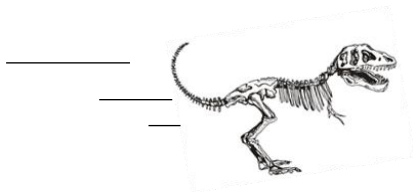
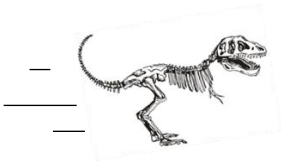
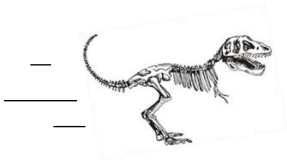


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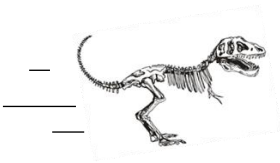
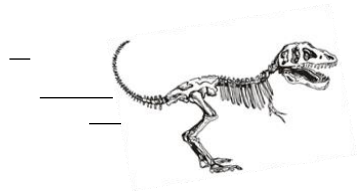
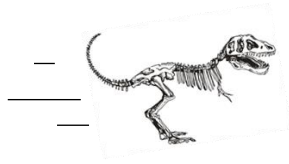
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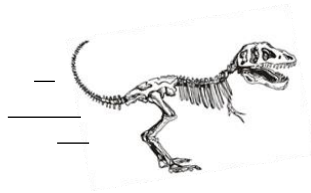
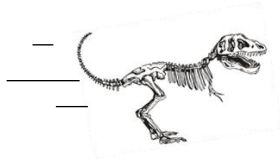
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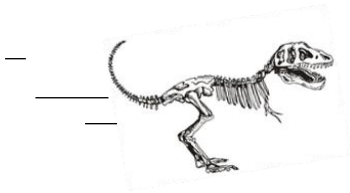
*Author's Comments:*

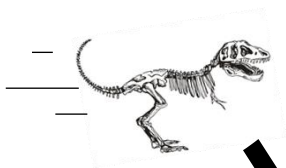
*This book is an ABC reflection book that was required to be made throughout the Fall Semester 2022 while I attended the University of Kentucky of Lexington, KY.*

*Class entitled Geology for Teachers with Professor Frank Ettensohn.*

*I hope that you enjoy the book.*

*-Carol Lee Brunk, Author and Educator*





# My Alphabet Book

Geology



# My Alphabet Book Geology

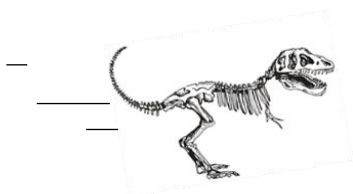
## Content



### Letter is for Word

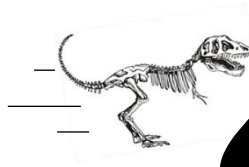
- A** is for **Atoms**
- B** is for **Batholith**
- C** is for **Constructive Processes**
- D** is for **Destructive Processes**
- E** is for **Element**
- F** is for **Fossil**
- G** is for **Geology**
- H** is for **Hypotheses**
- I** is for **Intrusive (origin and location)**
- J** is for **Joint**
- K** is for **Kentucky, USA**
- L** is for **Layers and Laws**
- M** is for **Minerals**
- N** is for **Nuclear Reactions**
- O** is for **Organic**
- P** is for **Precambrian and Phanerozoic**
- Q** is for **Quakes**
- R** is for **Rocks**
- S** is for **Sun and solar system**
- T** is for **Tectonic Plates**
- U** is for **Uniformitarianism**
- V** is for **Volcanoes**
- W** is for **Wall, Hanging & Foot, Faults**
- X** is for **Xenolith**
- Y** is for **Years in Geological Time**
- Z** is for **Zeugen or Yardang**

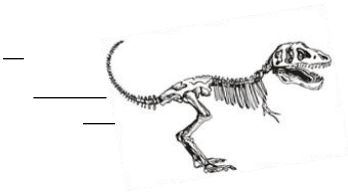
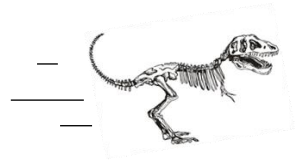




# My Alphabet Book

**Geology**

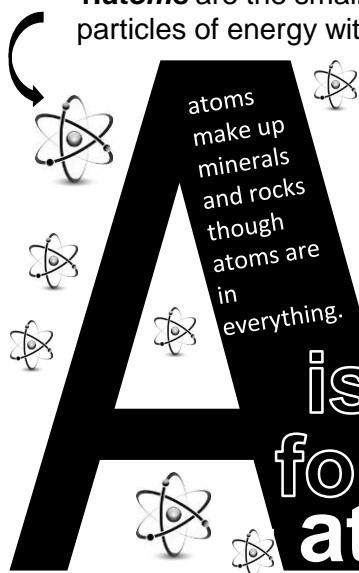




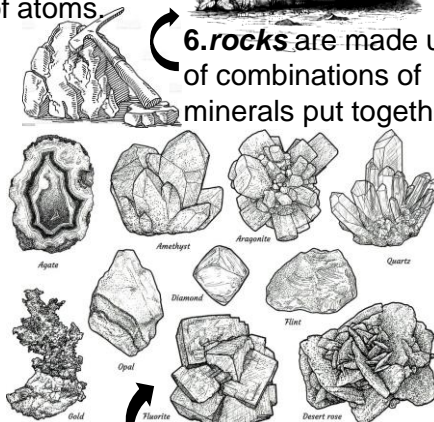
# A is for atoms of how the earth we walk on was formed in

**atomic energy?** As molten matter cooled and energy declined in the creation of the earth, energy of atoms sought other atoms and formed molecules of compounds that eventually formed the earth's foundation of what we walk on. The process started with atoms and molecules that we cannot see with our eyesight continued to build upon what we can see that we walk on-the minerals and rocks...

**1. atoms** are the smallest of individual particles of energy with different kinds of atoms.

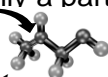


**6. rocks** are made up of combinations of minerals put together.



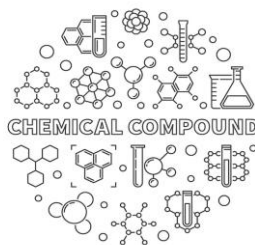
**5. minerals**, mostly, are **molecule of compounds** of two or more elements.

**2. molecules** are basically a particle with multiple atoms.



**3. molecule of elements** are molecules and/or molecule atom combinations. Pure elements are two or more atoms that are the same.

Periodic Table of the Elements																					
<div><div>Atomic Number</div><div>Symbol</div><div>Name</div></div>																					
1	2															18	19	20			
H	He															Ar	K	Ca			
3	4													5	6	7	8	9	10		
Li	Be													B	C	N	O	F	Ne		
11	12											13	14	15	16	17	18				
Na	Mg											Al	Si	P	S	Cl	Ar				
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36				
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr				
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54				
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe				
55	56	57-71		72	73	74	75	76	77	78	79	80	81	82	83	84	85	86			
Cs	Ba			Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn			
87	88	89-103		104	105	106	107	108	109	110	111	112	113	114	115	116	117	118			
Fr	Ra			Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Uut	Fl	Uup	Lv	Uus	Uuo			
Lanthanide Series																					
		57	58	59	60	61	62	63	64	65	66	67	68	69	70	71					
		La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu					
Actinide Series																					
		89	90	91	92	93	94	95	96	97	98	99	100	101	102	103					
		Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr					
		Alkali Metal				Alkaline Earth				Transition Metal				Main Group				Noble Gas			



**4. molecule of compounds** are a combination of two or more atoms in a specific ratio that are not the same atom that makes an element.

Reference: Ettenshoen, F.R., (Fall 2022) Lecture, Minerals and Rocks (new) ppt

Reference: Ettenshoen, F.R., (Fall 2022) Lecture, Introduction to minerals and basic earth processes ppt

Reference: Chemistry Hall.Com, 2022., Website. Reference Link: (<https://chemistryhall.com/can-we-see-real-atoms-and-molecules-electron-microscopy/#:~:text=It%20allows%20us%20to%20actually%20E2%80%9Csee%20E2%80%9D%20or%20E2%80%9Ctake,dijm ide.%20We%20can%20actually%20see%20a%20real%20molecule.>)

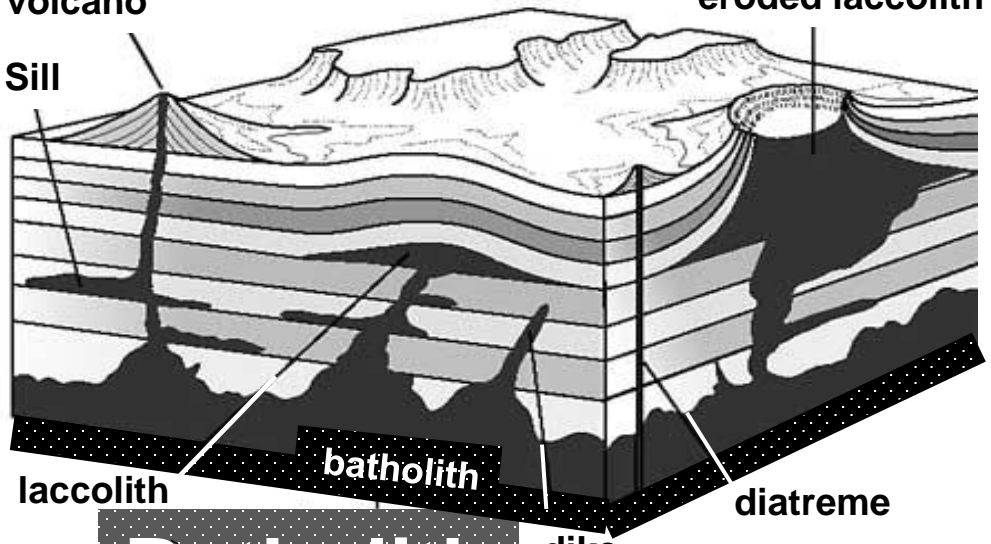
Reference: Elements, Atoms, Molecules, Ions, Ionic and Molecular Compounds, Cations vs Anions, Chemistry - Bing video

Reference: Image by <a href="https://pixabay.com/users/colin00b-346653/?utm\_source=link-attribution&utm\_medium=referral&utm\_campaign=image&utm\_content=1094989">Colin Behrens</a> from <a href="https://pixabay.com/?utm\_source=link-attribution&utm\_medium=referral&utm\_campaign=image&utm\_content=1094989">Pixabay</a>

volcano

eroded laccolith

Sill



laccolith

batholith

diatreme

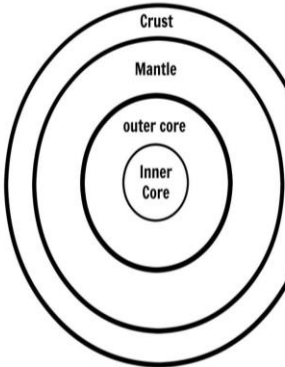
dike

# Batholith

## is for



The Layers of the Earth



Half Dome  
Batholith  
Granite in  
San  
Francisco  
Yosemite  
National  
Park



Batholiths are usually a 40 mile square body of igneous intrusive granite rock formed inside the earth's crust. They are believed to of crystalized at a deep depth below the earth's crust surface. Over millions of years during continental uplift, batholiths are exposed at the surface of the earth's crust. Due to huge pressure differences between their former location depth in the earth to the surface location, the crystal

structure expands slightly that causes relatively thin sheets of rock to slough off that are exposed at the surface called mass wasting and exfoliation. This type of weathering caused convex, clean and rounded rock faces. A well-known result was the Half-Dome in Yosemite Valley.

