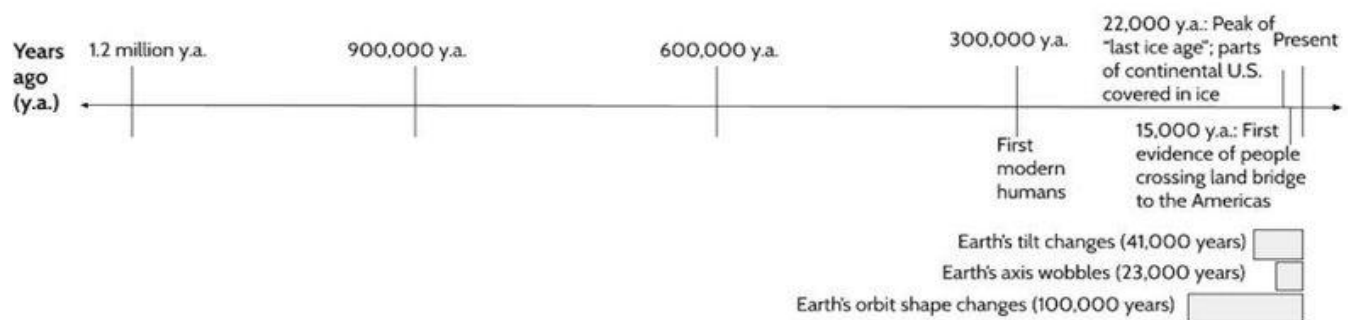


Earth's Orbit

Believe it or not, Earth's North Pole has changed over time, and Earth has even been closer to or farther away from the Sun at different times in the past! These changes are tied to long-term shifts in climate that we can see in ancient rocks. The changes happen in cycles called *Milankovitch cycles*, after the Serbian scientist Milutin Milankovitch. He identified three different ways in which long-term changes in Earth's orbit might affect the climate and seasons:

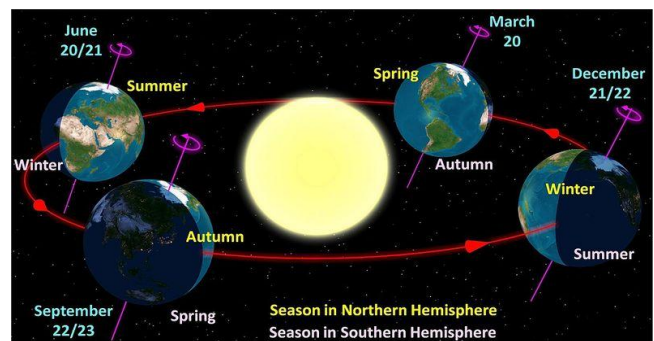
1. Earth's tilt on its axis changes on a 41,000-year cycle.
2. Earth's axis wobbles on a 23,000-year cycle.
3. Earth's orbit becomes more and less circular on a 100,000-year cycle.



Lengths of Milankovitch cycles.

How does any of this affect Earth's climate and seasons? You know from middle school that Earth is tilted on its axis. The diagram below shows how the axis's tilt does not change during the year, but the part of the Earth that is tilted toward the Sun changes. In June, the Northern Hemisphere is tilted toward the Sun and experiences summer, while the Southern Hemisphere is tilted away from the Sun and experiences winter. This is because the angle at which light hits the Northern Hemisphere is more direct in June, so it receives more direct sunlight and therefore more energy. If the tilt changes over time, the relative temperatures of the seasons change.

Earth's orbit is also somewhat *elliptical*, or oval-shaped. This is shown in an exaggerated way on the diagram. Earth is actually closest to the Sun during the Northern Hemisphere's winter and farthest away during summer. This has a minor effect in our lives. Because the Southern Hemisphere is closest to the Sun during its summer, summers are a little warmer there than in the



Northern Hemisphere. These small changes in seasons can slowly add up over hundreds or thousands of years to result in changes in climate.

Milankovitch cycles influence how much energy hits Earth, and when and where it is distributed. These cycles can make the seasons more or less even in temperature, or make the Earth slightly warmer or cooler. Scientists think Milankovitch cycles contribute to the timing and length of Earth's ice ages. However, there are other factors as well, like changes in ocean currents caused by sea level changes, and the movements of continental plates.

References

Buis, A. (2022, February 7). *Milankovitch (orbital) cycles and their role in Earth's climate – climate change: Vital signs of the planet*. NASA. Retrieved December 15, 2022, from <https://climate.nasa.gov/news/2948/milankovitch-orbital-cycles-and-their-role-in-earths-climate/>