Early Evolution

How did everything come to evolve on the Earth?
Early Evolution

4.6 Billion Years Ago

- Radioactive decay shows that Earth formed
Early Evolution

4.5 Billion Years Ago

• During the early formation Earth heated up due to radioactive decay of isotopes within the Earth’s interior
Oldest Zircon Crystals - 4.4 billion years old
Western Australia
Early Evolution

4.4 Billion Years Ago

• During early Earth’s melting, materials separated into zones according to their densities
  • Fe and Ni settled into the core
  • Silicates formed the earliest crust
  • Gaseous compounds made up the atmosphere
Early Evolution

4.2 Billion Years Ago

- Solid crust formed and plate tectonics started
- Gases trapped inside the Earth seeped out in a process called outgassing and created a completely different second atmosphere
Oldest Rocks - 4.28 billion years old
Hudson Bay in Northern Quebec
Early Evolution

3.9 Billion Years Ago

• After the crust had cooled enough, water vapor in the atmosphere began to precipitate and form water on Earth
Early Evolution

3.8 Billion Years Ago

• Weathering, erosion, and deposition began and the first sedimentary rock was formed
Early Evolution

3.5 Billion Years Ago

- Life forms that used CO$_2$ and released free oxygen began to evolve
- This allowed for oxygen to start collecting in our atmosphere
Early Evolution

3.5 - 2.8 Billion Years Ago

- Oxygen in the atmosphere reacted with iron in the soil to produce rust
- Resembled the surface color of current day Mars
Early Evolution

2.8 Billion Years Ago

• Most of the iron compounds that could have reacted with the oxygen had done so, thus oxygen in the atmosphere increased
Early Evolution

2.8 - Present Billion Years Ago

- Life slowly evolved from single-celled bacteria to multicellular to hard parts on life forms
Cambrian Explosion / Burgess Shale
### GEOLOGIC HISTORY OF NEW YORK STATE

<table>
<thead>
<tr>
<th>Eon</th>
<th>Era</th>
<th>Period</th>
<th>Epoch</th>
<th>Life on Earth</th>
<th>NY Rock Record</th>
<th>Time Distribution of Fossils (including important fossils of New York)</th>
<th>Important Geologic Events in New York</th>
<th>Inferred Positions of Earth's Landmasses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precambrian</td>
<td>Archean</td>
<td>UP</td>
<td>Early</td>
<td>First bacteria</td>
<td></td>
<td>E. coli fossils were found in the Archean Era.</td>
<td>Plate tectonics started</td>
<td>Planet was formed 4.54 billion years ago</td>
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<tr>
<td></td>
<td>Proterozoic</td>
<td>UP</td>
<td>Early</td>
<td>Cyanobacteria</td>
<td></td>
<td>E. coli fossils were found in the Proterozoic Era.</td>
<td>Continental drift began</td>
<td>Craton formed 4.3 billion years ago</td>
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<tr>
<td></td>
<td>Mesozoic</td>
<td>UP</td>
<td>Late</td>
<td>Dinosaurs</td>
<td></td>
<td>E. coli fossils were found in the Mesozoic Era.</td>
<td>Mountains formed</td>
<td>Plate tectonics dominated</td>
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<tr>
<td></td>
<td>Cenozoic</td>
<td>UP</td>
<td>Early</td>
<td>Mammals</td>
<td></td>
<td>E. coli fossils were found in the Cenozoic Era.</td>
<td>Volcanic activity increased</td>
<td>Plate tectonics dominated</td>
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<tr>
<td></td>
<td>Paleozoic</td>
<td>UP</td>
<td>Early</td>
<td>Reptiles</td>
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<td>E. coli fossils were found in the Paleozoic Era.</td>
<td>Continental drift continued</td>
<td>Plate tectonics dominated</td>
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<tr>
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<td>Neogene</td>
<td>UP</td>
<td>Early</td>
<td>Humans</td>
<td></td>
<td>E. coli fossils were found in the Neogene Era.</td>
<td>Mountain building continued</td>
<td>Plate tectonics dominated</td>
</tr>
<tr>
<td></td>
<td>Quaternary</td>
<td>UP</td>
<td>Early</td>
<td>Ice Age</td>
<td></td>
<td>E. coli fossils were found in the Quaternary Era.</td>
<td>Ice age started</td>
<td>Ice age ended 10,000 years ago</td>
</tr>
</tbody>
</table>

### Time Distribution of Fossils

- **Early Archean**: E. coli fossils were found in the Archean Era.
- **Proterozoic Era**: Continental drift began, Craton formed 4.3 billion years ago.
- **Mesozoic Era**: Mountains formed at the beginning of the era, Mountain building continued...
- **Cenozoic Era**: Ice age started 2.6 million years ago, Ice age ended 10,000 years ago.

### Important Geologic Events in New York

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- **Proterozoic Era**: Continental drift began, Craton formed 4.3 billion years ago.
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### Inferred Positions of Earth's Landmasses

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### Index Fossils

- **A**: Crinoids
- **B**: Brachiopods
- **C**: Corals
- **D**: Dinoflagellates
- **E**: Echinoderms
- **F**: Foraminifera
- **G**: Gastrotrichs
- **H**: Hemichordates
- **I**: Invertebrates
- **J**: Jellies
- **K**: Kerriella
- **L**: Lingula
- **M**: Mollusks
- **N**: Nematodes
- **O**: Ostracods
- **P**: Phanerobrachiopods
- **Q**: Quinqueloculina
- **R**: Radiolarians
- **S**: Siphonophores
- **T**: Terrestrial plants
- **U**: Urochordates
- **V**: Vertebrates
- **W**: Worms
- **X**: Xylophaga
- **Y**: Yoldia
- **Z**: Zooplankton

### References

- [E. coli fossils](#)
- [Human evolution](#)
- [Plate tectonics](#)