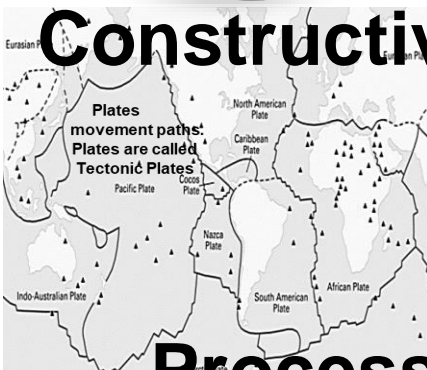
## New Land & Crust

Lava from volcanoes are the new rocks that build and repair the earth. The cooled rocks are called *igneous* that create land and earth's crust.



is  
for

Constructive



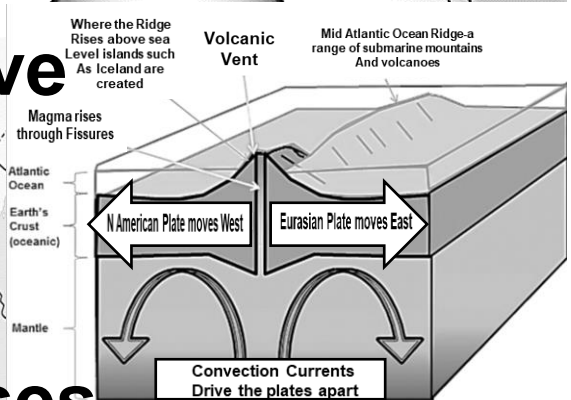
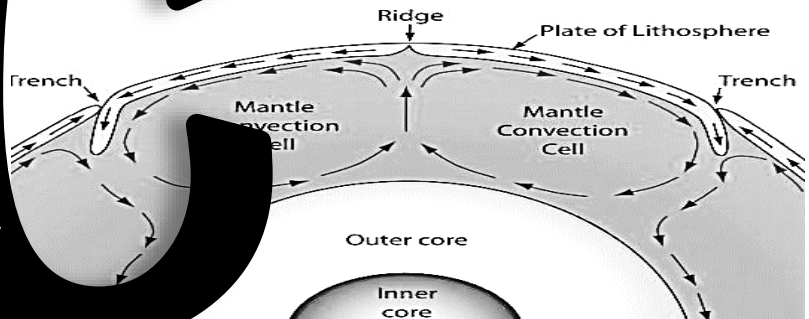
Processes

## Three Constructive Processes Combined For The Earth's Crust & Lithosphere

### 1. Convection

### 2. Constructive Plate Movement

**3. Volcanoes.** The outer and inner core is the **heat engine** of the earth that provides an enormous boiling point that causes the magma cells in the mantle to move in waves underneath the earth's crust in the mantle-equals the **process of convection**. In the earth's crust there are huge walls of rocks called **(tectonic) plates** that move the earth's crust around on the planet. The plates are moved by very hot convection cells of heated magma that rolled in waved circles in the mantle. When the constructive plate boundaries move, of moving rock, away from each other lava can escape through a **volcano**.



A constructive or DIVERGENT plate margin

Reference: Ettenshoen, F.R., (Fall 2022) ppt slides, Presentations Earth Systems, Presentation Constructive Processes I, Constructive Processes II, Constructive Processes III, Lab 4,5,6

Reference: Website: convection processes and the earth, Reference link:

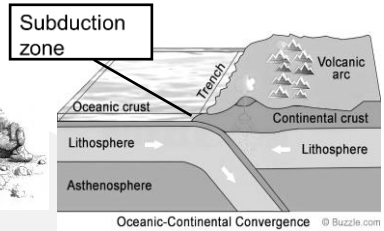
<https://www.bing.com/search?q=convection+processes+and+the+earth&cvid=e4f4472b29fd43f8b667307aa9539296&aqs=edge..69i57j0l8.23191j0j1&pglt=43&FORM=ANNTA1&PC=U531>

# Weathering

and erosion affect the age of the earth in minerals and rocks that make up the earth's mantle and crust.

Some eroded rocks, called sedimentary rocks, after millions of years slowly are pushed down under pressure reaches magma chambers where they completely melt or become some other rock. In the earth's mantle there are huge rock wall formations called plates that move the earth's crust. The subduction zone is the point area where one plate wall moves and goes under another plate of a wall rocks that move. That is where the eroded rock may return to be heated and be pressed by pressure and made into a different rock, called metamorphic rock, or return to melted magma that makes lava.

Arrows show the walls of rock movement (plates)

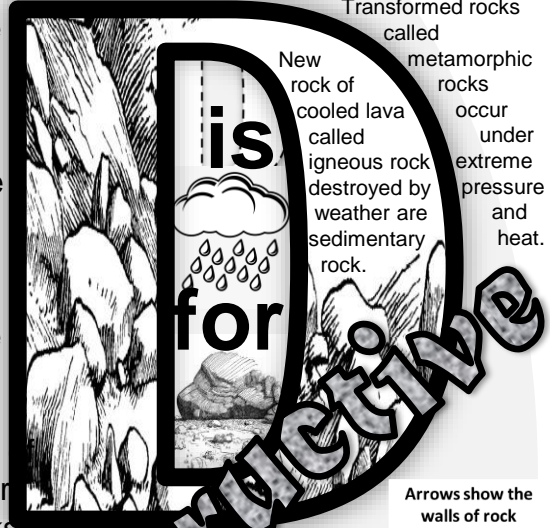


Oceanic-Continental Convergence © Buzzle.com

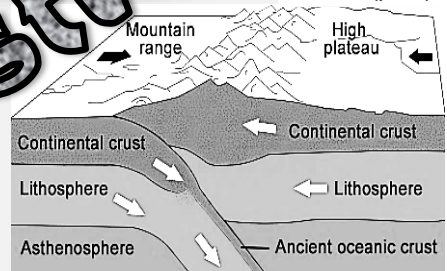
# Processes

Transformed rocks called

New rock of cooled lava called igneous rock destroyed by weather are sedimentary rock. metamorphic rocks occur under extreme pressure and heat.

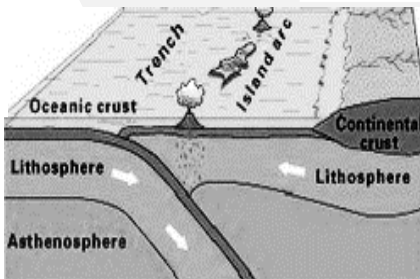


Arrows show the walls of rock movement (plates)



Continental-Continental Convergence © Buzzle.com

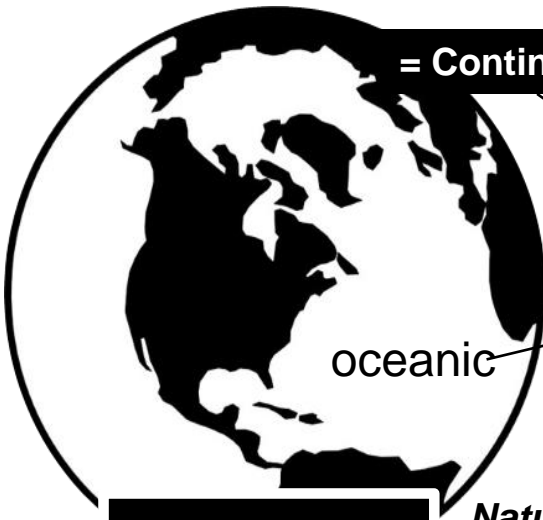
Arrows show the walls of rock movement (plates)



Oceanic-oceanic convergence

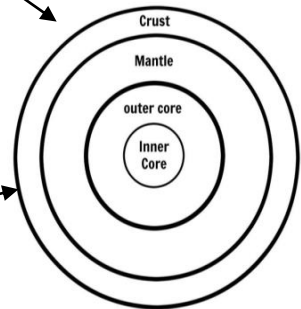
There are **three convergent (meaning destructive) plate boundaries** of moving wall rock that collides with another wall rock:

1. Oceanic-Oceanic Convergence
2. Continental-Continental Convergence
3. Oceanic-Continental Convergence



= Continental

The Layers of the Earth



**Natural elements make up everything on the earth.**  
*Most* of these elements come from *minerals* in the *Earth's crust*.

**is for Element.**

1

H

1.01

18

He

4.00

2

Li

6.94

3

Be

9.01

10

Ne

20.18

11

Na

22.99

12

Mg

24.31

13

Al

26.98

14

Si

28.09

15

P

30.97

16

S

32.07

17

Cl

35.45

18

Ar

39.95

19

K

39.10

20

Ca

40.08

21

Sc

44.96

22

Ti

47.87

23

V

50.94

24

Cr

51.99

25

Mn

54.94

26

Fe

55.85

27

Co

58.93

28

Ni

58.69

29

Cu

63.55

30

Zn

65.38

31

Ga

69.72

32

Ge

72.63

33

As

74.92

34

Se

78.97

35

Br

79.90

36

Kr

83.80

37

Rb

85.47

38

Sr

87.62

39

Y

88.91

40

Zr

91.22

41

Nb

92.91

42

Mo

95.95

43

Tc

98.91

44

Ru

101.07

45

Rh

101.07

46

Pd

106.42

47

Ag

107.87

48

Cd

112.41

49

In

114.82

50

Sn

118.71

51

Sb

121.76

52

Te

127.6

53

I

126.90

54

Xe

131.29

55

Cs

132.91

56

Ba

137.33

57-71

Lanthanides

72

Hf

178.49

73

Ta

180.95

74

W

183.84

75

Re

186.21

76

Os

190.23

77

Ir

192.22

78

Pt

195.08

79

Au

196.97

80

Hg

200.59

81

Tl

204.38

82

Pb

207.2

83

Bi

208.98

84

Po

[209]

85

At

[210]

86

Rn

222.02

87

Fr

223.02

88

Ra

226.03

89-103

Actinides

104

Rf

261.10

105

Db

262.10

106

Sg

266.10

107

Bh

264.10

108

Hs

277.10

109

Mt

268.10

110

Ds

271.10

111

Rg

272.10

112

Cn

285.10

113

Nh

286.10

114

Fl

289.10

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Mc

290.10

116

Lv

293.10

117

Ts

294.10

118

Og

294.10

La

Ce

Pr

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Pm

Sm

Eu

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Np

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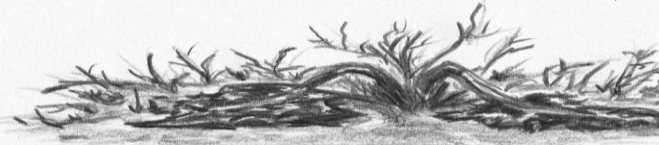
There are 90 elements in the earth's crust.  
 The earth's crust is the outer shell of rock that include the *oceanic* and *continental*.



