THE GEOLOGIC TIME SCALE

Table 1. The development of life through time.

Million years before present	Era, System, or Event	Relative to a calendar year (date time)
	Precambrian	
4600	**Earth formed from planetary nebula**	**1/1 0:00**
3900	Inferred origin of life (first cells)	2/25 13:02
3800	Oldest age-dated rocks on Earth	3/5 11:28
3600	Fossil algae and stromatolites (prokaryots)	3/21 8:20
3250	Fossil evidence of bacteria	4/18 2:52
2100	Fossil evidence of cells with a nucleus (eukaryots)	7/18 8:52
1500	First multi-celled organisms (seaweed and algae)	9/3 23:28
670	Oldest marine worms and jellyfish	11/8 20:05
600	Vendian period begins: Edicarian fossils	11/14 9:23
	Paleozoic	
544	**Cambrian system begins**	**11/18 20:02**
515	Burgess Shale animals, animals with a notochord	11/21 3:15
505	**Ordovician system begins**	**11/21 22:18**
505	First fish	11/21 22:18
470	First fossil evidence of land plants	11/24 16:57
438	**Silurian system begins**	**11/27 5:53**
430	First vascular land plants	11/27 21:07
414	Oldest lung fish fossils	11/29 3:36
408	**Devonian system begins**	**11/29 15:01**
408	Oldest fossil evidence of mosses	11/29 15:01
385	First insects (beetles), scorpions, and centipedes	12/1 10:49
380	First lobe-finned fish	12/1 20:20
375	First land animals (amphibians)	12/2 5:52
370	First sharks	12/2 15:23
365	First seed plants (ferns)	12/3 0:54
360	**Mississippian system begins**	**12/3 10:26**
330	First possible reptiles	12/5 19:33
320	**Pennsylvanian system (Kentucky coal)**	**12/6 14:36**
286	Permian system begins	12/9 7:21
260	Sail-backed reptiles (Dimetrodon)	12/11 8:52
245	End of Paleozoic, 96% of all life on Earth perishes	12/12 13:26
	Mesozoic, the "Age of Reptiles"	
245	**Triassic system begins**	**12/12 13:26**
240	First crocodiles	12/12 22:57
228	First dinosaurs (Eoraptor and Saltoposuchus)	12/13 21:48
221	First mammals (shrew-like)	12/14 11:08
210	First turtles	12/15 8:05
208	**Jurassic system begins**	**12/15 11:53**
195	Dilophosaurus, an early Jurassic dinosaur	12/16 12:39
155	First bird, Archeopteryx	12/19 16:49
152	Apatosaurus and Brachiosaurus (long-necked	12/19 22:32
150	Allosaurus, (meat-eating dinosaur)	12/20 2:20
148	Stegosaurus, (plate-backed dinosaur)	12/20 6:09
144	**Cretaceous system begins**	**12/20 13:46**
115	First flowering plants	12/22 21:00
82	Duck-billed dinosaurs (Maiasaurus)	12/25 11:50
80	Protoceratops (first dinosaur eggs discovered)	12/25 15:39
75	Triceratops	12/26 1:10
70	Tyrannosaurus rex and Velociraptor	12/26 10:41
65	End of Mesozoic, probably meteor or comet impact	12/26 20:13
	Cenozoic, the "Age of Mammals"	
65	**Tertiary system begins**	**12/26 20:13**
64	First ancestors of dogs and cats	12/26 22:07
60	Grasses become widespread	12/27 5:44
57	First ancestors of pigs and deer	12/27 11:27
55	First horses (Eohippus)	12/27 15:15
45	First ancestors of rabbits	12/28 10:18
39	First monkeys	12/28 21:43
4	Oldest human like ancestors (hominids)	12/31 17:20
2	**Quaternary system begins**	**12/31 20:57**
1	First of four ice ages	12/31 22:05
1	Oldest direct human-ancestor fossil, Homo habilis	12/31 23:02
0.1	First modern man, Homo sapiens	12/31 23:48
0.05	Mammoth and mastodon bones, Big Bone Lick, KY	12/31 23:54
235 years	Revolutionary War	12/31 23:59
70 years	World War II	1/1 0:00

The scale of geologic time is vast, currently estimated at nearly 4.6 billion years. During that time, life evolved into the familiar forms we see today. These materials are provided to assist in understanding time relationships and how life on Earth changed through time.

