NC Geologic History Reference Pages

The land that is North Carolina existed long before humans arrived — *billions* of years before, in fact. Based on the age of the oldest rocks found on earth as well as in meteorites, scientists believe that the earth was formed about 4,500 million years (4.5 billion years) ago. The landmass under North Carolina began to form about 1,700 million years ago, and has been in constant change ever since. Continents broke apart, merged, then drifted apart again. As landmasses came together, the Appalachian mountains (and other mountain ranges on the earth) were formed — and wind and water immediately began to wear them down by [erosion](http://web.archive.org/web/20160302025139/http://www.learnnc.org/lp/editions/nchist-twoworlds/glossary#erosion). After North Carolina found its present place on the eastern coast of North America, the global climate warmed and cooled many times, melting and re-freezing the polar ice caps and causing the seas to rise and fell, covering and uncovering the Coastal Plain. Recent geologic processes formed the Sand Hills, the Uwharrie Mountains, and the Outer Banks.

The first single-celled life forms appeared as early as 3,800 million years ago. It then took 2,000 million years for the first cells with nuclei — simple bacteria — to develop, and another 500 million years for multi-celled organisms to evolve. As life forms grew more complex, they diversified. Plants and animals became distinct. Gradually life crept out from the oceans and took over the land. Seed-bearing plants developed, then flowering plants, and finally grasses. Animals developed hard exterior shells for protection, then interior skeletons. Flying insects, amphibians, reptiles, dinosaurs, birds, and finally mammals emerged. Sudden changes in climate caused mass extinctions that wiped out most of the species on earth, making room for new species to evolve and take their places. The ancestors of humans began to walk upright only a few million years ago, and our species, *Homo sapiens*, emerged only about 120,000 years ago. The first humans arrived in North Carolina just 10,000 years ago — and continued the process of environmental change through hunting, agriculture, and eventually development.

To help you understand the vastness of the time scales we’re talking about, consider this: If the history of our planet were condensed into a single day, humans would have emerged just 2.3 seconds before midnight, and would have arrived in North Carolina *two tenths of a second* before midnight — literally the blink of an eye. And if that last two tenths of a second of human habitation were expanded into a full day, Europeans would have arrived at 11:02 pm, and a student now in eighth grade would have been born at 11:58 pm!

Natural history at a glance

The history of all of these processes — geologic, climatic, environmental, biological — is called natural history. Scientists have divided the natural history of the planet into chunks of time called eons, eras, periods, and epochs. These chunks of time have names and approximate dates that correspond to events in geologic or fossil records. As scientists find new evidence, they revise these dates, and they don’t always agree on how to do so. The science of natural history, like natural history itself, is an evolutionary process.

This chart summarizes the major events in North Carolina’s natural history. Dates are listed in Mya (Million years ago).[1](http://web.archive.org/web/20160302025139/http://www.learnnc.org/lp/editions/nchist-twoworlds/1671#note1)

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| Neo-  proterozoic | The first fossils of multi-celled animals survive from this period. Very simple multi-celled life forms called eukaryotes appeared as early as 1000 million years ago, and worm-like animals and the first sponges by about 600 million years ago.  The land under North Carolina was pulled apart, and inland seas emerged. Island volcanoes developed, first along the North Carolina-Virginia border, then in an arc from Virginia to Georgia. Rocks formed by those volcanoes extend today over a wide area of the Piedmont and Coastal Plain. Fossilized tracks of primitive worms have been found in those volcanic rocks, formed about 620 million years ago. | | | 1000 Mya |