# WHAT ARE FOSSILS?

**Fossils** are remains and traces of naturally preserved organisms from the past. Fossils are a good source for relative dating that means to find out approximately when life on earth began.

The first known fossil life records back to 3.7 billion years ago was found in Greenland called Stromatolite (algae). There are some **live** stromatolites that are alive today that can be found today in Shark Bay, Australia.



## The Prerequisites For Preservation

**As A Fossilization**

- a. Burial** was quick in a protective medium
- b. Hard parts** are present



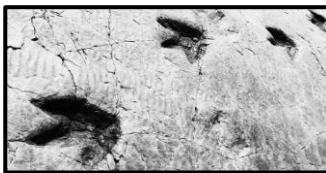
## THREE MAJOR TYPES OF FOSSILS

**1. Body Fossils** are preserved fossils of part of an actual hard or soft organism. Include direct that are unaltered soft frozen parts, desiccated, pickled or entrapped or entombed.

And indirect fossils that are molds and casts of hard Parts i.e. Pompei (79 AD)

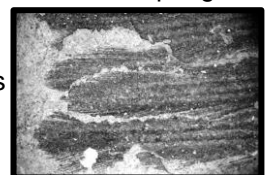


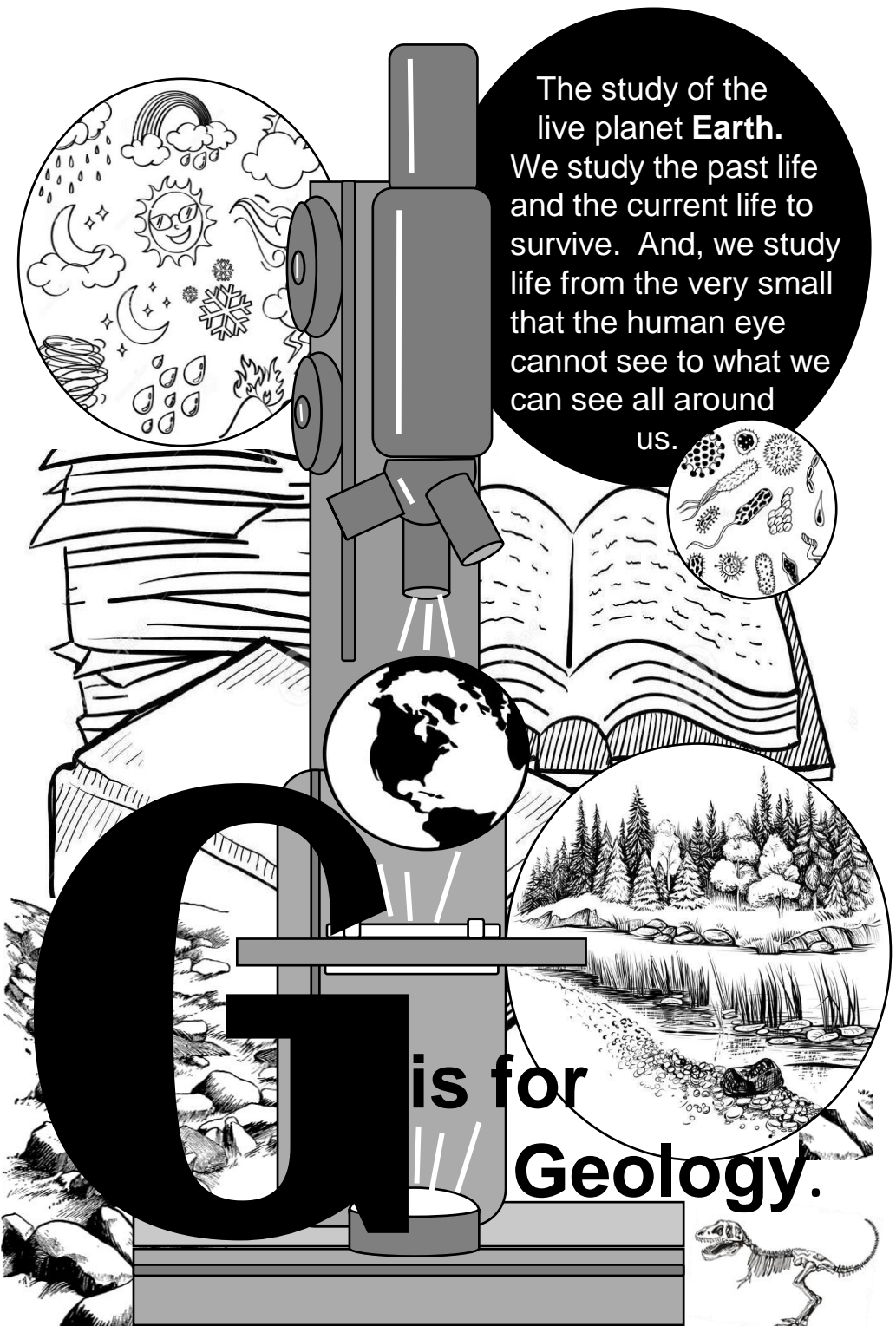
**2. Trace Fossils** are something made by organisms as a result of activity that made a borrow or structure, trail and/or tracks.



Also included in Trace fossils are eggs, gastroliths, Leopard tooth and fecal matter called coprolites.

**3. Chemical Fossils** are chemicals of like DNA and pigments found in rocks. The chemicals are degraded organic substances from the molecules found in organisms i.e. giant red penguin.





The study of the  
live planet **Earth**.  
We study the past life  
and the current life to  
survive. And, we study  
life from the very small  
that the human eye  
cannot see to what we  
can see all around  
us.

**To  
check ✓ a hypothesis**

**Steps 1 through 5**

**1. Ask a  
Question**

**2. Do  
Research**

**3. Explore in  
an  
Experiment**

**4. Record the  
Results**

**5. Inform  
Results  
to  
others.**

**An**

**educated guess**

**is called a**

**Is  
for  
hypothesis**

A hypothesis is a guess of using one's own educational knowledge of why something happened that needs to be proved as true or false. There are 5 steps to prove a guess is true fact or false fiction.



## Concept Magma

### INTRUSIVE ORIGIN

The process of rock formation of the earth's crust is the hot minerals that form rock in the earth are called magma. The magma that became lava on the surface are in the surface's earth crust of the volcano

and in the subsurface (underneath) the volcano. Magma of hot minerals combined in different ways made different types of rocks.

In magma form before it gets expelled in volcanic activity, different minerals of rocks combined are formed in two different locations (origins) in the earth.

**I & II LOCATIONS are where magma/lava/igneous rock are made.**

1) **extrusive:** magma/lava/igneous rock is the location outside the earth's crust (contained in a volcano) is the igneous rocks formed that includes rhyolite, andesite and basalt. Textured fine-grained rocks.

Any **magma** that is expelled on the earth's surface we call

**Igneous**

**Rocks** are expelled out of two locations.

The locations of the earth where three classifications of igneous rock are made is called the origin.

**lava**

when cooled it

becomes

**igneous rock.**

Location

**extrusive**

## 3 Classifications of Chemical Compositions of Igneous Rocks

**1. Felsic Rocks:**

**rhyolite**

Earth's Crust

**2. Intermediate**

**andesite**

**3. Mafic**

**basalt**

Earth's Crust

**Rocks: granite**

**diorite**

**gabbro**

**Intrusive**

Location

The mineral compositions of the three classifications of rocks are formed with similar compositions at the two different locations of **extrusive** and **intrusive** origins are grouped below each other.

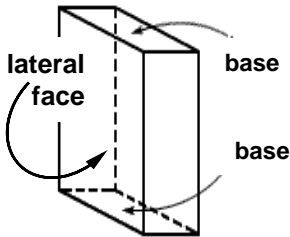
Textured Fine-Grained Rocks.

Textured Coarse-Grained Rocks.

II) **intrusive:** magma/plutonic magma/igneous rock is the location below the earth's crust inside the earth's mantle of magma in a batholith or magma chamber where the initial igneous rocks formed that includes granite, diorite and gabbro. Textured coarse-grained rocks.

**is for Intrusive means (origin and location)**





## Two Types Of Geological Joints That Apply To Two Types Of Rock

### 1. Igneous rocks

has what is known as **cooling joints**.

Cooling joints are formed when magma contracts as the magma loses heat.

### 2. Sedimentary

rocks are known to of formed **unloading joints** when rock undergoes

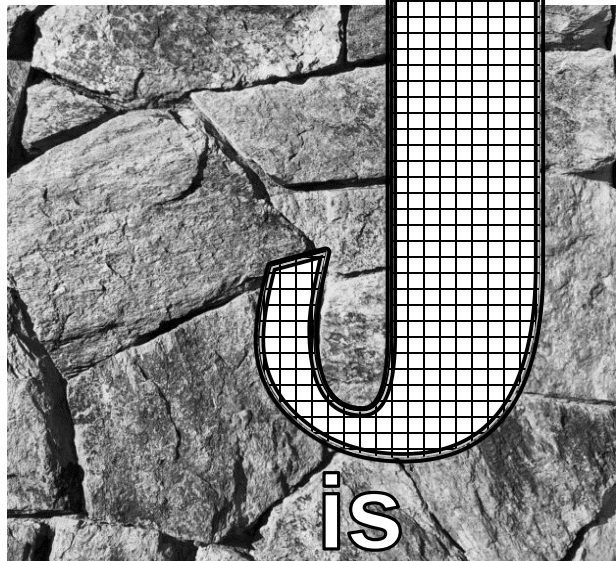
*compression* or *stretching* by the *tectonic plate forces* or by the weight of the overlying gemstone.

The results of compression or stretch, underlying rock is removed and the strata (layers in most sedimentary rocks) expand and stretch create unloading joints parallel to the surface.

## Joints Are Different From Faults.

**Joints** display no visible or measurable movement parallel to the surface plane of the fracture.

**Faults** display visible or measurable lateral movement between the opposite surfaces of the fracture.



Joints occur in quite different tectonic environments.