The dates shown were compiled from several available sources. Table 1 shows some important events in Earth history, presented in the order in which they occurred. The data are also shown on the scale of a calendar year. When geologic time is compressed to the scale of a calendar year, 1 second equals about 146 years. At this scale, World War II began about 0.4 second before midnight on December 31; because of rounding, this is shown as midnight of the new year.

On the back of this sheet is a chart showing the geologic eras, systems, and series; the oldest is at the bottom. On the chart, each dot, number, or letter represents 1 million years. The dots get "older" as you read down the chart, or to the right along a row. Thus, they represent millions of years before present ("mybp") and show the ages of the oldest known fossils of selected animals or the time of an event. Not all of the items shown in Table 1 are shown on the chart because of space limitations.

For more information on the geologic time scale, see:

- www.uky.edu/KGS/education/activities.html
- Dinosaurs: Fact & Fiction pubs.usgs.gov/gip/dinosaurs/
- Fossils, Rocks, and Time: pubs.usgs.gov/gip/fossils/
- Geologic Time: pubs.usgs.gov/gip/geotime/
- Teaching About Evolution and the Nature of Science: books.nap.edu/books/0309063647/html/index.html
- Learning from the Fossil Record www.ucmp.berkeley.edu/fosrec/fosrec.html
- Understanding Evolution: evolution.berkeley.edu/
- National Center for Science Education: www.natcenscied.org/

The dot scale of geologic time is adapted from an idea by Charly Zuppann of the Indiana Geological Survey, Bloomington, Indiana

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THE GEOLOGIC TIME SCALE

Era	System and Series		Began mybp	Relative Time (1 dot or character = 1 million years)
Cenozoic	Quaternary	Holocene	0.01	
		Pleistocene	1.8	X
	Tertiary	Pliocene	5	W
		Miocene	23	
		Oligocene	34	
		Eocene	57	V U T
		Paleocene	65	S RQ
Mesozoic	Cretaceous		144	P O N M
	Jurassic		208	L K J I
	Triassic		245	H G F
Paleozoic	Permian		286	E
	Carboniferous Systems	Pennsylvanian	320	
		Mississippian	360	D
	Devonian		408	C B A 9
	Silurian		438	
	Ordovician		505	8 7
	Cambrian		544	
Precambrian	Proterozoic Era		2,500	6 5
	Archean Era		3,800	4 3 2
	Hadean Era		4,600	1 0

Events

0 Earth formed
1 Life originates
2 Oldest age-dated rocks
3 Blue-green algae
4 Bacteria
5 Cells with a nucleus
6 Multicellular life
7 Fish
8 Land plants
9 Insects
A Amphibians
B Sharks
C Plants with seeds (ferns)
D Reptiles
E End-Permian extinction
F Early dinosaurs (such as *Eoraptor*)
G Mammals (shrew-like)
H Turtles
I *Archeopteryx*
J *Apatosaurus*
K *Allosaurus*
L *Stegosaurus*
M Flowering plants
N Duck-billed dinosaurs
O *Tricerotops*
P *Tyrannosaurus rex*
Q End-Cretaceous extinction
R Dogs and cats
S Grasses widespread
T Pigs and deer
U Horses (*Eohippus*)
V Monkeys
W Hominids
X First of four ice ages

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Jan.	Hadean																														
Feb.																	Eoarchean														
March																			Paleoarchean												
April																				Mesoarchean											
May																						Neoarchean									
June														Paleoproterozoic																	
July																															
August																									Mesoproterozoic						
Sept.																															
Oct.										Neoproterozoic											Silurian →										
Nov.																	Cambrian				Ordovician					Devonian				Quaternary →	
Dec.	Mississippian			Pennsylvanian		Permian					Triassic				Jurassic				Cretaceous					Paleogene			Neogene				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31