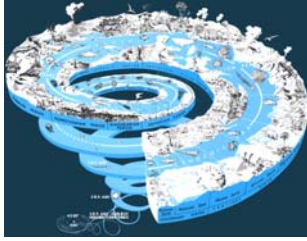


## Geologic Time Scale



Source: [http://en.wikipedia.org/wiki/Geologic\\_time\\_scale](http://en.wikipedia.org/wiki/Geologic_time_scale)

## Precambrian Time



Source: [http://sjhsearthscience.blogspot.com/2007\\_10\\_01\\_archive.html](http://sjhsearthscience.blogspot.com/2007_10_01_archive.html)

### This term:

- defined as the timing and relationships between events that have occurred during Earth's history

### This time:

- 4.6 billion – 2.5 billion years ago
- includes the Proterozoic, Archean, and Hadean eons

## Hadean Eon



Source: [http://www.novacelestia.com/images/hadean\\_earth\\_space\\_art.html](http://www.novacelestia.com/images/hadean_earth_space_art.html)

## Archaean Eon



Source: <http://www.ucmp.berkeley.edu/precambrian/archaeon.html>

### This eon:

- 4.5 billion - 3.9 billion years ago
- Earth formed as a solid planet
- provided no traces of life

### This eon:

- 3.9 billion - 2.5 billion years ago
- Earth's permanent crust formed
- vast amounts of metallic minerals were deposited
- oceans and atmosphere were created as the result of volcanic outgassing
- earliest life forms evolved in the seas

## Proterozoic Eon



Source: <http://www.physics4u.gr/articles/2004/geologicaltimescale1.html>

## Phanerozoic Eon



Source: <http://sil.usask.ca/palaeoclimatology.htm>

### This eon:

- 2.5 billion - 542 million years ago
- supercontinent Rodinia formed
- plate tectonics slowed to the present rate
- large mountain chains formed
- quartz-rich sandstones, shales, and limestones were deposited
- oxygen levels increased as life developed the ability photosynthesize
- eukaryotes evolved

### This eon:

- 542 million – present
- includes the Paleozoic, Mesozoic, and Cenozoic eras
- diverse, hard-shelled animals first appeared

## Paleozoic Era



Source: <http://www.palaeos.org/images/thumb/4/40/Dev11.gif/320px-Dev11.gif>

## Cambrian Period



Source: <http://www.biologyreference.com/BI-Ce/Cambrian-Explosion.html>

### This era:

- 542 million - 248 million years ago
- includes the Cambrian, Ordovician, Silurian, Devonian, Carboniferous, and Permian periods

### This period:

- 542 million - 490 million years ago
- part of the Paleozoic era
- sedimentary rocks formed in shallow seas
- Rodinia broke up and Gondwana formed
- had a generally mild climate
- marine metazoans with mineralized skeletons flourished; plant life was limited to marine algae

## Ordovician Period



Source: <http://www.villagesilversmith.net/orthoceras.ivnu>

## Silurian Period



Source: <http://museum.gov.ns.ca/fossils/geol/silur.htm>

### This period:

- 490 million– 443 million years ago
- part of the Paleozoic era
- Laurentia, Baltica, Siberia, and Gondwana separated by large oceans
- shallow seas covered North America, leaving limestone; seas recovered North America, depositing quartz, sandstones, and more limestone
- metazoan invertebrates dominant form of life; mass extinction of marine life

### This period:

- 443 million – 417 million years ago
- part of the Paleozoic era
- North American, European, and Asia near the equator; Laurentia and Baltica collided; Gondwana near the south polar region
- shallow flooding of continental areas deposited sediments; left oxidized "red beds" and extensive salt deposits
- sea life dominated by invertebrates; first sharks appeared

## Devonian Period



Source: [http://moldychum.typepad.com/moldy\\_chum/2007/08/angling-would-h.html](http://moldychum.typepad.com/moldy_chum/2007/08/angling-would-h.html)

## Carboniferous Period



Source: [http://www.naturenorth.com/dragonfly/DOM/Page03\\_Palaeobiology.html](http://www.naturenorth.com/dragonfly/DOM/Page03_Palaeobiology.html)