A joint can appear as a set or system that are two or more intersecting joint sets that are evenly spaced.

for joint

Parallel = side by side

In geological study, a **joint** in nature is a break(s) in a layer or body of rock.

unloading joint



Reference: Ettenshoyn, F.R., (Fall 2022) Lecture, Powerpoint Slides, Structural Geology ppt

Reference: stratification | geology | Britannica Website. Reference link:

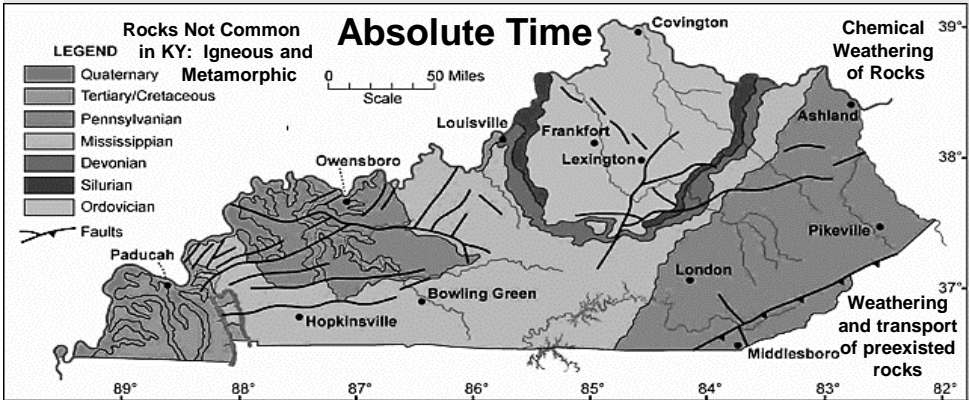
<https://www.britannica.com/science/stratification-geology>

Reference: Joint (geology) – Wikipedia Website. Reference link: [https://en.wikipedia.org/wiki/Joint\\_\(geology\)](https://en.wikipedia.org/wiki/Joint_(geology))

# Geological Facts

Kentucky, USA

**More than 50% Surface Rocks  
being Limestones Out of 99%  
Sedimentary Rocks in Kentucky**



## Types Of Fossils Found In Kentucky

Kentucky has the following fossils found in the state:

### **1. Invertebrates:**

Animals without backbones. The most common fossils in Kentucky are Arthropods (trilobites, ostracods, etc.)

Other fossils include  
Brachiopod sea shells (common fossil shells),  
Bryozoa (coral-like organisms), Corals (rugose and tabulates),  
Echinoderms (crinoids, starfish, etc.), Mollusks:  
Bivalve sea shells (clams, etc.), Mollusks:  
Cephalopods (squids with shells, etc.), Mollusks:  
Gastropods (snails, etc.),  
Sponges (Porifera).

Kentucky's State  
Energy Organic  
Rock is Coal.

is for  
**Kentucky  
USA**

## **Age Of Rocks In Lexington, KY Date Back To 450 Million Years Old.**

Lexington, KY rocks date back into the Paleozoic Era of the Ordovician that is the 2<sup>nd</sup> of 6<sup>th</sup> periods of Paleozoic Era

No dinosaur fossils found yet in the state of Kentucky

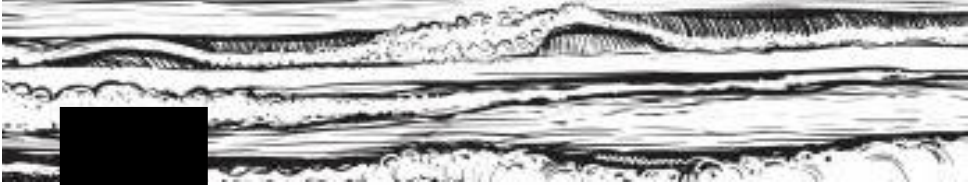
**2. Vertebrates:** Animals with backbones. Uncommon fossils in Kentucky Amphibia (salamanders, etc.), Aves (birds) Mammalia (mammoths, etc.), Pisces (fish, sharks, etc.), Plants (fossil ferns, wood, roots, etc.), Trace Fossils (fossil tracks and trails)

Uncommon fossils in KY: Amphibia (slamanders, etc.), Aves (birds), Mammalia (mammoths, etc.), Pisces (fish, sharks, etc.), Plants (fossil ferns, wood, roots, etc.), Trace Fossils (fossil tracks, and trails), Single-celled life (fossil algae and stromatolites).

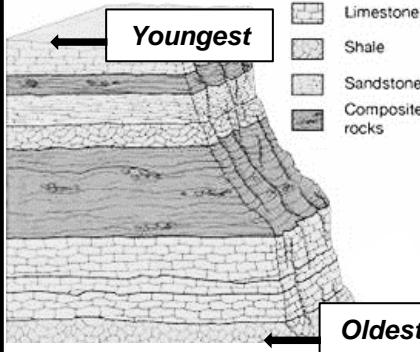
## Geology in Relative Time:

Is the relationship of age based on the first layers of sediment, earth's crust dirt, that were deposited on the earth.

← horizontal →



↑  
v  
e  
r  
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### Law of original horizontal:

**Layers of sediment, that is the earth crust dirt, are originally deposited horizontally** under the action of gravity.

# is for Layers and Laws

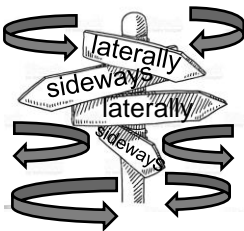
### Law of superposition:

**Oldest to Youngest Layers.**

Layers of the planet earth on the **bottom are the oldest** with fossils and sediment dirt and the **youngest of the ground is on the top** that we walk on or swim over.



**"Time Is In The Layers Of The Earth. We Can See Time In The Ground Due To Gravitational Laws."**

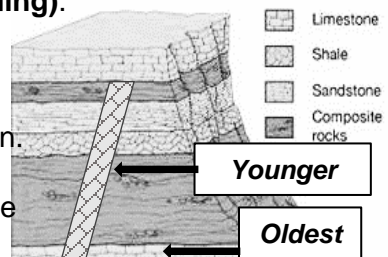


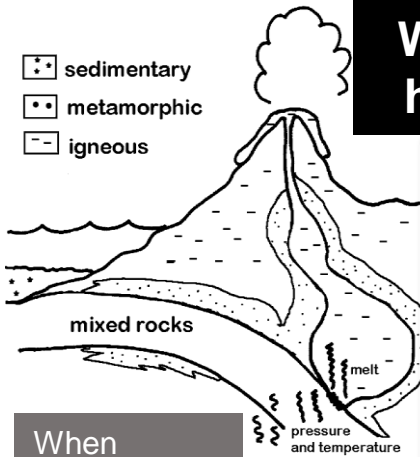
### Law of lateral continuity:

Layers initially **extend laterally (is sideways) in all directions**; in other words, they are laterally continuously (**never-ending**).

### Law of cross-cutting

**relationships:** A geologic layer formation which cuts another layer formation. The layer formation **that cuts the other layer formation is the younger layer** of the two layers features.





# What are minerals and how are they formed?

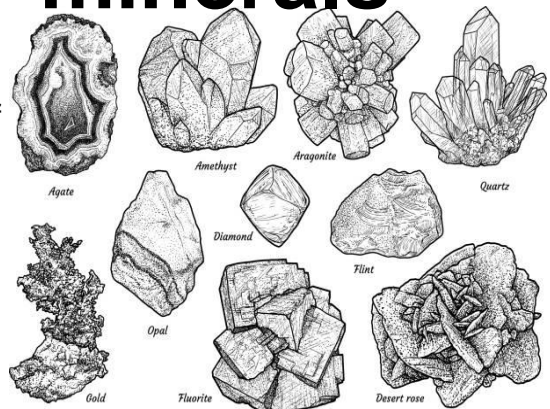
Minerals and rocks are the foundation of the earth's crust that we walk upon. Minerals are inorganic- meaning not of this earth, nonliving matter. They are from the contents of outer space that made up the earth from cooled molten matter when the earth was created.

When different combinations of minerals are put together, it changes into different rocks. Rocks are made up of several minerals. Minerals by itself are not rocks.

M is for

## minerals

Minerals are solids and not liquids. Minerals are made of atoms that are extremely organized in arrangement of a characteristic of atoms that make a structure called crystalline. There are a variety of crystalline structures. The different crystalline structures make up different minerals.



Reference: Ettenshoen, F.R., (Fall 2022) Lecture, Minerals and Rocks (new) ppt

Reference: Ettenshoen, F.R., (Fall 2022) Lecture, Introduction to minerals and basic earth processes ppt

Reference: Ettenshoen, F.R., (Fall 2022) Worksheet, Lab 2: Worksheet, Introduction to Minerals doc



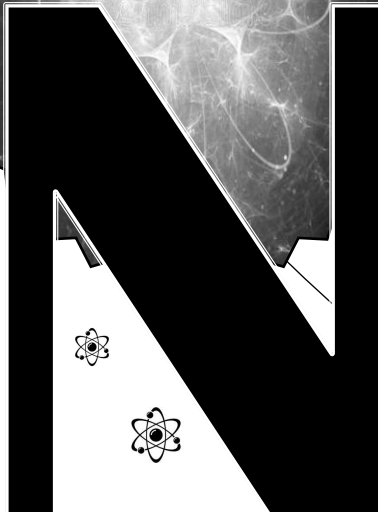


## Nuclear reactions

formed the sun, earth and solar system. The sun officially became a star when a lot of energy exploded into a lit hot molten magnum that keeps exploding over and over that was named ***fusion***.



nuclear  
fusion



***Nuclear reactions*** are when changes in atomic nucleus' results and the energetic particle acts as **fission, fusion or radioactive decay**. *It's energy that is high in concentration of dangerous energy that can create or destroy.*



When a **nuclear reaction** ignites in the process of fusion, the ***shock waves*** are so strong that it causes outer space particles and various materials to bond in various forms of stars, asteroids, gases and more. That stuff begins to circle/rotate/revolve in a path called a belt. The pathways of belts together that define the shape around the new sun is called the ***protoplanetary disc***.

***Nuclear reactions on earth compared to nuclear reactions to outer space.*** The nuclear reaction of nuclear energy used on earth is ***fission***. ***Fission*** energy is what we use in the nuclear power plants on earth. ***Versus.*** The nuclear reactions in outer space that are more dangerous that ignite stars and make solar systems in the process of explosions are called ***fusion***.



is for

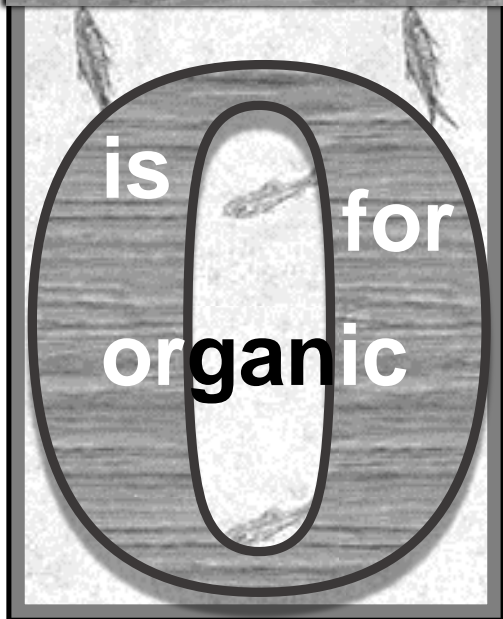


nuclear  
reactions



nuclear fission

**Organic** means to relate to an organism of a living entity in relation to an anatomical organ.



### ***What Happens To Organic Materials That Have Mineralized?***

When a living organic organism dies, the dead matter during the process of decay, over time, the organic composition may be filled in with inorganic minerals like chalcedony, opal, calcite, aragonite, pyrite or other minerals. The inorganic minerals then preserve an organic structure that would include petrified wood, fossil coral, dinosaurs, etc.



