Science 20 Unit C – Earth
Early Life on Earth

Name: KEY

Date: _____

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.

What evidence or proof do we have that there was life on Earth millions of years ago? Some of the best evidence is in our own back yard. Read the description of the Cameron Falls on page 302 of your text, then fill in the blanks below:

One assumption that early scientists made is that the thickness of the strata could tell us how old a particular sedimentary rock is. For example, try question 4 on page 303 below:

Some of Alberta's oldest rock is classified as Sedimentary rock. This type of rock is made up of layers called strata. One type of evidence that early life existed found in these rocks are fossils.

pg 303 #4) 11000 km = 1 100 000 cm / 1 cm/a = 1.1×10^6 years

1.1 million years.

(Ans: 1.1 x 10^6 years, or 1.1 million years old)

Considering that the rock at Cameron falls is now thought to be about 1.5 billion years old, this is not the most accurate method for age calculation. Science has since improved on these early methods.

So what type of life-forms could have lived on Earth when this rock was formed? Read page 303 the first paragraph of 304 and fill in the blanks below:

Fossils give evidence of early life, but life may have existed before our fossil records. It is generally agreed upon by scientists that the earliest life-forms date back 3.8 billion years ago, and were probably single - celled bacteria. An example of this type of life form is archaea. This life form lived when the Earth was very hot and had an atmosphere with little oxygen present. At this time, the atmosphere was mostly methane and hydrogen sulfide.

Another example of early life is the bacteria cyanobacteria. This life-form left fossil evidence in the form of a stromatolite a layered pile of calcium carbonite that can grow up to 1 m tall.

This type of fossil evidence is called a trace fossil because it is not the actual remains of a life form, just traces left behind.

Cyanobacteria may have been primarily responsible for creating our oxygen rich environment today. The cyanobacteria used chlorophyl molecules to covert sunlight into energy through photosynthesis. In this process, CO_2 and H_2O are converted to glucose and oxygen.

There is evidence that cyanobacteria were producing oxygen around 3.7 bya. One example of this evidence is banded iron. To learn more about this, read the investigation on page 304 and answer the Analysis questions on page 305 below.

pg 305 #1) Cyanobacteria produced O_2 from process of photosynthesis.

#2) a) Very little O_2 prior to 3.8 b years ago

b) Significant levels of O_2 present starting 1.8 b years ago

c) Red bands significant levels of O_2 present and grey bands meant low atmospheric O_2.

After the cyanobacteria began to flourish, a major setback occurred. The Earth was flung into a 10 million year long ice age, our longest ever. Read the past paragraph on page 305 and fill in the blanks below:

In the late Precambrian Era, early life was faced with a massive ice age. Most of the Earth's oceans were frozen solid, except for some pockets of liquid water produced by heat escaping from the convection in the Earth's mantle.

Strange Rocks

Early naturalists were fascinated by rocks that resembled living creatures, but the idea that a living creature could be preserved in rock was not accepted until relatively recently. An early observation of fossil evidence was made by Nicolas Steno in the late 1600's. Read the bottom paragraph on page 307 and answer questions 8 and 9 below to find out what kind of fossil Steno discovered and why his discovery was important.

pg 307 #8) Steno reasoned rock surrounding the fossils were in fluid form when deposited around the teeth. Fluid then hardened into solid rock
Modern explanation - teeth fell to bottom later buried by sediment. Eventually weight of sediment increased to compress sediment into solid rock.

#9) Strata must have been deposited first because layers are built on top of one another, older layers are deeper.

4/21/09

F
B older than A
A collision between crustal plates bent them
D is unconformity

Erosion, ice sheet
magma created intrusion
E younger

In order to determine the relative age of layers of rocks, geologists use the law of superposition. According to this law, sedimentary layers found closer to the surface are younger and layers found deeper down are older. The pattern formed is called the stratigraphic sequence. We call this overall process relative dating.

An exception to this idea is when convection forces streams of lava up through cracks in the sedimentary rock. This lava hardens to form intrusions. These new steams of material are younger than the surrounding rock.

Observations like Steno's lead to several important principles. Read page 308 and fill in the blanks below.

Page 308 #10

oldest
Oceanic basalt
Sandstone
Shale
limestone
Intrusive basalt
youngest

While the law of superposition gives a *relative* age to rock strata and fossils (i.e., which layer is older, which is younger), it does not give an absolute age, that is, exactly how old a strata or fossil really is. This is a major drawback of this law.

Working from Steno's law of superposition, English geologist William Smith devised a way for determining the relative age of a strata from any region on the planet. Read page 310 to 312 and fill in the blanks to find out about this method.

Smith traveled to many different locations in England and discovered that distinctive fossils appeared in similar layers of rock. The fossils always appeared in the same order, regardless of the location. If these fossils only appear over a short period of time, they can be used to identify the relative age of a strata. Fossils such as these are called index fossils.

