantic Ridge.**
- Igneous rock contains **magnetite**, which lines itself with the Earth's magnetic field, as the rock hardens on the surface, the mineral particles maintain their alignment with the magnetic field, indicating that the reversal strips must have formed at a different time. M*agnetometers* (electronic instruments that detect the direction and strength of a magnetic field) the magnetic field in the Atlantic sometimes pointed south, instead of north (these were called reversal strips).
- *Submersibles* are small submarines that enable divers to go deeper, protecting them from the pressure of the water
- *satellites and lasers* are used to measure incremental change (change that happens slowly) in plate movements

Interpreting the Patterns

The pattern of magnetic reversal strips along the **Mid-Atlantic Ridge** meant the sea floor was spreading, leading to the **Theory of Sea Floor Spreading**. (as new rock forms, it takes on the magnetic polarity of the Earth at the time of formation). The ocean floor is moving deep into the trenches along the continental boundaries. Confirmation of the theory of sea floor spreading was provided by the ship, Glomar Challenger, which brought drill samples up from the ocean floor (younger rock was closer to the ridge and older rock was closer to the continents). Most earthquakes and volcanoes are concentrated in specific areas, and there are places where no earthquakes or volcanoes occur.

The Theory of Plate Tectonics

All the evidence collected indicates that the Earth's crust is broken up into plates, which are moving on the Earth's mantle. The new theory is called the **Theory of Plate Tectonics**. Plates pushing together are called *converging plates*, whereas plates pulling apart are called *diverging plates*.



J Tuzo Wilson (a Canadian Scientist) helped form this new theory, by suggesting the plates slide past each other. This type of movement is seen at a *transform boundary*.

To see Animations of Plate Tectonics – from the US Geological Survey, visit the link below, or type the address in your browser.

http://www2.nature.nps.gov/geology/usgsnps/animate/pltecan.html

Convection Currents

A convection current is the circular flow within a fluid that is caused by the rising of warmer particles and sinking of cooler particles. Scientists believe it is this action, within the mantle, which is causing the plates to move. The plates that collide, or converge have one plate above and the other below (these places are called *subduction zones*). Subduction zones occur where the convection currents, in the mantle, cool and sink.

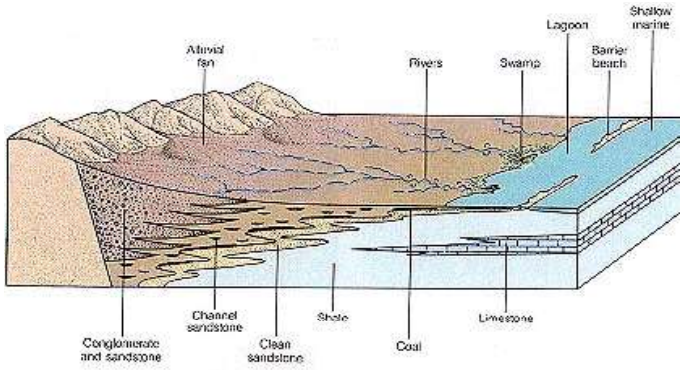
3.3 Mountain Building

What Is Mountain Building?

A mountain is part of the Earth's surface that is much higher than the land around it. A mountain range is a series of mountains (*Cordillera* is Spanish for mountain range).. The *Rocky Mountains* extend from the Yukon in the far North, between British Columbia and Alberta, through the western United States and into Mexico – making it one of the longest mountain ranges in the world. Mountain building takes many years. Most mountains are large areas that have uplifted due to the movement (converging, diverging or sliding) or heating of tectonic plates, where the build up of heat and pressure can cause folding and faulting.

Building The Mountains: An Alberta Story

%00 million years ago Alberta had a tropical climate, and it was bordered by a shallow sea (where British Columbia is now). The shallow sea was constantly being filled with sediments. The layers were 10-15kms thick.



After more than a billion years of sediment buildup the collision of two plates happened. The North American Plate and the Pacific Plate met. The Pacific Plate was forced down and the North American Plate rode above it. But the force and pressure of the collision cause the edge of the North American Plate to fold and break and some of the parts were pushed up and over each other, creating the Rocky Mountains. The Rocky Mountains are complex mountains.

The Structure and Development of Fold and Fault Mountains

Sedimentary rock under slow, gradual pressure can fold (bend like plastic because they are made soft by the heat) or break - and can be changed to metamorphic rock in the process. The upward, or top part of folded rock is called anticline, the bottom is called syncline. Rock that is too brittle to fold under heat and pressure, will break, called *thrust faulting*. When older rock ends up on top of younger rock as a result of thrust faulting, the result is the formation of fault block mountains. Movement of rock along a fault can be vertical or horizontal and can be traced by the location of the 'basement rock' on both sides of the fault.

Where Does The Folding Happen?

Heat and pressure soften and force rocks to fold and break. Mountains that are jagged at the top are 'young' mountains, while those that are more rounded (due to erosion and weathering) are 'old' mountains. The Himalayas are the youngest mountain range with the highest mountains (and still growing) mountains, such as Mount Everest. It rises about 1cm each year.

Mountains With Faults

Subduction of the Juan de Fuca plate (off the west coast of North America) has caused folding, faulting and uplifting, and magma has created volcanoes. The place wher the crack or break occurs is called the fault and is often below the surface of the Earth. Some faults are visible in layered rock that has been uplifted.

Section 3 – Landforms provide evidence of change - Quiz

3.1 Continental Drift

1. Alfred Wegner determined that the continents at one time all fit together to form one large supercontinent, called Pangaea. Their interlocking shapes and other evidence helped him form the Theory of Continental Drift. The other evidence included all of the following, **except** ...
   A. Glossopteris fossils
   B. Folded mountains
   C. Glacial deposits
   D. Gold deposits

2. Glaciers once existed in the southern hemisphere. The evidence Wegener found to prove this were the ...
   A. morraines found
   B. erratics found
   C. bedrock abrasions
   D. ice caves

3. The science community rejected Wegener's idea because they believed that mountains formed when the crust wrinkled like the skin of a dried-up ...
   A. apple
   B. pear
   C. grape
   D. orange

3.2 Plate Tectonics

1. The ocean floor has been mapped out in detail and provided interesting patterns. Scientists noted that volcanoes and earthquakes tended to occur in the …
   A. deep trenches of the ocean
   B. vast plains of the ocean floor
   C. same areas around the word
   D. continents that fit together