### This period:

- 417 million - 354 million years ago
- part of the Paleozoic era
- Europe and North America collided, forming ancestral Appalachians near the equator; Africa and South America positioned over the South Pole
- climate generally warm and moist
- dominated by fish; ammonites evolved
- first air-breathing arthropods
- plant life spread over the planet

### This period:

- 354 million– 290 million years ago
- part of the Paleozoic era
- Laurasia formed in the north and Gondwana to the south; collisions formed mountains
- coal-forming sediments in vast swamps
- global climatic changes from warm and wet to cooler and drier; result was long interval of glaciation in southern hemisphere
- fish diversified; insects flourished; first reptiles evolved

## Permian Period

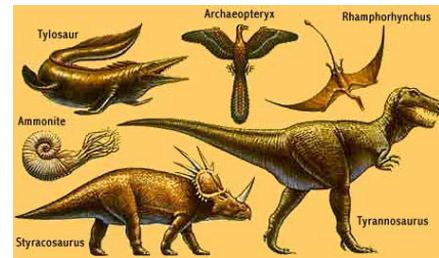


Source: <http://www.kheper.net/evolution/therapsida/index.html>

### This period:

- 290 million - 248 million years ago
- part of the Paleozoic era
- supercontinent Pangaea forms
- extensive glaciation in what is now India, Australia, and Antarctica; hot, dry conditions prevailed; deserts became widespread
- rich and diverse invertebrate marine life
- 99% of all life perished
- insects and reptiles continued to evolve
- ferns and conifers persisted in cool air

## Mesozoic Era



Source: [http://www.worldbook.com/wb/images/content\\_spotlight/dinosaurs/mesozoicdinos.jpg](http://www.worldbook.com/wb/images/content_spotlight/dinosaurs/mesozoicdinos.jpg)

### This era:

- 248 million - 65 million years ago
- includes the Triassic, Jurassic, and Cretaceous periods

## Triassic Period



Source: [http://chdmuseum.nic.in/history\\_museum/index.html](http://chdmuseum.nic.in/history_museum/index.html)

## Jurassic Period



Source: [http://uk.encyarta.msn.com/media\\_461520249/life\\_in\\_the\\_jurassic\\_period.html](http://uk.encyarta.msn.com/media_461520249/life_in_the_jurassic_period.html)

### This period:

- 248 million – 206 million years ago
- part of the Mesozoic era
- Pangaea covered nearly  $\frac{1}{4}$  of Earth's surface
- marked by few significant geologic events
- continental rifting began to break apart Pangaea
- general climate was warm, becoming semiarid to arid
- dinosaurs and reptiles evolved
- ferns, cycads, ginkgoes, and conifers flourished

### This period:

- 206 million– 144 million years ago
- part of the Mesozoic era
- Pangea broke up as North America separated from Eurasia and Africa; Atlantic Ocean began to form
- tectonic plate subduction caused Earth's crust to fold and mountains to form
- reptiles adapted to life in sea, air, and on land; dinosaurs were dominant land reptiles; mammals were small, shrew-like animals

## Cretaceous Period



Source: [http://www.worldbookonline.com/wb/Students?content\\_spotlight/dinosaurs/world\\_mesozoic](http://www.worldbookonline.com/wb/Students?content_spotlight/dinosaurs/world_mesozoic)

## Cenozoic Era



Source: <http://animals.howstuffworks.com/animal-facts/mammal-info.htm>

### This period:

- 144 million– 65 million years ago
- part of the Mesozoic era
- continents had similar shapes as present; South America and Africa separated; Atlantic ocean widened; Tethys Sea formed
- Rocky Mountains and Sierra Nevada formed
- sea levels rose, submerging about 30% of Earth's present land
- climate generally warm; poles free of ice
- dinosaurs and ammonites dominated

### This era:

- 1.8 million years ago - present
- includes the Tertiary and Quarternary periods

## Tertiary Period



Source: <http://www.britannica.com/EBchecked/topic-art/588461/6907/Phenacodus-restoration-painting-by-Charles-R-Knight-1898>