***What is Inorganic?*** **Inorganic** chemical compounds do not have either two atoms of hydrogen or carbon and are not of live matter. *The inorganic compounds make up most of the earth's crust of rocks.*

### ***What Is Organic And How Does It Pertain To Geology?***

When you hear the word 'organic' in chemistry, it represents "living matter" that once lived that contains a carbon atom and often a hydrogen atom that formed hydrocarbons.

Organic pertains to Geology in rock formation and fossilization.

Geologists when performing a carbon test can detect former life on earth. This helps geologists to historically date the earth in **absolute time**.



### ***Organic Matter: Carbon Dating:***

A living organism intakes both carbon-12 and carbon-14. Decay and decomposition of organic matter in relation to carbon dating only works on organic matter that are younger than 50,000 years old. Carbons in the environment are found in different forms: carbon-12 listed as a stable form and carbon-14 listed as unstable in form. Over time radioactive turns carbon-14 into nitrogen and returns to the earth. Scientists measure organic matter of how much carbon-14 is left relative to the carbon-12 can determine how long ago an organism died.



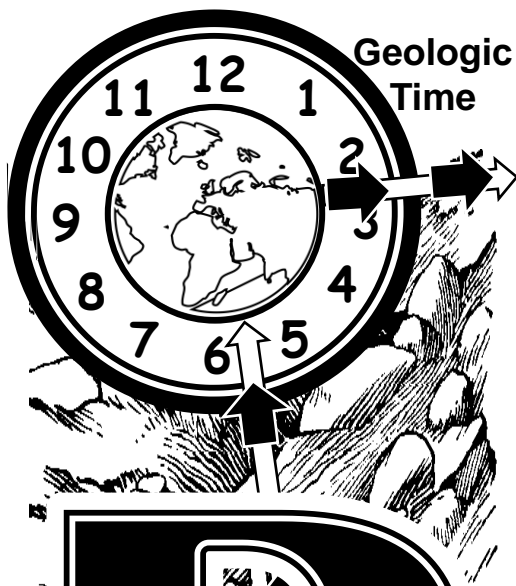
Reference: Ettensohn, F.R., (Fall 2022) Lecture 3, Powerpoint Slides, Geologic Time. ppt

Reference: Organic – Wikipedia Reference link: <https://en.wikipedia.org/wiki/Organic>

Reference: Inorganic compound – Wikipedia Reference link: [https://en.wikipedia.org/wiki/Inorganic\\_compound](https://en.wikipedia.org/wiki/Inorganic_compound)

Reference: Organic vs. Inorganic Compounds: The Main Differences (psiberg.com) Reference link:

<https://psiberg.com/organic-vs-inorganic-compounds/>



**P**  
is for

and

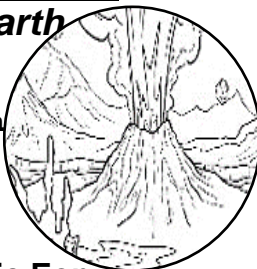
## 1. Precambrian Eon

Time the Earth  
is Created.

4.567 Billion  
Years Ago

Has two:  
Archean Eon  
And Proterozoic Eon

Each Eon in *Precambrian* has an Early Era, Middle Era and Late Era in time. *Precambrian* Eon has No Periods or Epochs in time. Then time rolls forward to **2. *Phanerozoic* Eon ...**



## 2. Phanerozoic Eon

Time Is The Time

Of Visual Signs Of Life.

Has three Era of time:  
Paleozoic Era, Mesozoic Era,  
Cenozoic Era. Each Era has  
Periods in time. Each Period  
has Epochs in time.

**C. Era: Cenozoic Era (humans)**

65 Million Years Ago to Present

**Periods:** Quaternary, Tertiary-Neogene,  
Tertiary-Paleogene

**Epochs:** Holocene, Pleistocene, Pliocene,  
Miocene, Oligocene, Eocene, Paleocene

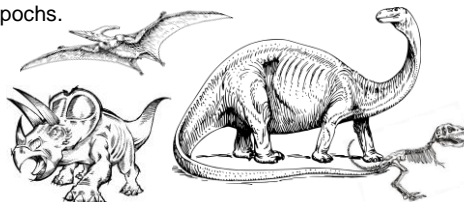


**B. Era: Mesozoic Era (dinosaurs)**

248 Million Years Ago

**Periods:** Cretaceous, Jurassic, Triassic

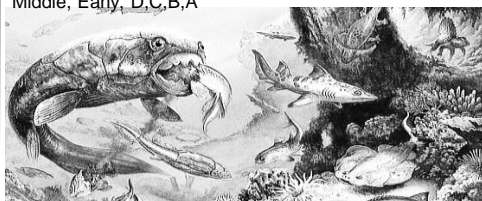
**Epochs:** Each Period had Late, Middle, Early Epochs.



**A. Era: Paleozoic Era (visual life  
543 Million Years Ago detected)**

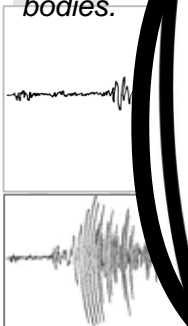
**Periods:** Permian, Pennsylvanian,  
Mississippian, Devonian, Silurian, Ordovician,  
Cambrian

**Epochs:** Late, Early, None for Pennsylvanian and  
Mississippian, Late, Middle, Early, Late, Early, Late,  
Middle, Early, D,C,B,A



# Quakes: Primary, Secondary & Surface Are Three Dimensions Of Waves

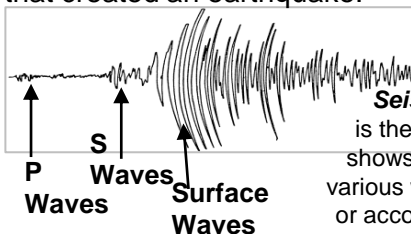
that are the result of breaks in the large bodies of rock in the tectonic plates-*the earthquake*. Unlike sound waves that travel the gaseous atmosphere, seismic waves travel into and through the solid Earth and liquid bodies.



**Seismographs** are machines that recorded waves of earthquakes.

## What causes earthquakes?

Most earthquakes happen along the tectonic plate boundaries of convergent, divergent and transform. The earthquake happens where the large bodies of rock break and move. The **epicenter** is the point at the surface of the Earth that is parallel or straight above the area **focus** where the break in the tectonic plate rock broke that created an earthquake.



**Seismogram** is the record that shows the wave in various waves relative or according to time.

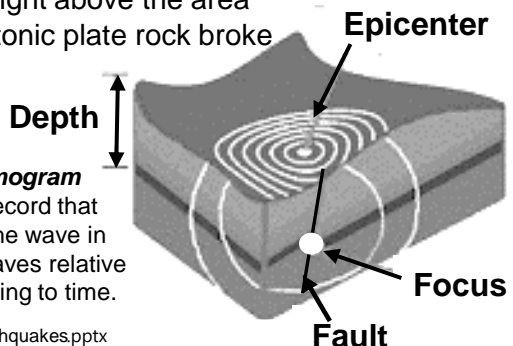
**1.Primary or P Waves** are the primary wave that move parallel to the direction they move, like pushing somebody forward. P waves are the first waves that start at the focus of the break, the initial area of break in the tectonic plate. P waves we can hear also travels through liquids.

**2.Secondary, S Waves or Shake Waves** that move up and down and perpendicular like shaking a rope. S waves travel through solid parts of the Earth but *do not* travel through liquids.

**3.Surface or L Waves** are waves that only travel along the earth's surface. Surface or L waves move in all kinds of directions, literally in several dimensions and in circular patterns. These are the waves that do the most damage to human habitat on the surface of the earth's crust.

# is for quakes

**Seismology is the study of earthquakes.**

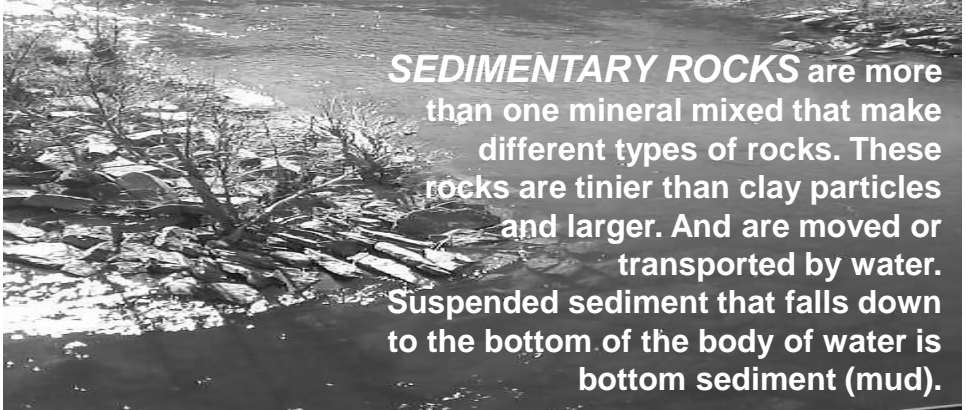


Reference: Ettenshoen, F.R., (Fall 2022) Lecture, Earthquakes.pptx

Reference Website:Science Class: vocabulary 12 earthquakes ([migstyle.blogspot.com](http://migstyle.blogspot.com)) Reference Link:

<http://migstyle.blogspot.com/2010/09/vocabulary-12-earthquakes.html>

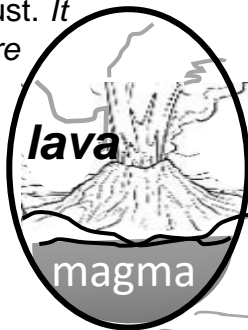
What do seismic waves and sound waves have in common? – Quora Reference link: <https://www.quora.com/What-do-seismic-waves-and-sound-waves-have-in-common>



**IGNEOUS ROCK** are formed of cooled and smooth magma called lava that erupts from a volcano. Magma is stored in magma chambers in the earth's mantle or crust. *It contains more than one mineral combination.*

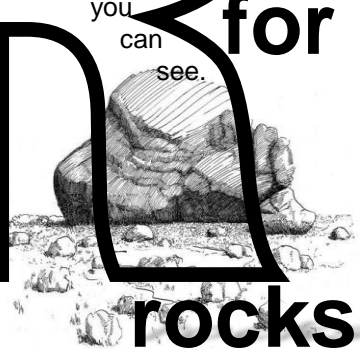
**Five Processes That Create Rocks and Cause Them to Change**

1. Melting
2. Cooling
3. Weathering & Erosion
4. Compaction & Cementing
5. Heat & Pressure



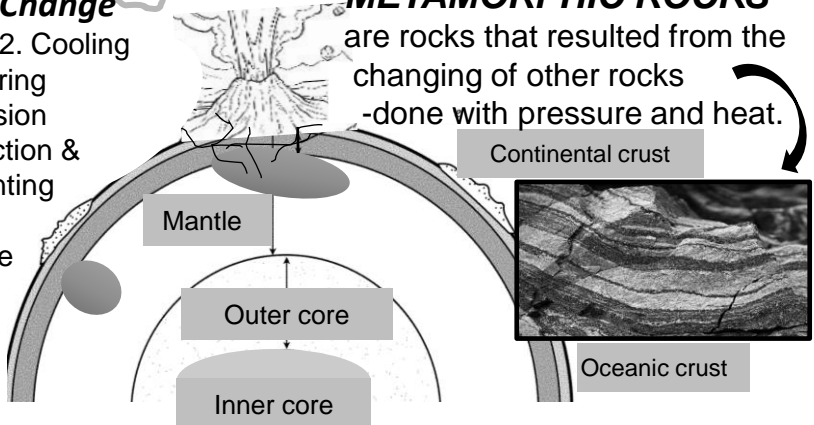
### Characteristics Of A Rock

1. **Inorganic** (not of living matter)
2. **Naturally** occurring aggregate of one or more minerals.
3. **Fabric** or pattern of grain you can see.



