# A Calendar Year as a Metaphor for Geologic Time -- Example

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I chose a calendar year as my metaphor for geologic time because it provides a good example for introductory geoscience students—a year is a scale with which everyone is familiar and which we can all understand. For simplicity, I am assuming that a year is exactly 365 days, even though it is actually closer to 365.25 days (hence the need for a leap year with an extra day in February every four years).

Also, until we get to the last few events, when seconds count, I’m rounding the times that particular events occurred to the nearest minute.

On this scale, the origin of the Earth, which happened approximately 4.6 billion years ago, corresponds to midnight (12:00 am) on January 1 of our metaphorical new year.

Unfortunately, because the Earth is geologically dynamic, none of the original surface is left, and we have no rock record at all on the Earth for the Hadean Eon. The oldest known rocks are only 4.0 billion years old, and wouldn’t have formed until February 17 at 2:37 pm.

Life didn’t appear until later. The oldest fossils are chemical fossils, recognized by the ratio of carbon isotopes preserved in accessory mineral grains in 3.85 billion year old rocks from Greenland. Based on these ratios, the carbon appears to be organic, and was presumably once part of a living cell. These 3.85 billion-year-old rocks would correspond to March 1 at 12:16 pm during our calendar year.

The oldest actual body fossils are single-celled microfossils resembling prokaryotic cyanobacteria. They are preserved in 3.465 billion year old rocks found in Australia, which would be April 1at 1:26 am during our year, a full month later than when the chemical fossils first appeared. Stromatolites, presumably formed by the sediment-binding action of mats of these cyanobacteria, are also found in the 3.465 billion year old rocks from Australia.

The earliest single-celled eukaryotic organisms appeared in the Earth’s seas 2.1 billion years ago, almost 1.4 billion years later than the earliest prokaryotic cells. Some biologists have suggested that the appearance of single-celled organisms composed of eukaryotic cells was second in importance in the history of life on Earth only to the appearance of life itself. Without eukaryotic cells, multicellular plants and animals could never have evolved. The appearance of the first eukaryotic cells corresponds to July 18 at 8:52 am during our calendar year, which was over three and a half months after the first prokaryotic cells arose.

There is an even longer interval of time, from 2.1 billion to 635 million years ago, almost 1.5 billion years, which corresponds to almost four months of our year, during which there were no dramatic changes in life on Earth. The earliest metazoans (multicellular animals), identified as sponges, appeared in the seas 635 million years ago. (This was a recent discovery, reported in 2010.) It is remarkable to note that the first animals did not appear on Earth until the second week of November! (The exact day and time was November 11 at 2:44 pm.)

The end of the Precambrian followed soon afterwards, 542 million years ago, which was November 18 at 11:50 pm during our metaphorical year.

The earliest fossil record of land plants, presumably spores from non-vascular plants like liverworts, is from the Early to Middle Ordovician about 475 million years ago, which is late November during our year (November 24 at 7:26 am).

Terrestrial animals appeared later. The earliest known terrestrial metazoan fossil has been identified as a millipede, and was found in 428 million year old rocks from Scotland, corresponding to November 28 at 12:56 am.

Terrestrial vertebrates appeared much later than terrestrial invertebrates. Tetrapods are animals with four legs and feet. The earliest tetrapod fossils, are tracks, not bones, and are about 397 million years old. These were recently discovered in Poland. This date corresponds to early December during our eventful year (December 1 at 11:58 am).

The Paleozoic Era, marked by the worst mass extinction of the Phanerozoic Eon, came to a close 251 million years ago. 251 million years before the present is equivalent to December 12, 2:01 am, and is just about two weeks after the first terrestrial tetrapods appeared on our calendar.

Dinosaurs first appeared on Earth in the Late Triassic Period, and became dominant about 200 million years ago, just after the start of the Jurassic Period. Dinosaurs were the dominant land animals for the next 135 million years, until they became extinct at the end of the Mesozoic Era, which was marked by another severe mass extinction. In our calendar year, dinosaurs were dominant for 10 days during mid-to-late December, from December 16 at 3:07 am to December 26 at 6:18 pm.

Our list of significant events from geologic history is about to end, and so is the calendar year. Our earliest human ancestors (genus Homo) appeared late in the evening of December 31st, about four hours before midnight (December 31 at 8:11 pm.)

The end of the Pleistocene, which traditionally also corresponds to the end of the Pleistocene Ice Age, occurred 11,700 years ago. (The Pleistocene Ice Age isn’t really over—we are presently in an interglacial.) This was equivalent to December 31 at 11:58:40 pm in our calendar year, just one minute and twenty seconds before our year will end.

All of recorded human history, which started 6000 years ago, fits into the last 41 seconds of our calendar year, starting at 11:59:19.

The average age of a Del Mar College student is 28. For the year 2012, this means they would have been born in 1984. 28 years of geologic history, compared to our calendar year, would have occurred a fraction of one second before midnight at 11:59:59.81 (exactly 0.19 seconds before midnight).

Interesting to note: (365 days) (24 hrs.) (60 min.) (60 sec.) = 31,536,000 seconds in one year. So each second of a calendar year represents almost 146 years of geologic time!

The use of one calendar year as a metaphor for geologic time is very effective, making a comparison to something with which we are all very familiar. A comparison to any length of time less than one year would not have been nearly as effective, as many of the more recent events would have been all squeezed together. This calendar-year metaphor should give anyone who considers it a better understanding and perspective of the immensity of geologic time.