## Paleocene Epoch



Source: <http://www.dmns.org/main/minisites/ancientDenvers/dia.html>

### This period:

- 65 million – 1.8 million years ago
- part of the Cenozoic era
- includes the Paleocene, Eocene, Oligocene, Miocene, and Pliocene epochs

### This epoch:

- 65 million – 55 million years ago
- part of the Tertiary period
- inland Cretaceous seas dried up, exposing large land areas in North America and Eurasia; Australia separated from Antarctica; Greenland split from North America
- remnant Tethys Sea persisted in the equatorial region
- mammalian life diversified; placental mammals dominated land

## Eocene Epoch



Source: <http://commons.wikimedia.org/wiki/File:Mesonyx.jpg>

## Oligocene Epoch



Source: <http://www.prehistory.com/bronto.htm>

### This epoch:

- 55 million – 34 million years ago
- part of the Tertiary period
- plate tectonics and volcanic activity formed Rockies; erosion filled basins; continental collisions between India and Asia created Alpine-Himalayan mountains; Antarctica and Australia continued to separate
- climate was subtropical and moist in North America and Europe
- early forms of horse, rhinoceros, camel, whales, sirenians, and bats evolved

### This epoch:

- 34 million – 24 million years ago
- part of the Tertiary period
- Africa and Europe nearly collided, leaving the Mediterranean Sea
- southern ocean formed; climate was temperate; glaciation began in Antarctica
- representatives of modern mammals became dominant and diversified; early apes appeared in Egypt
- grasslands expanded, forests diminished

## Miocene Epoch



Source: <http://www.adias-uae.com/stegotetrabelodon.html>

## Pliocene Epoch



Source: [http://www.webdyer.com/artifacts\\_fossils/time\\_periods/cenozoic\\_epochs/Pliocene.htm](http://www.webdyer.com/artifacts_fossils/time_periods/cenozoic_epochs/Pliocene.htm)

### This epoch:

- 24 million – 5 million years ago
- part of the Tertiary period
- modern ocean currents established; drop in sea level dried up the Mediterranean
- climate was cooler; cold transantarctic ocean current isolated waters around Antarctica
- half of mammal families and whales, seals, walrus, and modern birds were present; higher primates evolved
- coasts were submerged; kelp forests developed; grasslands replaced forests

### This epoch:

- 5 million – 1.8 million years ago
- part of the Tertiary period
- Isthmus of Panama emerged; Arctic ice cap formed; plate tectonics uplifted Sierra Nevada; formation of Cascades; strike-slip faulting on San Andreas; Alps rose
- global climates became cooler and drier
- camels and horses abundant; *Australopithecines*, antecedents to *Homo sapiens*, developed; in North America, rhinoceroses and orodeonts became extinct

## Quarternary Period



Source: <http://www.uky.edu/KGS/fossils/quatern.htm>

## Pleistocene Epoch



Source: [http://www.associatedcontent.com/article/164740/earths\\_pleistocene\\_epoch.html?cat=58](http://www.associatedcontent.com/article/164740/earths_pleistocene_epoch.html?cat=58)

### This period:

- 1.8 million years ago - present
- part of the Cenozoic era
- includes the Pleistocene and Holocene epochs

### This epoch:

- 1.8 million – 10,000 years ago
- part of the Quarternary period
- "Great Ice Age;" glaciers encroached and retreated; Great Lakes formed
- global warming began
- *Homo habilis* evolved
- flora and fauna in some regions unchanged; mammalian evolution included woolly mammoth, woolly rhinoceros, and others; some large mammals became extinct

## Holocene Epoch



Source: <http://blogs.smithsonianmag.com/thegist/2008/01/31/the-anthropocene-epoch/>

## Rodinia



Source: <http://www.palaeos.com/Proterozoic/Proterozoic.htm>

### This epoch:

- 10,000 years ago - present
- part of the Quarternary period
- may be interval between glacial incursions; marked by the presence and influence of *Homo sapiens*
- glaciers retreated, sea levels rose, climate warmed, and deserts formed
- human civilization developed and activities affect world climates
- species extinction continues

### This continent:

- formed about 1.1 billion years ago
- was one of the oldest known supercontinents
- began to break up during the Cambrian period