2. Mountain ranges were discovered along the ocean floor. These mountain ranges are called …
   A. trenches
   B. ridges
   C. pillow lava
   D. abyss

3. Because rock is moving away from the mountain ranges found along the mid-Atlantic ridge, new rock is being formed. This sea-floor spreading indicates that rock nearest the continents is …
   A. older
   B. younger
   C. softer
   D. harder

4. The place where tectonic plates meet is called a …
   A. transform
   B. convergence
   C. boundary
   D. divergence

5. A place where two tectonic plates slide past each other is called a …
   A. transform boundary
   B. diverging boundary
   C. converging boundary
   D. subduction boundary

3.3 Mountain Building

1. A converging boundary can happen where two continental plates are crushing together and the edges are being pushed up. The highest mountain range in the world developing in this way is the ..
   A. Alps
   B. Rockies
   C. Appalachians
   D. Himalayans

2. Over 500 million years ago Alberta was tropical and the border with British Columbia was …
   A. a mountain range
   B. a shallow sea
   C. an underwater trench
   D. a fluvial landform

3. Mountain formations that undergo more than one process are called ...
   A. complex
   B. compound
   C. multi-faulted
   D. transform

4. The collision of the North American Plate and the Pacific Plate caused the Pacific plate to slip under the North American Plate. At the same time, the force of the collision caused the North American plate to …
   A. slip and slide
   B. fold and break
   C. fold and separate
   D. Bend and compress

5. When older rock ends up on top of younger rock the mountains formed are called ...
   A. thrust mountains
   B. fault mountains
   C. block mountains
   D. fault block mountains

6. This factor might be the best way to determine the age of a mountain.
   A. kinds of rocks
   B. type of fault
   C. shape of peak
   D. difference between syncline and anticline

7. The downfold in the rock that is folded when pressure is placed on it is called …
   A. compression
   B. Fault block
   C. anitcline
   D. syncline

4.0 The fossil record provides evidence of Earth's changes over time.

4.1 Tracing Evidence of Geological Change Using Fossils

Fossils are preserved impressions in rock that tell us when, where, and how living organisms lived and behaved millions of years ago. The word fossil means '*dug out of the ground*'. The majority of fossils are found in exposed sedimentary rock. The most common types of fossil rocks are limestone, sandstone and shale.

Fossils

Paleontologists are scientists who study early life forms by interpreting plant and animal fossils. After carefully removing the fossils from the rock they are studied and interpreted. Most fossils are fragments or parts of skeletons, shells or other animal traces. The inferences made suggest that life on Earth has changed a great deal over the past million of years. Fossils found in younger rocks are much like the organisms living today. Older rocks contain fossils of organisms that are extinct (no longer existing).

The trilobite, that lived on the ocean floor over 300 million years ago, is an example of an extinct organism, that we have only seen as a fossil.

An animal dies and falls to the seafloor. It gets covered by sediment. The body dissolves, leaving a **mould**, which is then filled with more sediment and hardens into rock, making a **cast** of the original animal.

Becoming A Fossil

Remains of dead *plants and animals* that have been protected from scavengers can become fossilized in a number of ways:

- **petrified** (rock-like) fossils preserve the bones of dead animals by using silica
- an outline or **impression** from the carbon residue on rock surfaces can provide **a carbonaceous film**
- **original remains** may be preserved in tar, amber or peat bogs
- **trace fossils** are evidence of animal activity, like worm holes, footprints, and burrows

Dinosaur Provincial Park is a world UNESCO Heritage site, where over 36 species of *Dinosaur* have be found;

- *Albertosaurus*, found in Dinosaur Provincial Park is a relative of Tyrannosaurus Rex.
- *Oviraptor* (when a clutch of eggs were found with a fossil of this dinosaur, it was thought it was a scavenger, but further evidence indicates it was likely an overprotective parent)
- *Bambiraptor*, a dinosaur, found by a 14 year old boy in Glacier National Park, may help to provide the link between birds and dinosaurs

Nearby, **Burgess Shale** in B.C. is also renowned because of the rich deposits of fossilized marine animal soft-body parts, such as;

- *Trilobites*, which date back before the dinosaurs roamed the Earth
- *Ammonites* are common fossils found in Alberta

Telling Time Geologically

Layers of sediment formed over millions of years are called **strata**. By studying strata, paleontologists and geologists interpret the strata formations to learn about the environment of long ago. If a sediment layer is thick, the climate was stable. When a new layer appears in the strata, a change occurred. Paleontologists use particular fossils to identify certain time periods. These are known as **index fossils**.

4.2 Methods Used to Interpret Fossils

The fossil record in rocks indicates a sequence of different life forms appearing at different times. Single celled life forms appeared before multi-celled life forms, plants before animals, and invertebrates before vertebrates. Older rocks show more diversity than there is today.
The ability to reconstruct fossils based on knowledge of current living things is an important part of understanding the history of our planet. With only fragments and pieces, scientists must try to fill in the missing gaps - through inferences and educated guesses.

 Insect preserved in a piece of **amber** (fossilized tree sap). Remember Jurassic Park!

Studying Sedimentary Layers Of Rock

The principle of **superposition** states that in undisturbed layers of rock, the oldest layers are always on the bottom and the youngest layers are always on the top. Knowing this, geologists can study layers in places where many layers are exposed, like the Grand Canyon and Dinosaur Provincial Park. Geologists use a technique called **relative dating**, to find the order in which events occurred. The relative age of the rock is determined by its position within the strata. Fossils found in a layer can help to identify the age of the rock.

Fossil Beds

The *Burgess Shale Community* is a diorama that illustrates the type of community that lived there, and *Dinosaur Provincial Park* is a great place to see the community of dinosaurs.

The Royal Tyrell Museum

The Royal Tyrell Museum of Paleontology, is located in Dinosaur Provincial Park, in the Badlands of Drumheller, Alberta.
It was named after Joseph Burr Tyrell, a geologist with the Geological Survey of Canada. Back in 1884 Joseph Burr Tyrrell discovered the skull of Albertosaurus near Drumheller, Alberta. His find sparked international interest among paleontologists, and the area has attracted dinosaur hunters ever since.