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| Carboniferous/  Pennsylvanian | Winged insects spread, including very large species. Amphibians were common and diverse. The first reptiles appeared.  About 320 million years ago, the North American and Euro-African continents collided, resulting in the last period of Appalachian mountain building. The land under the Piedmont and Coastal Plain was also pushed upward. The continents were united in a "supercontinent" that geologists call Pangaea. | 318 Mya |
| Triassic | Dinosaurs appeared and became dominant, as did ichthyosaurs and nothosaurs in the seas and pterosaurs in the air. The first mammals and crocodilia (ancestors of crocdiles and alligators) also appeared.  As soon as they had formed, the Appalachians began to erode. Wind and rain wore away the rock and carried it as sediment to lower-lying land or to the sea. Meanwhile, the continents began to move apart again.  At this time, North Carolina probably lay near the equator, and had a tropical climate in which a great diversity of life must have flourished. | 251 Mya |
| Pleistocene | The Sand Hills formed during this time. Streams eroded the Piedmont and Blue Ridge, carrying sediment to the Coastal Plain. There, water seeped through those sediments, carrying heavier clay downward and leaving behind sands that were piled into dunes by winds.  The polar ice caps melted, and the sea level rose more than 300 feet above its present level. The resulting shoreline can be seen today in an [escarpment](http://web.archive.org/web/20160302025139/http://www.learnnc.org/lp/editions/nchist-twoworlds/glossary#escarpment) — a sharp drop-off — that runs through Scotland, Hoke, and Cumberland counties. When the seas receded, that sudden change in elevation caused rivers to fall rapidly. The town of Cross Creek, which became Fayetteville, would be located along this "fall line."  About 1.7 million years ago, the present "Ice Age" began. As glaciers and polar ice caps re-formed, sea level fell, exposing the Coastal Plain. Several periods of glaciation (the forming of glaciers) and melting followed, with corresponding falls and rises in sea level. A series of escarpments can now be seen at various points on the Coastal Plain where the shoreline once lay.  The glaciers began to recede for the last time about 18,000 years ago. The rising seas left a ridge above water, creating the modern barrier islands.  Between 10,000 and 15,000 years ago, as the climate warmed, North Carolina’s forests began to look as they do today, with pine, spruce, and fir in the cooler Blue Ridge and oak and hickory more common in the Piedmont. | 1.8 mya |

## How do scientists know…

**…the age of rocks and fossils?**

Radioactive forms of certain elements such as carbon-14 and uranium-235 are not chemically stable; they slowly decay into stable elements by radiating away particles. Scientists have determined through experiment the rate at which these elements decay. Based on the amount of radioactive material left in a rock, fossil, or artifact, they can determine how long ago it was created. (You can read more about the dating of artifacts in “[The process of archaeology](http://web.archive.org/web/20160302025139/http://www.learnnc.org/lp/editions/nchist-twoworlds/1854).”)

**…the age of the earth?**

The oldest rocks found on earth are 4.4 billion years old, so the earth must have formed at least that long ago. The oldest rocks found in meteorites and brought back from the moon are between 4.5 and 4.6 billion years old, and scientists use that figure as an estimate of when the solar system was formed, and with it the earth.

**…when water appeared on the earth?**

Rocks found in Greenland have been found to be 3,800 million years old. The rocks are metamorphic — they were changed by heat and pressure. That process can only occur in the presence of liquid water, and so geologists estimate that by this time the earth had oceans — and an atmosphere, because otherwise the oceans would have evaporated.

**…where the continents and oceans used to be?**

In some cases, we can look at the fossil record. For example, if fossils of ocean-dwelling animals are found on dry land, we know that when that animal lived, the land must have been under water. When animals found on different parts of the globe have similar ancestors, scientists may surmise that those parts of the earth were once connected by land. Scientists can also determine how fast and in what direction the earth’s plates are moving now, and use that information to develop theories about what happened in the past.

**…what the climate was like in the distant past?**

During the Ice Age, glaciers left telltale signs in the rocks they covered. Sometimes mineral deposits are laid down only in certain climatic conditions — for example, salt deposits are laid down primarily when the climate is warm and dry (when water evaporates most quickly). In other cases, the fossil record indicates that the earth (or a particular location on it) must have been warm or cool.

**…when various kinds of plants and animals appeared?**

Based on dating of fossils, we know when various plants and animals lived. Often, though, fossils are incomplete — they show only part of a species, and scientists have to make educated guesses about the rest. And the fossil record itself is not complete — we certainly haven’t found fossils of every life form that ever existed, or from the entire period that a given life form existed. So while scientists know that certain species existed at certain times, there is a tremendous amount they don’t know.