## Gondwana



Source: <http://www.gondwana.at/>

## Laurentia



Source: <http://profile.myspace.com/index.cfm?fuseaction=user.viewProfile&friendID=118408434>

This continent:

- during the Cambrian period incorporated South America, Africa, Antarctica, and Western Australia as well as peninsular India and parts of Arabia

This continent:

- during the Ordovician period, with the continents of Baltica, Siberia, and Gondwana, were separated by large oceans
- collided with Baltica during the Silurian period

## Baltica



Source: <http://www.palaeos.com/Earth/Geography/Baltica.html>

## Siberia



Source: <http://student.britannica.com/comptons/art-66985/The-Yenisey-River-cuts-northward-across-the-vast-region-of>

This continent:

- during the Ordovician period, with the continents of Laurentia, Siberia, and Gondwana, were separated by large oceans
- collided with Laurentia during the Siurian period

This continent:

- during the Ordovician period, with the continents of Laurentia, Baltica, and Gondwana, were separated by large oceans



## Laurasia



Source: <http://www.geo.arizona.edu/Antevs/ecol438/lect06.html>

## Eurasia



Source: <http://schencka.mindsay.com/leadership.mws>

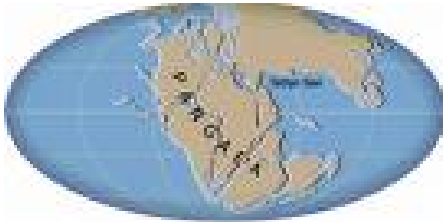
### This continent:

- during the Carboniferous period included North America, Greenland, Eurasia, and Scandinavia
- collisions with Gondwana formed major mountain ranges

### This continent:

- part of Laurasia during the Carboniferous period
- during the Paleocene large inland seas dried up exposing vast areas

## Pangaea



Source: <http://www.websitetoolbox.com/tool/post/apologia/printadd?id=2532923&pid=25766887>

## Supercontinent



Source: <http://ponderingconfusion.com/expanding.shtml>

### This continent:

- formed during the Permian period
- during the Triassic period covered nearly  $\frac{1}{4}$  of Earth's surface

### This term:

- landmass comprising more than one continental core, or craton

## Ice Age



Source: <http://www.answersingenesis.org/articles/am/v2/n2/setting-stage-for-ice-age>

This term:

- period of lower temperatures, resulting in an expansion of ice sheets and glaciers

## Extinction Event



Source: [http://www.scienceagogo.com/news/20061026232914data\\_trunc\\_sys.shtml](http://www.scienceagogo.com/news/20061026232914data_trunc_sys.shtml)

This term:

- sharp decrease in the number of species in a relatively short period of time

## Craton



Source: <http://www.nationmaster.com/encyclopedia/Laurentia>

This term:

- old and stable part of the continental crust that has survived the merging and splitting of continents and supercontinents for at least 500 million years

## Panthalassa



Source: <http://en.wikipedia.org/wiki/File:Pangaea.png>

This ocean:

- surrounded the supercontinent Pangaea, during the Paleozoic and the early Mesozoic eras

## Tethys



Source: <http://en.wikipedia.org/wiki/File:Laurasia-Gondwana.png>

## Continent



Source: <http://lcweb2.loc.gov/frd/cs/continent.html>

### This ocean:

- existed between the continents of Gondwana and Laurasia before the opening of the Indian Ocean during the Mesozoic era

### This term:

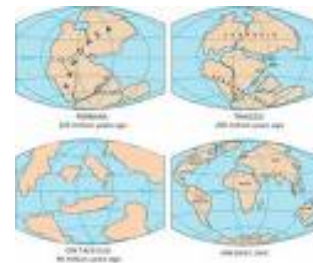
- ancient ones include Pangaea and Gondwana
- modern ones include Africa, North and South America, Antarctica, Asia, Australia, and Europe

## Plate Tectonics



Source: [http://faculty.kutztown.edu/friehauf/friehauf\\_personal.html](http://faculty.kutztown.edu/friehauf/friehauf_personal.html)