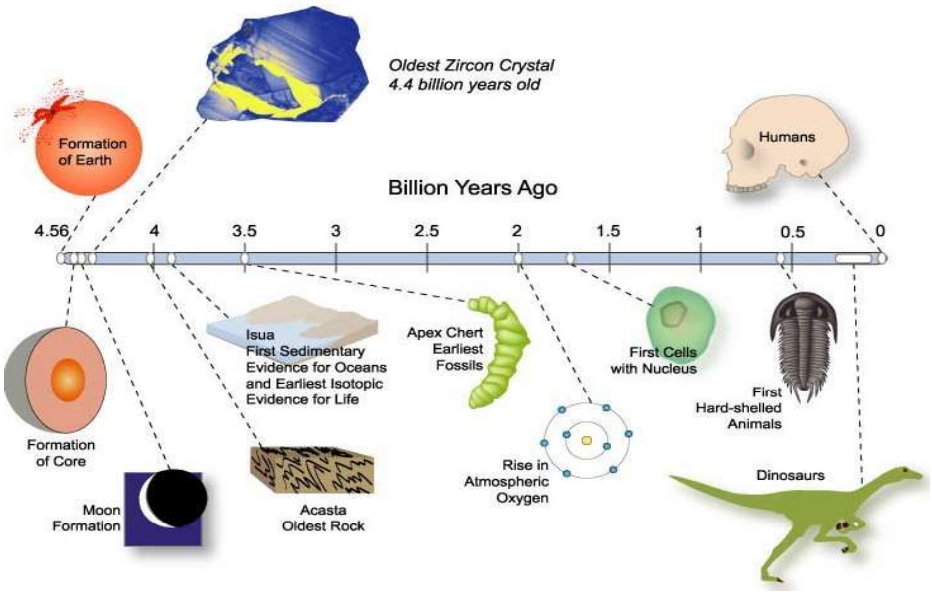



The Tyrrell Museum of Paleontology opened in 1985 to instant acclaim, and in 1990, Queen Elizabeth granted it "Royal" status. The museum has 35 complete dinosaur skeletons on display, and more than 200 dinosaur remains, the largest such collection in the world.

Find out more about the history of finding Dinosaur bones at:
http://www.arches.uga.edu/~rfreeman/GEOL3350_'4HistoryDinoSt.htm

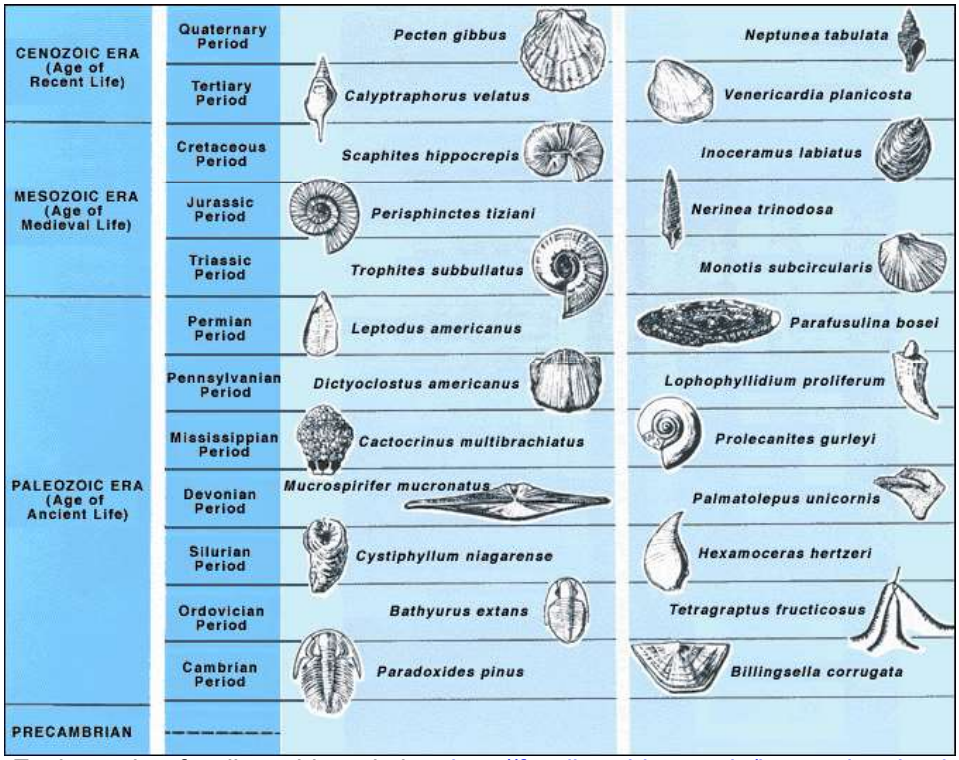
4.3 Geological Time

Looking Back Into Time



All that science knows about the ancient past, it has gathered from the fossil records. Fossils found in a particular layer can help to identify the age of the rock. If the fossil was on the Earth for a short time and widespread then it is called an **index fossil**.

A chart of Index Fossils



Explore other fossils at this website: http://fossils.valdosta.edu/home_time.html

Geologic Time Scale

Geologists use this knowledge to organize the Earth's history into geologic time intervals. These intervals are called **eras**, and are based on the principle of superposition. The geological time scale is a division of Earth's history into smaller units based on the appearances of different life forms.

The largest divisions are called eons, which are divided into eras and then further divided into periods.

Check out ***Figure 4.17*** in your Science In Action 7 Textbook. Page 421

EON	ERA	PERIOD	MILLIONS OF YEARS AGO
Phanerozoic	Cenozoic	Quaternary	1.6
		Tertiary	66
	Mesozoic	Cretaceous	138
		Jurassic	205
		Triassic	240
	Paleozoic	Permian	290
		Pennsylvanian	330
		Mississippian	360
		Devonian	410
		Silurian	435
		Ordovician	500
		Cambrian	570
Proterozoic	Late Proterozoic Middle Proterozoic Early Proterozoic		2500
Archean	Late Archean Middle Archean Early Archean		3800?
Pre-Archean			

Relative age of rock is determined by its position within the strata. To determine the age of rock geologists use a technique called **relative dating.** Over billions of years, some elements will change into other elements - uranium is such an element - in 4.5 billion years, half of the uranium will change into lead (which will not change). The uranium is called the parent element. This time period is called the half-life of uranium. By measuring the amounts of change in a sample, scientist can calculate the absolute age of the rock. This is called **Radiometric Dating.** http://pubs.usgs.gov/gip/geotime/radiometric.html Scientists also use a process called **radiocarbon dating** (which uses carbon-14, a rare form of carbon, as its parent material) http://www.cs.colorado.edu/~lindsay/creation/carbon.html

Understanding Fossil Evidence

Fossils are the only evidence scientists have of early life forms. Paleontolgists use these fossils to develop theories and models of what they think prehistoric life looked like and what interactions took place. Because fossils are rare, assumptions are made based on the fragments of information they are able to gather.

