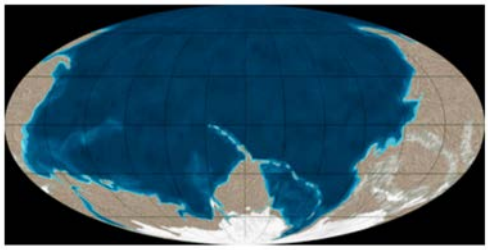
Science 20 Unit C: Geology



The Earth is Changing

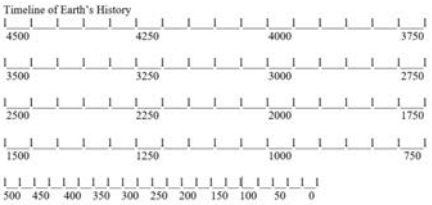
POS Checklist:

- ☐ describe the challenges in investigating the changes that take place over hundreds of millions of years to Earth's crustal plates, to past climates and to life forms
- ☐ describe, in general terms, how the theories of geologic processes have changed over time.
- ☐ refer to the contributions of Hutton, Lyell and Wegener to the development of theories of geologic processes

The Earth has been changing. Just what changes, over how long and how we know it has changed makes up the first part of Unit C.

To understand this change, let's look at how things are right now.

Activity: Building a Timeline of the Earth



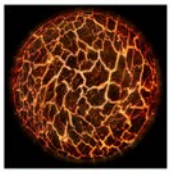
To get an idea of the Earth's history and just how long it took many events to take place as well as the huge times between significant events, complete the timeline activity.

A Model for the History of the Earth

- Our solar system formed out of a disk of hot, dense gases left over from the "big bang" creation of the universe.

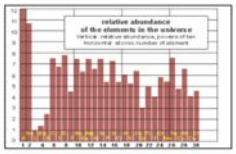
- Some of these gases were pulled together through gravity and cooled to form a molten ball we think of as the early Earth.

- This happened about 4.6 - 4.5 billion years ago.

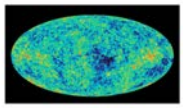


How Do We Know That?

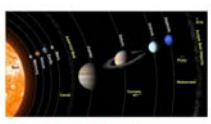
These ideas are scientific models that propose a set of rules and explanations for how the Earth was formed. They are supported by a broad range of observations, such as:



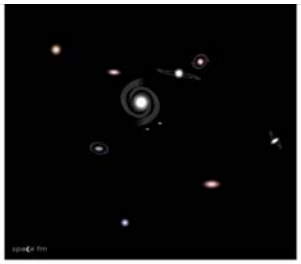
There are lots of small elements (hydrogen, helium) in the universe



We can observe and measure cosmic background radiation we think was left over from the Big Bang



The structure of the Solar System fits this model



The expansion of the universe fits this model

We can observe other clouds of gasses that we think are forming planets right now

About 500 million years after forming, the Earth was hit by another large object (about 10% of the mass of the Earth), and a portion of the Earth and this other object fell into orbit around the Earth.

And thus we have a moon (which has an identical stable-isotope rock ratio to the Earth).

As you can see from your timeline, most of Canada was formed with the rest of the continents, around 3.8 billion years ago (bya).

This time is called the Precambrian Era.

Precambrian Era: 4.6 bya to 590 mya when the earth was first formed. The earliest geologic time period.

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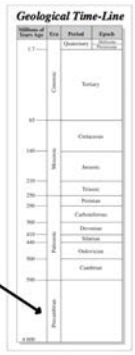
A geologic timeline is found on page 4 of your data booklet.



The rocks formed during the Precambrian era are the oldest on the earth. There are many of these rocks found in the Canadian Sheild in Ontario and Quebec.

While the outer part of the Earth cooled, the inside remains very hot. At this point, we should look at the composition of the Earth.

The Earth is like an onion. It has layers.

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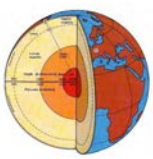
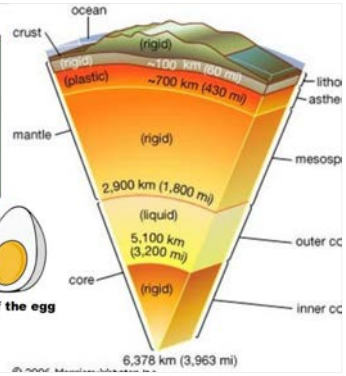


Let's take a look at these layers:

The layers of the Earth include:

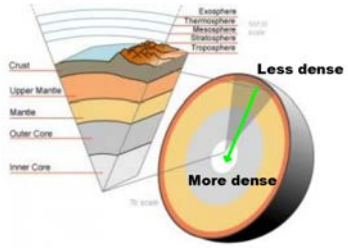
- **mantle**
  - Crust (50 km)
  - Lithosphere (100 km)
  - Asthenosphere (~350 km)
  - Mesosphere (~2550 km)
- **core**
  - Liquid core (~2260 km)
  - Solid core (~1220 km)

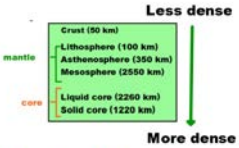


Now that I think of it, the earth is like an egg:

- **Crust = Shell: thin and on the outside**
- **Mantle = Egg White: makes up the bulk of the egg**
- **Core = Yolk: in the centre of the egg**

As we get closer to the center of the Earth, the layers become more dense. We can think of the less dense crust floating on the more dense mantle.





Watch: Why Does the Earth Have Layers?

However, we have never seen any of these layers of the Earth other than the crust. Our deepest mine-shaft only goes down 4 km and the deepest well only 13 km.

How do we know what the inside of the earth looks like? We mainly look at seismic data, which we will study in more detail when we tackle earthquakes.

Now, as we were saying, the Earth is an egg.

But, it's a cracked egg. Each piece of shell can move on its own a little.

We call these pieces of moving crust tectonic plates.

Tectonic Plates: a large piece of continental or oceanic crust that floats and slowly moves on the asthenosphere.

Any hot fluid undergoes a movement called convection. Convection of heat from the center of the Earth outwards causes the tectonic plates to move.

The plates move about a few cm per year (the same as your fingernails).

But this can add up over time...

According to this theory, the plates are spreading out in some regions (mostly under the ocean) and are coming closer together in others.

Now, just because we think we have a pretty good idea of how the Earth formed today doesn't mean we always understood.

Theories about how the Earth has changed have changes as much as the Earth has.

We will study 3 main theories:

- **Hutton's**
- **Lyell's**
- **Wegener's**

Use your textbook or the internet to complete your notes handout.