## Continental Drift



Source: <http://doodlius.blogspot.com/2007/11/here-today-gone-tomorrow.html>

### This term:

- large scale motion of Earth's lithosphere
- includes the concepts of continental drift and sea floor spreading

### This term:

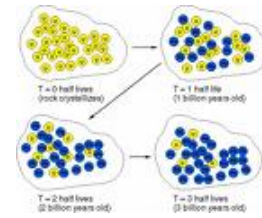
- movement of Earth's plates relative to each other
- geological explanation was provided by plate tectonics

## Sea Floor Spreading



Source: [http://www.uwsp.edu/geo/faculty/ritter/glossary/S\\_U/sea\\_flr\\_spread.html](http://www.uwsp.edu/geo/faculty/ritter/glossary/S_U/sea_flr_spread.html)

## Radiometric Dating



Source: [http://people.hofstra.edu/j\\_b\\_bennington/2cnotes/dating.html](http://people.hofstra.edu/j_b_bennington/2cnotes/dating.html)

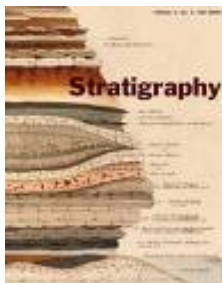
### This term:

- occurs at mid-ocean ridges, where new oceanic crust is formed through volcanic activity and then gradually moves away from the ridge
- helps explain continental drift

### This term:

- used to determine the age of materials, usually based on a comparison between the observed abundance of a naturally occurring isotope and its decay products
- principal source of information about the absolute age of rocks and other geological features, including the age of the Earth itself

## Stratigraphy



Source: <http://www.micropress.org/stratigraphy/papers.html>

## Unconformity



Source: <http://www.castlekirk.co.uk/geology.html>

### This term:

- study of rock layers and layering
- primarily used in the study of sedimentary and layered volcanic rocks

### This term:

- buried erosion surface separating two rock masses or strata of different ages, indicating that sediment deposition was not continuous
- types are disconformity, nonconformity, and angular unconformity

## Paleogeology



Source: <http://paleogeology.blogspot.com/2008/10/hornfels.html>

## Ocean



Source: <http://www.kidsgeo.com/geography-for-kids/0143-ocean-movements.php>

### This term:

- historical geological state of a particular area
- study of the geologic history and origins of the Earth, including reconstructions of previous configurations of continents, the history and evolution of Earth's surface geological configuration, formation and development of continents

### This term:

- ancient ones include Panthalassa and Tethys
- modern ones include the Pacific, Atlantic, Indian, Antarctic

## Orogeny



Source:

[http://www.geology.wisc.edu/~unstable/Orogenic\\_Belts/Orogenic\\_Belts.htm](http://www.geology.wisc.edu/~unstable/Orogenic_Belts/Orogenic_Belts.htm)

## Fossil



Source: <http://news.nationalgeographic.com/news/2007/08/070816-fossil-spider.html>

### This term:

- process of natural mountain building
- occurs as a result of plate tectonics

### This term:

- preserved remains or traces of animals, plants, and other organisms from the remote past
- range in age from the youngest at the start of the Holocene Epoch to the oldest from the Archaean Eon which are several billion years old

History of the Earth Card Data Set #1 Color: red

A	B	A	B	A	B	A	B
Question card number	Answer card letter(s)	Question card number	Answer card letter(s)	Question card number	Answer card letter(s)	Question card number	Answer card letter(s)
1	I	14	O	27	UU	40	HH
2	R	15	OO	28	WW	41	DD
3	FF	16	BB	29	E	42	H
4	J	17	F	30	V	43	QQ
5	C	18	M	31	JJ	44	B
6	GG	19	Y	32	VV	45	A
7	SS	20	MM	33	U	46	PP
8	S	21	LL	34	II	47	P
9	N	22	XX	35	TT	48	CC
10	Z	23	L	36	ZZ	49	RR
11	G	24	X	37	D	50	Q
12	NN	25	W	38	K	51	YY
13	AA	26	KK	39	T	52	EE