Reconstructing the fragments into a full-size animal or plant takes skill and inferences based on knowledge of modern plant and animal anatomy. Creating a life-like replica requires careful study of the evidence and a little imagination.

Skull fragment

Allosaurus Cast

Life-like Replica

Section 4 – The fossil record provides evidence of Earth's changes over time - Quiz

4.1 Tracing Evidence of Geologic Change Using Fossils

1. The preserved remains (even the soft parts) of a plant or animal can likely be found in ...
   A. amber
   B. sediment
   C. gemstones
   D. Burgess Shale

2. Trilobites are one of the most famous groups of fossils. They are now extinct. They lived in ...
   A. Gobi Desert
   B. Antarctic Tundra
   C. Fresh water lakes
   D. Warm ocean water

3. Scientists who study early life forms by interpreting animal and plant fossils are called …
   A. geologists
   B. geophysicists
   C. paleontologists
   D. archaeologists

4. When an organism is buried under many layers of sediment, pressure and heat build up, leaving a thin film of carbon residue on the rock surfaces. This residue forms the outline of the organism and is called ...
   A. petrified residue
   B. carbonaceous film
   C. carbon-dated remains
   D. trace fossil residue

5. When an organism falls into soft sediment, like mud, its hard parts dissolve leaving a cavity called a ...
   A. trace layer
   B. cast
   C. mould
   D. chamber

6. There is more than one way for living organisms to become fossilized. A cavity or track that was left behind by a living organism – providing evidence that it existed, is a type of fossil called a …
   A. cavity fossil
   B. evidence fossil
   C. trace fossil
   D. track fossil

7. The process that takes thousands of years and can only happen under certain conditions is called fossilization. The most common fossils found are …
   A. plants
   B. worms
   C. jellyfish
   D. vertebrates

8. Over time layers upon layers of sediment build up , providing important information about the past. These layers called strata revel certain fossils that lived in certain time periods. These fossils are known as …
   A. trace fossils
   B. index fossils
   C. amber fossils
   D. cast fossils

4.2 Methods Used to Interpret Fossils

1. Geological columns are formations in sedimentary rock that help scientists to determine the age of the fossils they find. Fossils found in column 7 will be …
   A. older than those found in 2 and 8
   B. younger than those found in 10 and 6
   C. older than those found in 4 and 3
   D. younger than those found in 2 and 9

2. Scientists have found organisms intact in this type of fossil and have even been able to extract DNA from the organism, with limited success ...
   A. shale
   B. amber
   C. trilobite
   D. albertosaurus

3. Layers of sedimentary rock stay in their original position, with the newest layers on the top and the older layers on the bottom. These layers of rock are called ...
   A. indexing
   B. parent rock
   C. rock strata
   D. superimposed

4. The preserved remains of many soft tissue species have been located in the Burgess Shale Fossil Beds, located in Yoho National Park, British Columbia. These fossils are usually the remains of …
   A. producers and herbivores
   B. herbivores and consumers
   C. consumers and decomposers
   D. decomposers and scavengers

5. An important dinosaur discovery by Joseph Tyrell sparked interest in the Badlands of Drumheller. The Royal Tyrell Museum of Paleontology was built for the 70-million-year-old dinosaur skull he named …
   A. Albertosaurus
   B. Tyrannosaurus Rex
   C. Apatosaurus
   D. Brachiosaurus

4.3 Geologic Time

1. The general time periods that organize the history of the Earth are called ...
   A. eras
   B. periods
   C. years
   D. centuries

2. In the Geologic Time Scale, dinosaurs ruled the land and then became extinct during this era.
   A. Precambrian
   B. Paleozoic
   C. Mesozoic
   D. Cenozoic

3. Scientists have inferred that there might be some relationship between dinosaurs and birds from some of the Archaeopteryx fossils they discovered a few impressions of feathers
   A. wings
   B. feathers
   C. webbed feet
   D. hollow bones

REVIEW … Key Concepts

Unit 5 – Planet Earth

1.0 Changes on the Earth's Surface

- Layers: **Crust**, **Mantle**, **Core** (Inner and Outer)
- **Earthquakes** and **Volcanoes** can suddenly change the Earth's surface
- Scientist's use a variety of tools and technologies to investigate the Earth's forces
- Wind, water and ice change the Earth's surface slowly

2.0 Rock Cycle

- Rocks are composed of minerals and have distinctive characteristics
- Three classes include: **igneous**, **metamorphic** and **sedimentary**
- Breaking down and transforming rock is explained in the **rock cycle**
- Sedimentary rocks are the most common found in Alberta

3.0 Landforms change

- The **Theory of Plate Tectonics** describes the huge chunks of rock called plates that move on the Earth's surface
- Continents and Ocean floors are carried on the plates which are moving on the partly melted mantle
- The collisions and rubbing together of these plates forms the mountains

4.0 Fossils – Evidence of Earth's Changes over Time

- **Fossils** are living or non-living things preserved in stone
- Fossil evidence is interpreted and conclusions are based mostly on inferences because the fossil remains are incomplete
- **Geological Time** divides the history of the Earth into four periods, called **Eras.**
- Determining what animals and plants looked like from fossil records is often based on inferences

1.0 Changes on the Earth's Surface

❖ Layers: **Crust**, **Mantle**, **Core** (Inner and Outer)

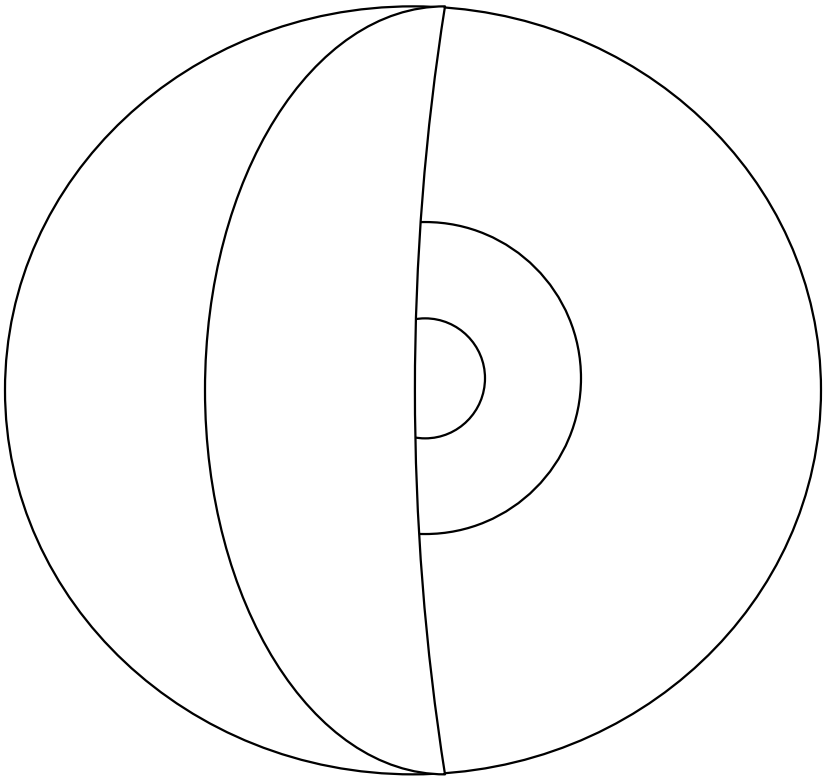
What is a **model** and when is it useful? _____