### METAMORPHIC ROCKS

are rocks that resulted from the changing of other rocks -done with pressure and heat.



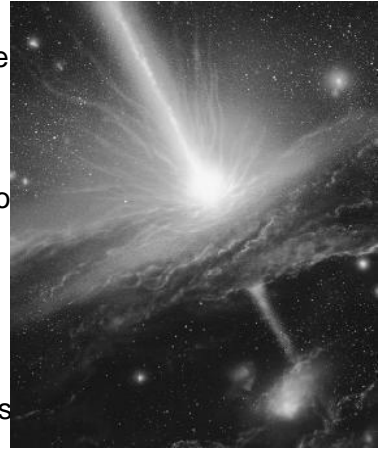
Reference: Ettensohn, F.R., (Fall 2022) Lecture, Minerals and Rocks (new).pptx

Reference: Website: [Sediment and Suspended Sediment | U.S. Geological Survey \(usgs.gov\)](https://www.usgs.gov/faqs/what-are-igneous-rocks)

Reference Website: <https://www.usgs.gov/faqs/what-are-igneous-rocks>



The **sun** is the center of the earth's **solar system** that is located beyond the sky we see. The **solar system** is a black outer space universe that has stars, planets, comets and much more. The planet earth plus eight other planets revolve (rotate) around the **sun** due to an enormous gravitational pull that keeps all the planets flying around it. *During one year of travel around the **sun***, the earth has four seasons that include fall, winter, spring and summer. One revolution or (rotation) around the **sun** for the planet earth is 365 to 366 days a year. The planet earth is the third planet from the **sun**. The earth is the only planet that is 93 million miles away from the **sun** and is in the continuously habitable zone known as the CHZ-meaning the earth is the only planet in our **solar system** that contains life support systems of water H<sub>2</sub>O and other gases. There are many

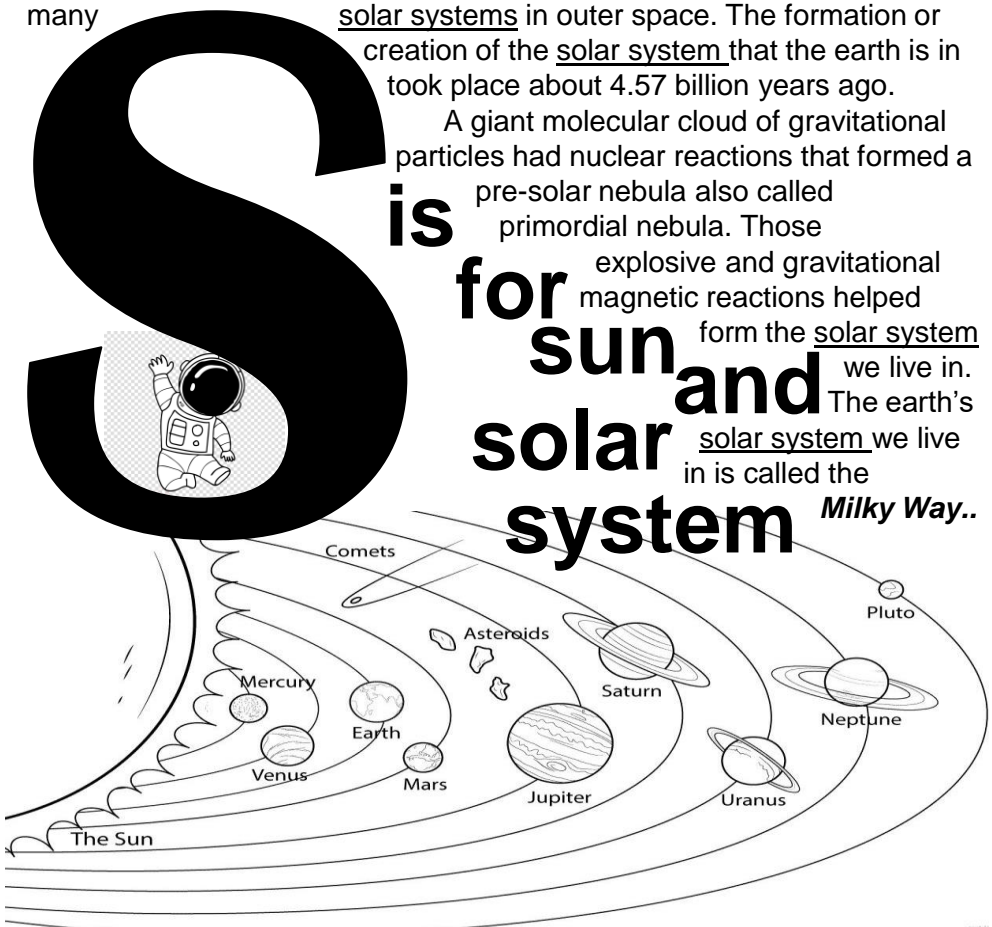


**solar systems** in outer space. The formation or creation of the **solar system** that the earth is in took place about 4.57 billion years ago.

A giant molecular cloud of gravitational particles had nuclear reactions that formed a pre-solar nebula also called primordial nebula. Those

explosive and gravitational magnetic reactions helped form the **solar system** we live in. The earth's **solar system** we live in is called the

**Milky Way..**



The diagram is divided into two main parts. The top part shows five types of plate boundaries with corresponding block diagrams and a cross-section:
 

- Convergent plate boundary:** Two blocks move toward each other.
- Transform plate boundary:** Two blocks slide past each other horizontally.
- Divergent plate boundary:** Two blocks move away from each other.
- Convergent plate boundary (oceanic-oceanic):** Two oceanic plates move toward each other, with one subducting under the other.
- Continental rift zone (young divergent plate boundary):** Two continental blocks move apart, creating a rift.

 A cross-section at the bottom shows the **Lithosphere** and **Subs** (asthenosphere) with arrows indicating mantle convection patterns: rising at mid-ocean ridges and sinking at trenches.

The bottom part of the diagram is a cross-section of the Earth showing the **Outer core** and **Inner core**. It illustrates the **Mantle Convection Cell** with arrows showing material rising at the **Ridge** and sinking at the **Trench**. The **Plate of Lithosphere** is shown moving over the mantle.

<u>Plate Boundary Type</u>	<u>Movement of Plates</u>	<u>Volcanoes</u>	<u>Earthquakes</u>
Constructive/Divergent (Mostly Oceanic bottom)	Plates move away from each other	Yes	Yes (weak)
Destructive/Convergent (Continental plate to Oceanic plate)	Plates movement towards each other	Yes	Yes
Destructive/Convergent (Continental plate to Continental plate)	Plates movement towards each other (collision) (creates folded mountains)	No	Yes
Conservative/Transform (sliders/gliders)	Plates movement slides and glides next to each other	No	Yes

# tectonic plates

is for

is  
for

2. The **Destructive/Convergent plates** is the Oceanic plate that folds under the Continental plate where pressure from convention magma

Reference: Ettenshoorn, F.R., (Fall 2022) Lecture, Powerpoint Slides, Origin of Earths System (2019) ppt  
Reference: Website, Simply Geography. 2021. The 4 Tectonic Plate Boundaries and the hazards they creates. Reference Link:  
<https://www.bing.com/videos/search?q=tectonic+plates&view-detail&mid=556AFB6F0417BFCABCE1&FORM=VRD&ru=%2FVideos%2Fsearch%3Fq%3Dtectonic%2520plates%26qs%3Dn%26%3D%25eManage%2520Your%2520Search%2520History%25E%26p%3D-1%26q%3Dtectonic%2520F%2520%26%3D10-9%26%3D%26v%3D%26v%3D%256B0F5AFB32A469AB4FC90C3B276D281%26hsh%3D00%26hacc%3D0%26hpl%3D%26FORM%3DDVDDVXX>

**Erosion Agents:**

*streams, ground water, wind, ice and mass movement*

**Not** *Catastrophism that formed the first creation of the earth in a series of catastrophes i.e. meteorites.*

*gravity, glaciers and waves and tides.*

# Weathering

## Erode

is the break down of rocks that include the weathering agents of water, ice, wind, animals, and growing plants.

## Transport

is the movement of sedimentary rocks that include mud in water transport. Stream transport of sediment are in the uplift in *three* uploads: Bedload, suspended load, dissolved load. The erosion agents for stream movement are water, wind, ice and gravity.

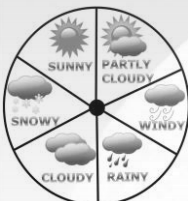
# uniformitarianism

**Uniformitarianism** is the process of slow continuous change over a large expansion of time of the earth's surface by reference to causes in present time

**Uniformitarianism** processes gradually reshape and reform the earth's surface still today through the gradual forces of operation are erosion, deposition, lifting that act continuously over a long period of time.

**deposit** is where the sedimentary rocks are dropped went the gravity and water slows due to the sun evaporation or reduced wind movement.

HOW'S THE WEATHER TODAY?



Reference: Ettenshoen, F.R., (Fall 2022) Lecture2,3,15, Powerpoint Slides, Study of Geology ppt., Igneous Rocks, Streams and Weathering. ppt

Reference: Uniformitarianism – Wikipedia Website. Reference link: <https://en.wikipedia.org/wiki/Uniformitarianism>  
What Is Uniformitarianism What Theory Did It Oppose – TISWHA Website. Reference link: <https://tiswha.blogspot.com/2021/01/what-is-uniformitarianism-what-theory.html>



## Four Volcanoes with Three Key Points: Outstanding Feature, Lava Rock Expelled and Tectonic Plate

### 1. Stratovolcanoes:

\*High volcano. \*Highly explosive. \*Rocks are igneous rocks of felsic with rhyolite extrusive and granite intrusive. Includes Igneous Intermediate rocks of andesite extrusive and diorite intrusive \*Tectonic plates are *Destructive/Convergent* plates- the *Oceanic* plate folds under the *Continental* plate.