History of the Earth Card Data Set #2 Color: yellow

A	B	A	B	A	B	A	B
Question card number	Answer card letter(s)	Question card number	Answer card letter(s)	Question card number	Answer card letter(s)	Question card number	Answer card letter(s)
1	D	14	E	27	N	40	JJ
2	Q	15	EE	28	MM	41	II
3	DD	16	QQ	29	Y	42	V
4	WW	17	T	30	L	43	I
5	F	18	GG	31	ZZ	44	UU
6	S	19	G	32	KK	45	W
7	RR	20	SS	33	H	46	J
8	FF	21	B	34	U	47	VV
9	P	22	M	35	TT	48	NN
10	BB	23	Z	36	HH	49	C
11	YY	24	LL	37	X	50	PP
12	OO	25	O	38	A	51	XX
13	R	26	AA	39	K	52	CC

## History of the Earth Card Data Set #3 Color: tan

A	B	A	B	A	B	A	B
Question card number	Answer card letter(s)	Question card number	Answer card letter(s)	Question card number	Answer card letter(s)	Question card number	Answer card letter(s)
1	L	14	GG	27	PP	40	N
2	A	15	H	28	HH	41	V
3	X	16	ZZ	29	O	42	NN
4	LL	17	E	30	BB	43	JJ
5	R	18	P	31	VV	44	XX
6	EE	19	CC	32	D	45	Y
7	G	20	UU	33	OO	46	B
8	SS	21	F	34	J	47	M
9	FF	22	DD	35	U	48	Z
10	S	23	TT	36	II	49	K
11	RR	24	Q	37	C	50	W
12	YY	25	I	38	AA	51	KK
13	QQ	26	T	39	WW	52	MM

## History of the Earth Card Data Set #4 Color: green

A	B	A	B	A	B	A	B
Question card number	Answer card letter(s)	Question card number	Answer card letter(s)	Question card number	Answer card letter(s)	Question card number	Answer card letter(s)
1	P	14	V	27	WW	40	DD
2	C	15	XX	28	GG	41	A
3	T	16	ZZ	29	F	42	X
4	UU	17	M	30	K	43	RR
5	B	18	OO	31	BB	44	MM
6	Q	19	PP	32	II	45	R
7	N	20	E	33	VV	46	YY
8	Y	21	L	34	HH	47	Z
9	O	22	AA	35	CC	48	LL
10	U	23	KK	36	G	49	S
11	TT	24	JJ	37	J	50	W
12	D	25	EE	38	H	51	NN
13	SS	26	I	39	FF	52	QQ

History of the Earth Card Data Set #5 Color: blue

A	B	A	B	A	B	A	B
Question card number	Answer card letter(s)	Question card number	Answer card letter(s)	Question card number	Answer card letter(s)	Question card number	Answer card letter(s)
1	O	14	M	27	W	40	XX
2	F	15	LL	28	VV	41	K
3	JJ	16	QQ	29	S	42	Y
4	NN	17	X	30	B	43	Z
5	II	18	AA	31	FF	44	L
6	E	19	WW	32	YY	45	KK
7	OO	20	ZZ	33	V	46	N
8	P	21	C	34	J	47	G
9	HH	22	R	35	CC	48	MM
10	Q	23	GG	36	UU	49	A
11	D	24	RR	37	T	50	U
12	PP	25	BB	38	EE	51	DD
13	H	26	I	39	SS	52	TT

History of the Earth Card Data Set #6 Color: purple

A	B	A	B	A	B	A	B
Question card number	Answer card letter(s)	Question card number	Answer card letter(s)	Question card number	Answer card letter(s)	Question card number	Answer card letter(s)
1	X	14	I	27	W	40	FF
2	Z	15	O	28	XX	41	K
3	AA	16	QQ	29	P	42	LL
4	MM	17	V	30	II	43	OO
5	T	18	CC	31	H	44	M
6	EE	19	B	32	RR	45	G
7	D	20	YY	33	WW	46	Q
8	VV	21	J	34	U	47	HH
9	R	22	N	35	DD	48	SS
10	F	23	KK	36	C	49	Y
11	TT	24	PP	37	E	50	ZZ
12	GG	25	BB	38	S	51	NN
13	JJ	26	A	39	UU	52	L