

Lab 03: Motion of the Sun

September 10, 2019

The Earth orbits the sun. For many purposes, we can assume that the Earth's orbit around the Sun is circular, although orbit does vary over time to become more elliptical. This means at the present time, the reason seasons are present on the Earth is not because sometimes it is further from the sun. The time frame for this however is on the order of 100,000 years so we are going to be mostly circular for a while. However, the fact that the orbit is not exactly circular has consequences with regard to the severity of seasons. **We will simulate this orbit today.**

The Earth precesses. The furthest point of the orbit is the aphelion and currently the northern hemisphere is at this point during the summer. The perihelion is when the orbit is closest to the sun and this currently happens during winter in the northern hemisphere. As a consequence of this, currently the southern hemisphere will experience more severe seasonal variations than the northern hemisphere. The time frame for these two to switch is on the order of 26,000 years. We are safe for our lives to consider that things will stay this way while we are alive.

The Earth tilts. It is mostly the tilt of the Earth's axis away from the plane of orbit that results in the phenomena of seasons. The tilt of the axis varies with a time frame of about 40,000 years for a complete cycle. Right now, the tilt is about 23.5 degrees but in the cycle, it can vary from 22.1 to 24.5 degrees. We are safe to assume that the tilt of the axis is 23.5 degrees away from the axis of the orbital plane. **We will simulate this today.**

The Earth rotates. Basic observations show that the sun rises in the east and sets in the west. This means, that the Earth is rotating from west to east. We see as a consequence of the Earth being round that the sun rises later in the west than the east. For example, 12 noon in Washington DC will be when it is 9 AM in California. This is the source of day and night. The tilt of the axis means that the further north you go during summer, the longer the days are until for parts of the year, the sun does not set. Likewise, in winter you will see parts of the year when the sun does not rise.

As the Earth rotates during the day, the sun will go through a range of angles with respect to a pole pointing straight up from the Earth. The positions of the shadow can be used to show the motion of the sun through the day. For our purposes, the most energy collected from the sun will be during the part of the day when the pole shadow is shortest and the sun is most close to being directly overhead. **We will follow this today with marking chalk marks on the sidewalk for a bit of today.**

Your assignment: understand the orbit of the earth, understand why seasons happen, and observe the motion of the sun through the day. Then write in your own words why seasons happen and how this influences energy collection for a solar panel.