A large number of these special fossils were and their distinctive strata were put together to form one large index, called the ~~Geological Time Scale~~ Grand Record. This record allows us to organize geological time by fossil remains.

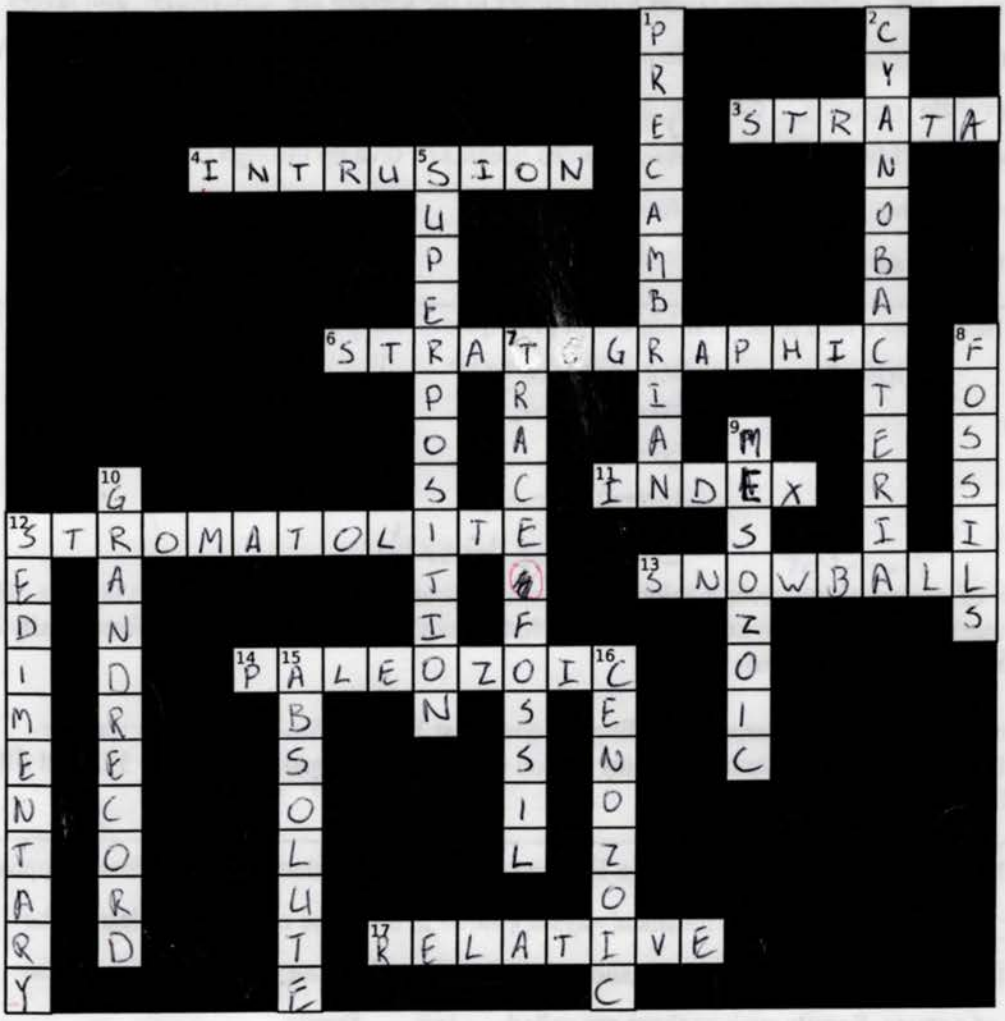
This record is broken into four eras, from oldest to youngest, the precambrian paleozoic mesozoic, and cenozoic. The eras are further broken into epoch periods. Each new era is marked by a massive appearance of fossils.

Activity: Earth Crossword

Geology Crossword Puzzle

Brad Langdale

A puzzle for Unit C in the Alberta Science 20 course.



Across

3 the layers in sedimentary rock
4 a crack filled with cooled lava that violates the law of superposition
6 _____ sequence. The pattern in which strata are arranged.
11 _____ fossils are used for determining relative age of a layer in a stratigraphic sequence.
12 layers of calcium carbonate left behind by cyanobacteria
13 _____ Earth. Description for the long-term ice age that gripped the Earth for 10 million years
14 the second oldest geological era
17 _____ dating. Allows one to tell which strata is older, which is younger, by comparison.

Down

1 the first geological era
2 single-celled bacteria that convert carbon dioxide and water to oxygen
5 Law of _____.
7 stromatolites are examples of this
8 evidence or remains of ancient life
9 the third oldest geological era
10 (one word) a large collection of index fossils spanning the entire age of the Earth.
12 this type of rock is formed from compressed layers of rock or organic material
15 _____ dating. Allows one to determine the actual age of a strata or fossil.
16 the most recent geological era