_____

Who are **geologists**? _____

_____

Illustrate, label and color the different **layers of the Earth**

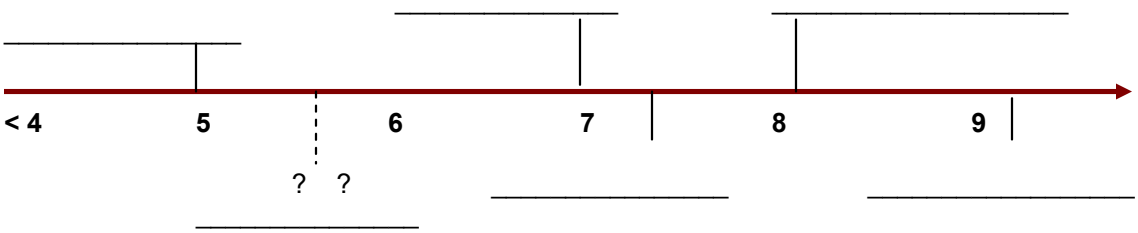


Facts about the Earth's different layers

	Thickness	State	Characteristic Features
Crust			
Mantle			
Outer Core			
Inner Core			

❖ **Earthquakes** and **Volcanoes** can suddenly change the Earth's surface

Complete the list of major **Canadian Earthquakes** in order of their magnitude (highest to lowest)



Illustrate and describe what happens during an earthquake.

What is the difference between an **epicenter** and a **focus** in an earthquake?

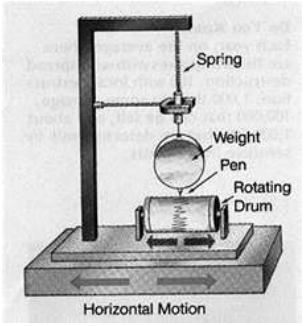
How are earthquakes measured?

Illustrate and identify the ***process*** that happens during a **volcanic eruption**.

❖ Scientist's use a variety of tools and technologies to investigate the Earth's forces

Identify the following **tools and techniques** that are used by scientists who study volcanoes (volcanologists).

_____ _____ _____



❖ Wind, water and ice change the Earth's surface slowly

Describe and give examples of three different kinds of **weathering**.

Type	Description	Examples

What is the difference between **weathering** and **erosion**?

What is **deposition** and **sedimentation**?

Describe a **fluvial landform**.

_____

_____

_____

What developments led to the **landslide** (mudslide) in Vancouver – in January 2005?

_____

_____

_____

Identify the **glacial features** created - by glacial movement - using the descriptions given

A large boulder that is left behind when a glacier melts or recedes.

Small hill formed by a receding glacier.

Piles of rocks and boulders that are left behind in pits or groupings when a glacier melts

Scrapings left behind in bedrock from the action of an advancing or retreating glacier.

A hollow area that traps a large chunk of a glacier when it melts.

A snake-like hill filled with eroded rock fragments and soil, that is left behind when a glacier melts or retreats

Identify the different forces that act to shape the surface of the Earth by the speed of their action.

Gradual Transformation of the Landscape	Sudden Change in the Earth's surface

2.0 Rock Cycle

❖ Rocks are composed of minerals and have distinctive characteristics

Minerals are pure, naturally occurring solid materials forming the building blocks of rocks. The majority of rocks are made from combinations of five different minerals found in the Earth's crust. Identify these five minerals by their properties.

Properties	Quartz	Calcite	Feldspar	Mica	Hornblende
Color					
Lustre					
Streak					
Cleavage					
Fracture					
Hardness					

Use a relative description to identify the hardness of a mineral, referred to by Moh's Hardness Scale

Moh's Hardness Scale	**Description of the how hard a mineral is …**
1	*very easily scratched with a fingernail*
2	
3	
4	
5	
6	
7	
8	
9	*cuts glass and scratches a steel file*
10	

❖ Three classes include: **igneous**, **metamorphic** and **sedimentary**

Describe how each type of rock is formed

Igneous (intrusive) _____

_____

_____

Igneous (extrusive) _____

_____

_____

Sedimentary _____

_____

_____

Metamorphic _____

_____

_____

Describe the **high-tech tools** used by geologists to find minerals in the Earth's crust

