SUN-EARTH ACTIVITY

GOAL

To model and visualize the Earth's motions and to learn how they affect our view of the sky.

VIEW FROM SPACE

You can begin by asking a volunteer to play the Sun. Make sure there is enough room around him[1] since you will have to move around. You can also ask a volunteer to play the Earth, or simply play the role yourself.

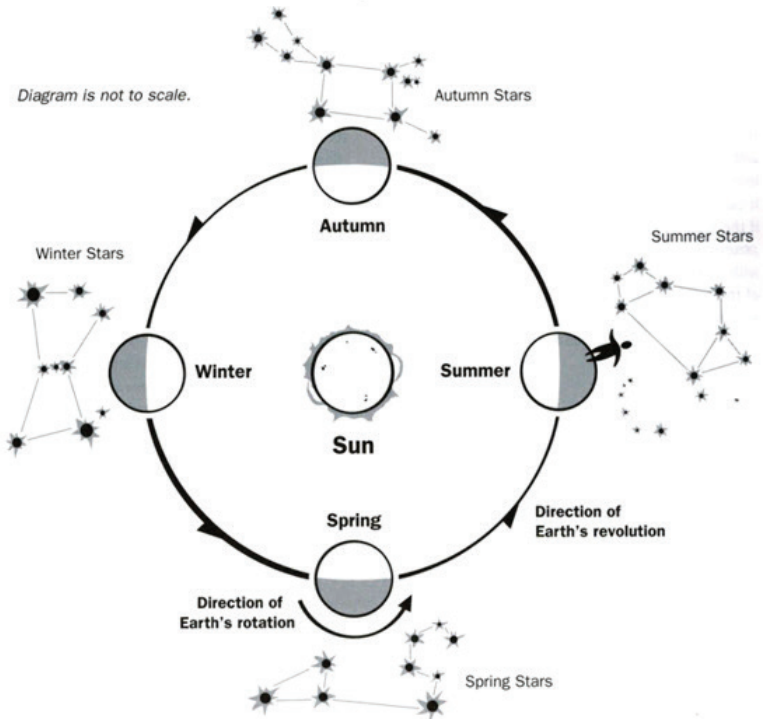
- What motions does the Earth-person need to do? Spin and travel around the Sun.
- Which way? If the head of the Earth-person represents the Northern hemisphere, then both motions will be counter clockwise, as seen from above.
- How long does each motion last? One day for the rotation and 365 days to go around the Sun. It is obviously impossible to respect the time scale for both motions since the Earth-person would have to spin 365 times while going around the Sun once.

VIEW FROM THE EARTH

After a few rotations, we can **add the concept of the horizon in order to visualize the view from Earth**. The Earth-person can stretch his arms to 180° on each side in order to create his horizon. If we respect the counter clockwise motion, his right arm will become the western horizon while his left arm will be the eastern horizon. So if the Earth-person is looking towards his right arm, it is similar to a person on Earth looking west. When he is looking right in front of him, it is equivalent to looking high in the sky in the southern direction. And looking towards his left arm is like looking towards the east. Finally, everything that is behind the person's head is located below the horizon, therefore invisible to the observer.

1. The masculine form is used merely to simplify the text.

We can then ask the Earth-person t**o spin to simulate the change between day and night on Earth**. To understand better, we can start by having the Earth face the Sun directly. It is then noon and the Sun is high in the sky (looking south for us in the Northern hemisphere). By slowing spinning counter clockwise, the right hand will start pointing towards the Sun and the Sun will soon get hidden below the western horizon: it's sunset. Turning a bit more and the Sun is located directly behind the Earth-person: it's midnight. Finally, the Sun will pass by the left hand of the Earth-person: it's sunrise on the eastern horizon. Make sure to go around a few times to make it clear. You can have the rest of the group say out loud the main times of the day: noon, sunset, sunrise and midnight when the Earth-person is in the right position. Invite your students to try this model in small groups, so that each person gets to be the Earth and model the different times of the day.



Credit: *Skyways*, Royal Astroomical Society of Canada

Next **we will add stars and constellations into our model**. You can ask other volunteers to stand anywhere outside the Earth's orbit. Minimally, you should have two people, or any other points of references, on opposite sides of the Sun. You can now show how some stars are impossible to see at certain times of the year because they are up in the sky at the same time as the Sun. This is a new concept for many people: there are stars in the sky in the daytime, but we can't see them because the Sun makes the sky too bright.

In the figure, we can see how, in summer, a person will see the summer stars in the sky at midnight. However, it will be impossible to see the winter stars since they will be in the day sky, when the Sun is also up. During the summer at midnight, the Earth-person could also look east (towards his left hand) and see the autumn stars rising. If he looks west (towards his right hand), he will see the spring stars about to set.

We can now pretend six months have passed and the Earth is now on the other side of the Sun. At midnight, the Earth-person can see the winter stars very well and the summer stars are now impossible to see since they are up in the sky during the day.

Our model is good, but stars are everywhere: even above and below our model! The stars which are above (towards the North Pole) are visible throughout the year from Canada. There are also stars we never see here which are visible to people in the Southern hemisphere. These are the stars that would be under the feet of the Earth-person. **The stars that are always visible (above the horizon) are called circumpolar stars.** The Big Dipper (Ursa Major) is the best known circumpolar constellation in the Northern hemisphere.

OTHER OPTIONS:

- You can also do this activity alone with an object, or a lamp, representing the Sun in the middle. You can be the Earth. It takes a bit of practice to become familiar with the concepts and the motions. It is recommended to practise a few times before trying with an audience.

- You can also use a ball or a globe to represent the Earth. If you place a coloured marker (sticker…) where we are on Earth, it is possible to visualize what can be seen in the sky. Simply imagine yourself where the marker is: the horizon is created by the globe itself, which means everything above the Earth is visible in the sky. By turning the globe, we easily simulate the Earth's rotation.

- With the globe, it is also easier to talk about the Earth's inclination (it is harder for the Earth-person to stand at 23.5°)! This can be handy if you want to talk more about the North Star and the seasons.