Stratovolcano

Mount Fuji



Caldera Volcano

Quilotoa Crater, Lake Ecuador

### 3. Caldera Volcanoes:

\*Volcanoes crater collapses into an empty magma chamber. \*Rocks from lava are all types of igneous rocks. \*Tectonic plates are *Constructive/Divergent* of *Eurasian and North America*.



Shield Volcano

Hawaii

### 2. Shield Volcanoes:

\*Low level volcanoes. \*Not explosive. \*Lava rocks are igneous mafic, basalt extrusive with gabbro intrusive-(lava flow is almost like water) \*Tectonic plates are not near the Hawaiian shield volcanoes. The movement of the volcanic activity is

distributed by the *Oceanic* plates over an upwelling of magma known as the hotspot.

is for

# volcanoes

### 4. Cinder Cone Volcanoes:

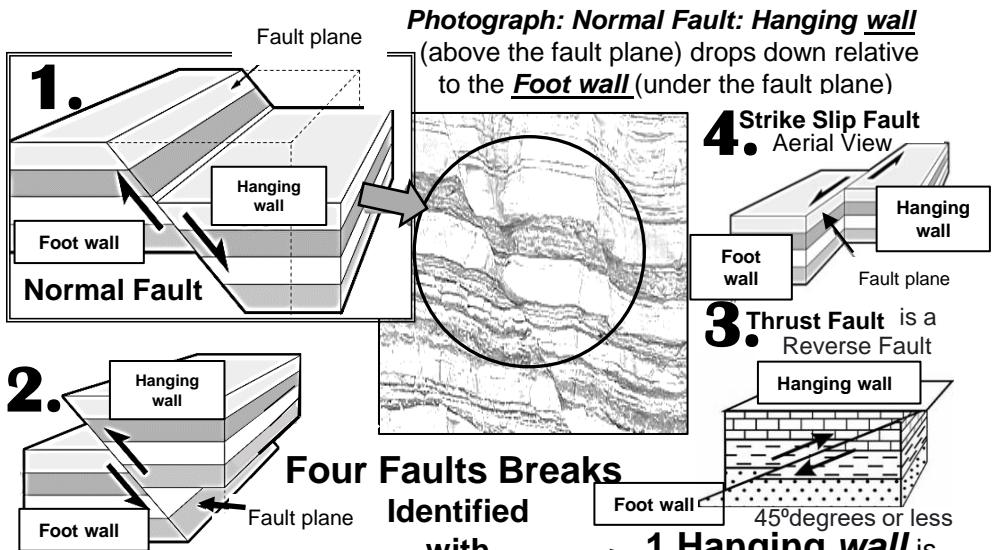
\*Low level volcanoes circular cone shaped crater. \*Erupts with more gas than lava -(gas produces cinder cones).

\*Rocks are pyroclastic, scoria and loose cinders that are sand size debris. \*Tectonic plates are *Destructive/Convergent* plates of where the *Oceanic* plate rolls underneath the *Continental* plate or *Oceanic* plate.



Cinder Cone Volcanoes

Mauna Kea



# FAULTS

*Faults* are not cracks or joints in the earth surface crust. *Faults* are the **break** in the earth's surface crust of rock caused by **stress**. The tectonic plates of rock provided the movement of stress to break the rock in no particular size or length.



**2. Foot wall** is the side of the rocks on the lower side of an incline fault plane.

the **foot wall** and the **hanging wall**

are the two main clues to what kind of fault break was made during rock movement that includes movement by tectonic rock plates.

**wall**

with Two Clues

## Walls Identify Faults

**1. Hanging wall** is the upper or overlying block of rock along fault plane.



**for Stress The Three Types:**

*Stress-the force applied over an area,*

**1. Tensional stress**-to pull apart in the opposite direction for a break to occur.

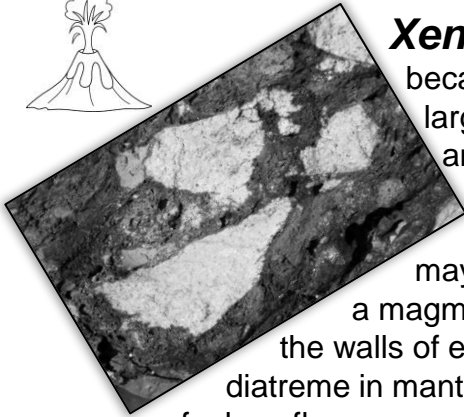
**2. Compressional stress**- to push together in the same direction for a break to occur. (Destructive/Convergent Tectonic Plates.)

**3. Shear stress**-to glide/slide by each other in opposite directions. (Conservative Transform Tectonic Plates)

*Strain-the result of stress in the change of shape.*



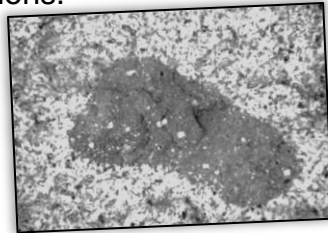
**Xenoliths** are rock fragments that became mixed, enveloped within a larger rock during its development and solidification (cooling off period).



**Xenoliths** (fragmented rocks) may be pulled in along the margins of a magma chamber, rock torn or loose from the walls of erupting lava or explosive diatreme in mantle or picked up by the flowing base of a lava flow.

**Xenoliths** (fragmented rocks) are formed at different time periods and at times different temperatures and pressure conditions.

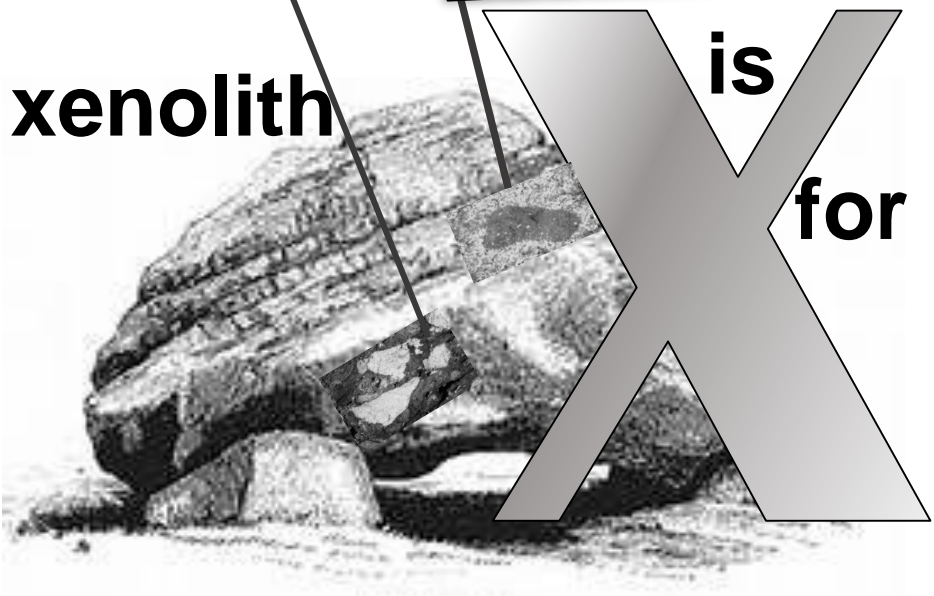
**Geologists** study xenoliths for information on the Earth's mantle to understand the depth the rocks are formed.



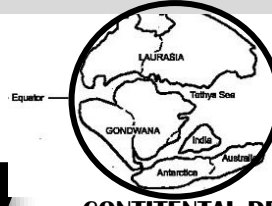
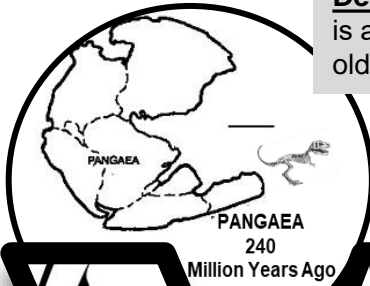
**xenolith**

**is**

**for**



**Deep Time** is the **concept** that geological time is a scale of vast time because the earth's very old. Universe is 13,800,000,000 or 13.8 Ga



**LAURASIA**  
180 to 85  
Million Years Ago

**CONTINENTAL DRIFT IS CONTINUAL**

The Earth's Crust floats on magma (lava). Tectonic plates still move the earth's crust today evidence through earthquakes and volcanoes in formation of new earth that starts with lava.



Present Day  
2022

**Measurement**  
Ga = billion

Earth's Age is  
4,567,000,000 or 4.5 Ga

Geology  
Derived  
from two  
Greek words  
Geos (Earth)  
and  
Logos (study  
of or  
understanding)

is  
for  
Years  
in

**Geological**

**Gregorian Calendar** is the orbital calendar used present day for most of the world that accumulates time in a four year period for an extra day on the calendar called Leap Year.

## **TWO TYPES OF GEOLOGICAL TIME**

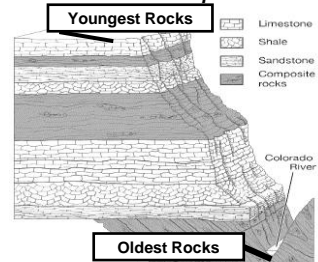
**1. Relative Time** are the ages based on **relationships**.

Time dated from the youngest to the oldest in age dating of inorganic and organic rocks and layers of rocks that made of the Earth's crust. The youngest rocks are at the top layer of the earth's crust are the most recent lava cooled into igneous rock and the rocks at the bottom of the earth's crust being the oldest in formation of the earth's crust.

**2. Absolute Time** the specific age of an item. Scien measured time in **units** of years usually determined radiometrically based on elemental half lives at a known rate of the parent atoms of decay to daughter atoms. Methods measured physical properties of object itself.

**Two Methods Used in Measuring Absolute Time:**

1. **Uranium** dating used to date inorganic rock samples and to date index fossils. 2. **Carbon** dating used for organic rock samples and impression and compression types of fossils.