Remote Sensing _____

_____

Geophysical Prospecting _____

_____

Geochemical Prospecting _____

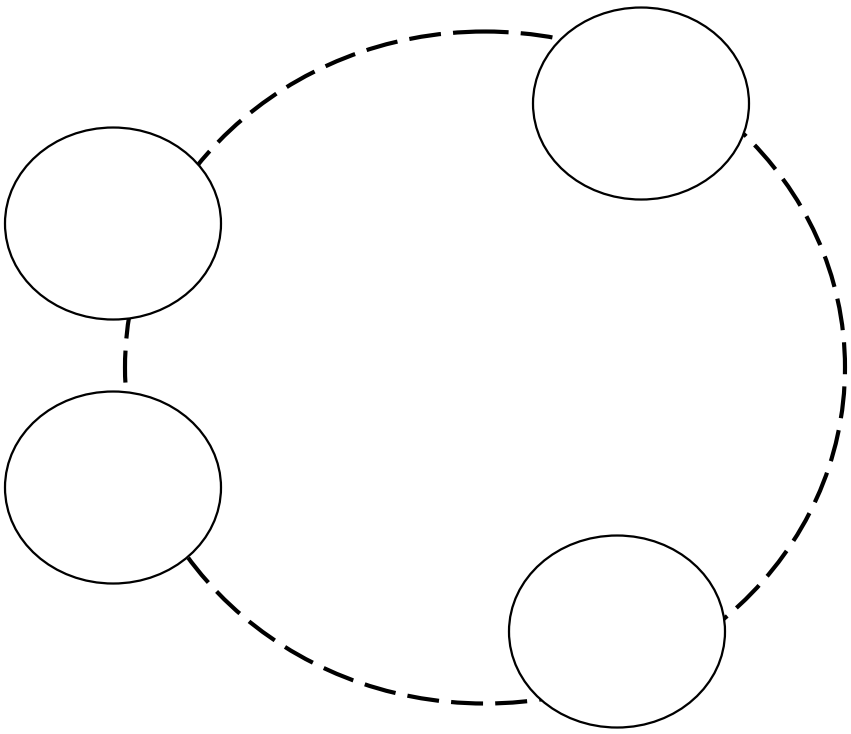
_____

Exploration _____

_____

❖ Breaking down and transforming rock is explained in the **rock cycle**

Illustrate and label the rock cycle and the processes that occur within it.



❖ Sedimentary rocks are the most common found in Alberta

What is below the ***overburden*** in Alberta?

_____

_____

_____

What does this picture tell you about the types of rocks found here.

_____

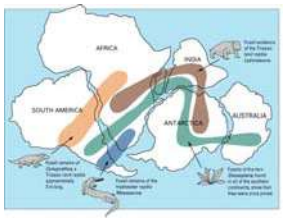
_____

3.0 Landforms change

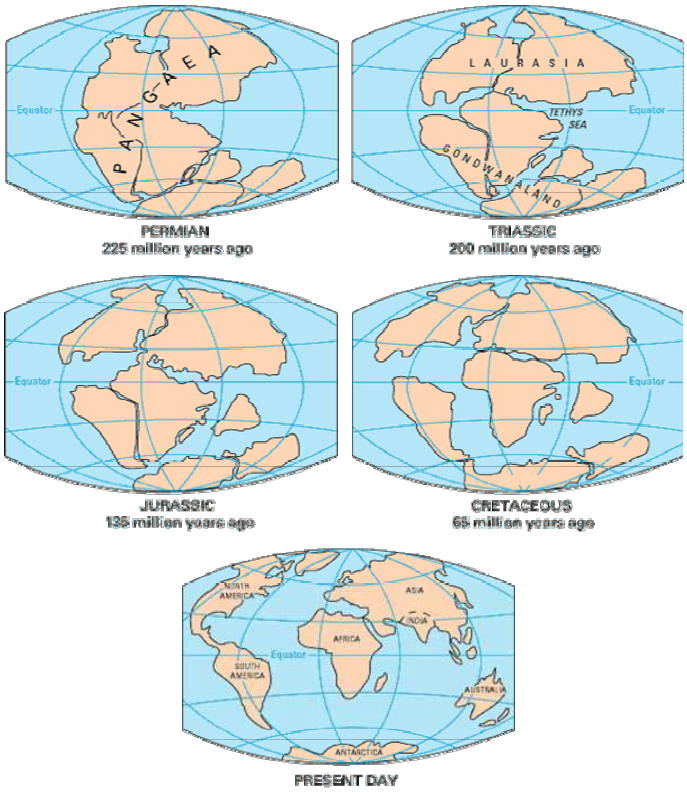
Briefly describe what
Alfred Wegener

tried to prove in his
Theory of Continental Drift.
Include reference to the evidence he collected to prove his theory:

- Fossils



- Mountains
- Glaciers
- Coal



_____

_____

_____

_____

_____

_____

- The **Theory of Plate Tectonics** describes the huge chunks of rock called plates that move on the Earth's surface. Animation: http://www.ucmp.berkeley.edu/geology/anim1.html

What technologies helped to prove Wegener's theory about Continental Drift, and laid the framework for the new **Theory of Plate Tectonics**?

_____ _____

_____ _____

Illustrate what is happening along the Mid-Atlantic ridge that has helped scientists develop this theory of plate tectonics (moving plates).

❖ Continents and Ocean floors are carried on the plates which are moving on the partly melted mantle

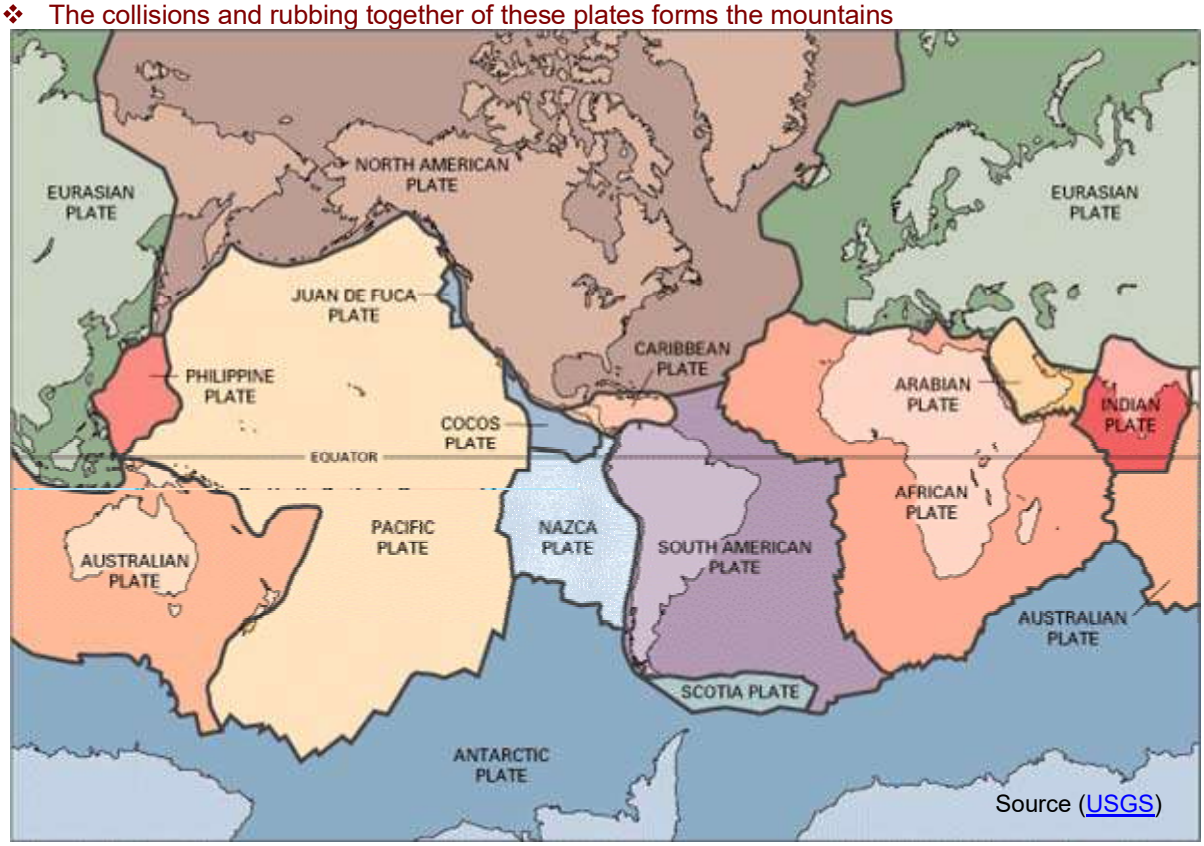
Illustrate the different types of plate boundaries showing how they interact with each other.

Diverging Boundaries

	Subduction	**Collision** (up and over)
Converging Boundaries		

Transform Boundaries

❖ The collisions and rubbing together of these plates forms the mountains



Using your knowledge of plate tectonics, describe the various types of mountains formed on the Earth's surface.

Folded Mountains _____

_____

_____

Thrust Fault Mountains _____

_____

_____

Fault Block Mountains _____

_____

_____

4.0 Fossils – Evidence of Earth's Changes over Time

❖ **Fossils** are living or non-living things preserved in stone

How are fossils formed?

_____

_____

_____

Briefly describe and illustrate (sketch) 4 different types (classifications) of fossils found by paleontologists.

Sketch	Type of Fossil	Description
	_____	_____
		_____
	_____	_____
		_____
	_____	_____
		_____
	_____	_____
		_____

❖ Fossil evidence is interpreted and conclusions are based mostly on inferences because the fossil remains are incomplete

Describe how scientists are able to reconstruct plants and animals from millions of years ago and show the environmental interactions that were going on at that time, just from fragments of evidence.

_____

_____

_____

_____

_____

_____

Explain the significance of the following fossil discoveries …

Burgess Shale _____

_____

_____

_____

Albertosaurus _____

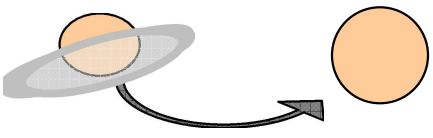
_____

_____

_____

❖ **Geological Time** explains the history of the Earth

Complete the Illustration that shows the evolution of the Earth



Use the **Geological Timeline** to illustrate and list important developments in different **ERAS**

Present day

❖ *First human-like species (about 2-3 million years ago)* 

Cenozoic

65 m

Mesozoic

225 m

Paleozoic

600 m

Precambrian

4600 m

❖ *First simple organisms (bacteria)* 

❖ *formation of the earth* 

❖ Determining what animals and plants looked like from fossil records

What do scientists rely on to recreate the past from fragments of fossils found in rock?

_____

_____

_____

Planet Earth Unit Test

Section 1 – Earth's surface undergoes gradual and sudden changes

1. Scientists estimate the age of the Earth to be about 4.6 billion years old, using evidence and theories. Then they construct a model of what the Earth is composed of. A model is based on what is …
   A. known
   B. inferred
   C. observed
   D. proven

2. The core of the Earth is made up of two layers. The inner core, which is made up of nickel and iron reaching temperatures of **7000^{o}C**, because of the pressure of the other layers on this inner core, it is …
   A. molten
   B. liquid
   C. solid
   D. crystal

3. Which of the following foods would you use to model what the Earth is made of …
   A. pear
   B. apple
   C. peach
   D. banana

4. It is likely that San Diego would be able to get early warnings of possible earthquakes in the area because of this attraction ...
   A. San Diego Zoo
   B. San Diego Emergency Center
   C. San Diego Observatory
   D. Pacific Climatology Center

5. The source of an earthquake can be determined by recording the interval time between the p waves and s waves. The first place that rocks break below the surface in an earthquake is called the ...
   A. focus
   B. fault line
   C. epicenter
   D. shadow zone

6. In 1935 Charles Richter developed a scale that helped geologists understand about the strength or magnitude (intensity) of an earthquake. The scale he developed starts at 0 and each increase of 1 indicates an increase of 10 times the amount of …
   A. damage
   B. seismic waves
   C. ground motion
   D. fault movement

7. Volcanoes erupt when they become active. Until an eruption occurs, volcanoes are described as ...
   A. stagnant
   B. dormant
   C. extinct
   D. plugged

8. One of the most dangerous side effects of an erupting volcano is a ...
   A. hurricane
   B. tornado
   C. earthquake
   D. tsunami

9. A device that geologists use to measure minute changes in the angle of the ground's slope is called a …
   A. seismograph
   B. seismogram
   C. surveyor's level
   D. magmascope

10. Not very many volcanologists use this special suit to study molten lava up close, but those who do are able to get close enough to the magma flow to make observations, take measurements, or collect gas and lava samples. This special suit is coated with …
   A. reflective plastic
   B. fireproof insulation
   C. reflective metal
   D. flammable liquid

11. André tested the effects of water on the natural rock samples found in his schoolyard. He tested the rock samples with pure water (pH 6.8), rainwater (pH 4.5) and tap water (pH 6.7). The type of weathering he investigated was classified as ...
   A. chemical
   B. biological
   C. mechanical
   D. gravitational

12.	The movement of materials from place to place is called …	13.	A science field trip included a stop at the 'Big Rock' in Okotoks. A receding glacier left behind this rock. It is called ...
A.	**weathering**	**A.**	**an erratic**
B.	**deposition**	**B.**	**a moraine**
C.	**glaciation**	**C.**	**a striation**
D.	**erosion**	**D.**	**an abrasion**

14. Allison and Rachel were investigating the effects of landforms that have been created by the action of running water. They were told that the Alberta badlands are an example of this type of landform, called ...
   A. sediment
   B. fluvial
   C. bedrock
   D. striation

Section 2 – The Rock Cycle describes how rocks form and change over time

15. Specific patterns such as cubic, tetragonal, hexagonal, orthohombic, monoclinic and triclinic describe how minerals line up in a regular pattern creating smooth surfaces and sharp edges, making systems of ...
   A. mineral hardness
   B. crystal structure
   C. cleavage types
   D. synthetic models