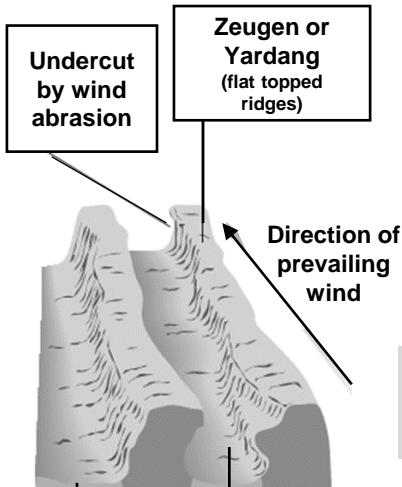
Reference: Ettenshoen, F.R., (Fall 2022) ppt slides, Lecture 3, Geological Time

Reference: Answered: How does Uranium dating differ from... | Bartleby (2022) Reference link:

<https://www.bartleby.com/questions-and-answers/how-does-uranium-dating-differ-from-carbon-dating-as-an-absolute-dating-technique-i-uranium-dating-8b7c7e6c-190c-4d41-b573-ad460f2ab699>

Reference: **Gregorian calendar** - Wikipedia Reference link: [https://en.wikipedia.org/wiki/Gregorian\\_calendar](https://en.wikipedia.org/wiki/Gregorian_calendar)



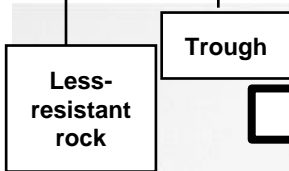
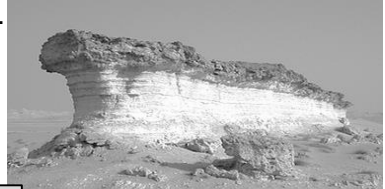


## Wind Erosion in the Desert

In the desert areas of climates that had little or no rain, called arid areas, the landscapes of rocks are under the process of wind erosion of wind abrasion.

**Agents of Erosion** include: wind, water, streams, groundwater, mass movement, glaciers (ice) and waves and tides (beach processes).

Up to  
100ft  
(30m) high



## Zeugen or

### The Wind Abrasion, Transport And Deposition Processes

**\*Abrasion** is the process action result of dust, sand and pebbles that are sediments hitting against rock causing the reaction of rock being chipped away.

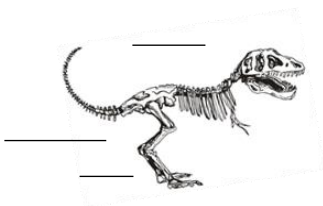
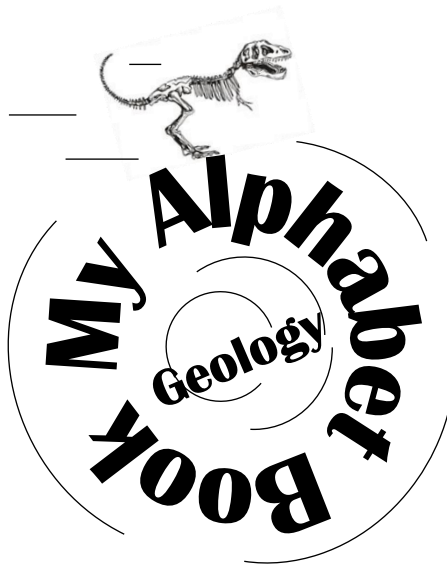
is  
for

In arid areas, large rock formations were formed of horizontal layers of hard and soft rocks in huge tablet shape. Over time the huge tablet of rocks formed joints. Those joints expanded by dew and temperature change. The wind abrasion, transport and deposition processes created furrows/channels in the soft rocks. As a result the hard flat rock formed ridges called **Zeugen or Yardang**.

## Yardang

**\*Transport** is the process of carrying the suspended load dust, sand and pebbles in an erosion agent or agents. **\*Deposition** is the process of where the chipped away rock and the sediments are released and dropped by their agent of erosion.

# CORE CONTENT/CURRICULM STANDARDS PER ALPHABET LETTER



## **Core Content/Curriculum Standards**

- ✓ The following pages contain an educational core standard for the alphabet letter that is displayed in text, illustration and graphic depiction throughout this book.
- ✓ Educational core standards are guidelines used in public schools in the United States of what is taught under certain topics of the educational grade level in curriculum.
- ✓ This tells you what exposure grade level of science the topic of the alphabet letter covers that is displayed for comprehensive understanding in text and visual view.
- ✓ Two standards were applied to several alphabetic letters, but not all, for instructors inclusion of more than one topic area of lesson plans.

# CORE CONTENT/CURRICULUM STANDARDS PER ALPHABET LETTER

## Letter is for Word with Core Standard Underneath

### **A is for Atoms**

SC-E-2.1.1: Earth materials are solid rocks and soils, water, and the gases of the atmosphere. Water on earth and in the atmosphere can be a solid, liquid or gas.

### **B is for Batholith**

4-ESS1.1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. [Clarification Statement: Examples of evidence from patterns could include rock layers with shell fossils above rock layers with plant fossils and no shells, indicating a change from water to land over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.][Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.]

### **C is for Constructive Processes**

4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features. [Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes.]

### **D is for Destructive Processes**

4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features. [Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes.]



# **CORE CONTENT/CURRICULUM STANDARDS PER ALPHABET LETTER**

## **Letter is for Word with Core Standard Underneath**

### **E is for Element**

E-2.1.1: Earth materials are solid rocks and soils, water, and the gases of the atmosphere. Water on earth and in the atmosphere can be a solid, liquid or gas.

### **F is for Fossil**

3-LS4-1. Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago. (Clarification Statement: Examples of data could include type, size, and distributions of fossil organisms. Examples of fossils and environments could include marine fossils found on dry land, tropical plant fossils found in the Arctic areas, and fossils of extinct organisms.) (Assessment Boundary: Assessment does not include identification of specific fossils or present plants and animals. Assessment is limited to major fossil types and relative ages.)

### **G is for Geology**

SC-E-3.3.2: When the environment changes some plants and animals survive and reproduce and others die or move to new locations.

### **H is for Hypotheses**

K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

# **CORE CONTENT/CURRICULUM STANDARDS PER ALPHABET LETTER**

## **Letter is for Word with Core Standard Underneath**

### **I is for Intrusive**

4-ESS1.1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. [Clarification Statement: Examples of evidence from patterns could include rock layers with shell fossils above rock layers with plant fossils and no shells, indicating a change from water to land over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.][Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.]

### **J is for Joint**

4-ESS1.1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. [Clarification Statement: Examples of evidence from patterns could include rock layers with shell fossils above rock layers with plant fossils and no shells, indicating a change from water to land over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.][Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.]

# CORE CONTENT/CURRICULUM STANDARDS PER ALPHABET LETTER

## **Letter is for Word with Core Standard Underneath**

### **K is for Kentucky**

4-ESS1.1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. [Clarification Statement: Examples of evidence from patterns could include rock layers with shell fossils above rock layers with plant fossils and no shells, indicating a change from water to land over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.][Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.]

### **L is for Layers and Laws**

4-ESS1.C: The History Of Planet Earth -- Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. (4-ESS1-1)

### **M is for Minerals**

SC-E-2.1.1: Earth materials are solid rocks and soils, water, and the gases of the atmosphere. Water on earth and in the atmosphere can be a solid, liquid or gas.

# CORE CONTENT/CURRICULUM STANDARDS PER ALPHABET LETTER

## Letter is for Word with Core Standard Underneath

### **N is for Nuclear Reactions**

Fifth Grade:PS2.B: Types of Interactions. The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center. (5-PS2-1) ESS1.A: The Universe and its Stars The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth. (5-ESS1-1). ESS1.B: Earth and the Solar System. The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year. (5-ESS1-2)

### **O is for Organic**

4-ESS1.1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. [Clarification Statement: Examples of evidence from patterns could include rock layers with shell fossils above rock layers with plant fossils and no shells, indicating a change from water to land over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.][Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.]

# CORE CONTENT/CURRICULUM STANDARDS PER ALPHABET LETTER

## **Letter is for Word with Core Standard Underneath**

### **P is for Precambrian and Phanerozoic**

ESS1.C: The History of Planet Earth -- The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale. (08-ESS1-4) § Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches. (HS.ESS1.C GBE) (secondary to 06-ESS2-3)

### **Q is for Quakes**

4-ESS1.1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. [Clarification Statement: Examples of evidence from patterns could include rock layers with shell fossils above rock layers with plant fossils and no shells, indicating a change from water to land over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.][Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.]

# **CORE CONTENT/CURRICULUM STANDARDS PER ALPHABET LETTER**

## **Letter is for Word with Core Standard Underneath**

### **R is for Rocks**

4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. (Clarification Statement. Examples of evidence from patterns could include rock layers with shell fossils above rock layers with plant fossils and no shells, indicating a change from water to land over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.) (Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.)

4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice wind, or vegetation. (Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.) (Assessment Boundary: Assessment is limited to a single form of weathering or erosion.



# CORE CONTENT/CURRICULUM STANDARDS PER ALPHABET LETTER

## Letter is for Word with Core Standard Underneath

### **S is for Sun and solar system**

ESS1.A: The Universe and its Stars. Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted. (1-ESS1-1)

ESS1.B: Earth and the Solar System Seasonal patterns of sunrise and sunset can be observed, described, and predicted. (1-ESS1-2)

### **T is for Tectonic Plates**

4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features. [Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes.]

### **U is for Uniformitarianism**

4-ESS2-1. Make observations and /or measurements to provide evidence of the effects of the weathering or rate of erosion by water, ice, wind, or vegetation. [Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.] [Assessment Boundary: Assessment is limited to a single form of weathering or erosion]

### **V is for Volcanoes**

2-ESS1-1. Use information from several sources to provide evidence that Earth events can occur quickly or slowly. [Clarification Statement: Examples of events and timescales could include volcanic explosions and earthquakes, which happen quickly and erosion of rocks, which occurs slowly.] [Assessment Boundary: Assessment does not include quantitative measurements of timescales.]

# CORE CONTENT/CURRICULUM STANDARDS PER ALPHABET LETTER

## **Letter is for Word with Core Standard Underneath**

### **W is for Wall**

4-ESS1.1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. [Clarification Statement: Examples of evidence from patterns could include rock layers with shell fossils above rock layers with plant fossils and no shells, indicating a change from water to land over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.][Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.]

### **X is for Xenolith**

4-ESS1.1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. [Clarification Statement: Examples of evidence from patterns could include rock layers with shell fossils above rock layers with plant fossils and no shells, indicating a change from water to land over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.][Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.]

# CORE CONTENT/CURRICULUM STANDARDS PER ALPHABET LETTER

## Letter is for Word with Core Standard Underneath

### **Y is for Years**

2-ESS1-1. Use information from several sources to provide evidence that Earth events can occur quickly or slowly.

[Clarification Statement: Example of events and timescales could include volcanic explosions and earthquakes, which happened quickly and erosion of rocks, which occurs slowly.] [Assessment Boundary: Assessment does not include quantitative measurements of timescales]

4-ESS2-1. Make observations and /or measurements to provide evidence of the effects of the weathering or rate of erosion by water, ice, wind, or vegetation. [Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.] [Assessment Boundary: Assessment is limited to a single form of weathering or erosion]



### **Z is for Zeugen or Yardang**

4-ESS1.1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. [Clarification Statement: Examples of evidence from patterns could include rock layers with shell fossils above rock layers with plant fossils and no shells, indicating a change from water to land over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.] [Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.]