16. Minerals can be identified by certain clues. The clue that identifies the color of the powdered form of the mineral left behind when it is rubbed against a rough surface is called its ...
   A. streak
   B. lustre
   C. color
   D. cleavage

17. The relative hardness of a mineral is measured with a scale. The scale is used to help identify different minerals, because each mineral will scratch all the minerals with a lower scale ranking than its own. Named after a German scientist, the scale is called...
   A. Newton's Force Scale
   B. Fahrenheit's Scale
   C. Mohs Hardness Scale
   D. Richter's Seismic Scale

18. Igneous rock can be classified by how it is formed. If it has formed beneath the surface, cooling slowly, it has larger grains and is called …
   A. interior
   B. intrusive
   C. exterior
   D. extrusive

19. Soil that has organic, living material, gets covered over and each layer puts pressure on the organic debris – compressing it into peat, lignite, bituminous and anthracite. The hardest type of coal …
   A. peat
   B. anthracite
   C. lignite
   D. bituminous

20. Shale changes to slate and then changes to schist. To change these rocks into other types requires …
   A. time and technology
   B. time and sediments
   C. heat and pressure
   D. heat and temperature

21. Geologists identify mineral ores locations, which are hidden below the surface of the Earth, using different tools and technologies. Using sensitive instruments, such as a magnetometer, geologists are using this technique ...
   A. remote sensing
   B. geophysical prospecting
   C. geochemical prospecting
   D. exploration

22. The formation of different types of rocks is described in the Rock Cycle. An important feature of this cycle is that it ...
   A. always forms rocks the same way
   B. cannot be reversed
   C. does not have a set order
   D. doesn't have any shortcuts or detours

23. The rocks and minerals that cover the first 50 meters or so of the Earth's surface include sand, gravel, stones, and boulders. This material is called …
   A. underburden
   B. overburden
   C. shield cover
   D. common rock cover

24. You will likely find dramatic examples of these types of rocks in *The Badlands* of Dinosaur Provincial Park, around Drumheller. The erosion and exposure of this type of rock took many years to complete.
   A. igneous
   B. magma
   C. sedimentary
   D. metamorphic

Section 3 – Landforms provide evidence of change

25. Alfred Wegner determined that the continents at one time all fit together to form one large supercontinent, called Pangaea. Their interlocking shapes and other evidence helped him form the Theory of Continental Drift. The other evidence included all of the following, **except** ...
   A. Glossopteris fossils
   B. Folded mountains
   C. Glacial deposits
   D. Gold deposits

26. Glaciers once existed in the southern hemisphere. The evidence Wegener found to prove this were the ...
   A. morraines found
   B. erratics found
   C. bedrock abrasions
   D. ice caves

27. The science community rejected Wegener's idea because they believed that mountains formed when the crust wrinkled like the skin of a dried-up ...
   A. apple
   B. pear
   C. grape
   D. orange

28. The ocean floor has been mapped out in detail and provided interesting patterns. Scientists noted that volcanoes and earthquakes tended to occur in the …
   A. deep trenches of the ocean
   B. vast plains of the ocean floor
   C. same areas around the word
   D. continents that fit together

29. Because rock is moving away from the mountain ranges found along the mid-Atlantic ridge, new rock is being formed. This sea-floor spreading indicates that rock nearest the continents is …
   A. older
   B. younger
   C. softer
   D. harder

30. A place where two tectonic plates slide past each other is called a …
   A. transform boundary
   B. diverging boundary
   C. converging boundary
   D. subduction boundary

31. Over 500 million years ago Alberta was tropical and the border with British Columbia was …
   A. a mountain range
   B. a shallow sea
   C. an underwater trench
   D. a fluvial landform

32. The collision of the North American Plate and the Pacific Plate caused the Pacific plate to slip under the North American Plate. At the same time, the force of the collision caused the North American plate to …
   A. slip and slide
   B. fold and break
   C. fold and separate
   D. Bend and compress

33. The downfold in the rock that is folded when pressure is placed on it is called …
A. compression
B. Fault block
C. anitcline
D. syncline

Section 4 – The fossil record provides evidence of Earth's changes over time

34. Trilobites are one of the most famous groups of fossils. They are now extinct. They lived in ...
A. Gobi Desert
B. Antarctic Tundra
C. Fresh water lakes
D. Warm ocean water

35. There is more than one way for living organisms to become fossilized. A cavity or track that was left behind by a living organism – providing evidence that it existed, is a type of fossil called a …
A. cavity fossil
B. evidence fossil
C. trace fossil
D. track fossil

36. The process that takes thousands of years and can only happen under certain conditions is called fossilization. The most common fossils found are …
A. plants
B. worms
C. jellyfish
D. vertebrates

37. Geological columns are formations in sedimentary rock that help scientists to determine the age of fossils they find. Fossils found in column 7 will be …
A. older than those found in 2 and 8
B. younger than those found in 10 and 6
C. older than those found in 4 and 3
D. younger than those found in 2 and 9

38. Layers of sedimentary rock stay in their original position, with the newest layers on the top and the older layers on the bottom. These layers of rock are called ...
A. indexing
B. parent rock
C. rock strata
D. superimposed

39. The preserved remains of many soft tissue species have been located in the Burgess Shale Fossil Beds, located in Yoho National Park, British Columbia. These fossils are usually the remains of …
A. producers and herbivores
B. herbivores and consumers
C. consumers and decomposers
D. decomposers and scavengers

40. The general time periods that organize the history of the Earth are called ...
A. eras
B. periods
C. years
D. centuries

41. In the Geologic Time Scale, dinosaurs ruled the land and then became extinct during this era.
   A. Precambrian
   B. Paleozoic
   C. Mesozoic
   D. Cenozoic

42. Scientists have inferred that there might be some relationship between dinosaurs and birds from some of the Archaeopteryx fossils they discovered a few impressions of feathers
   A. wings
   B. feathers
   C. webbed feet
   D. hollow bones

NR1 - Match the description with the type of ***mineral identification*** it is describing.

1 this the mineral's scratchability
2 reflects light from its surface
3 breaks along smooth, flat planes
4 the colored powdered form of the mineral

_____ _____ _____ _____
lustre **streak** **cleavage** **hardness**

	.	.	
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

NR 2 - Which category of **rock family** belongs with which rock type described?

1 Igneous
2 Sedimentary
3 Metamorphic
4 Magma

___ **melted rock**
___ **layered rock**
___ **crystallized rock**
___ **changed rock**

	.	.	
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9