Teaching Guide

Product name: Soft Earth - by Star In A Star
Science area: Earth and Space Science (Astronomy)
Grade: K-8
NGSS: 5-ESS1 *Earth's Place in the Universe*- "The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year. (5-ESS1-2)" "Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky" (from 5-ESS1-2)

Introduction

A squishy Earth ball and adorable Peg People combine in this fun Soft Earth activity.

Goals

This model of the Earth shows how the globe - and our location on it - creates day and night. Kids learn that day and night happen not because the Sun is moving, but because the Earth is moving. Day and night occur because of where we live on a moving globe.

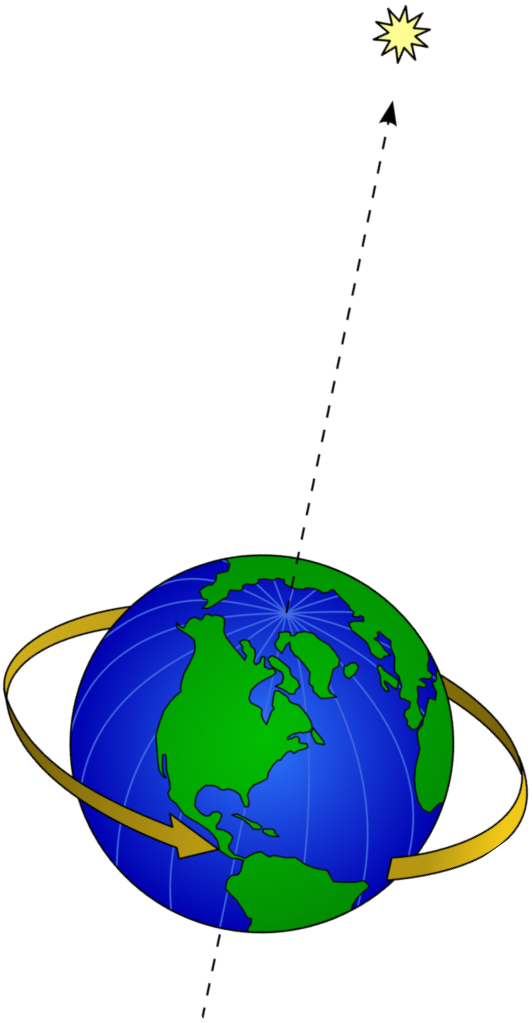
Kids will learn how the Sun is *always shining on some part of the Earth*. Sometimes the Sun shines on "their" part and sometimes it shines on other parts.

They will use this model to help shape their own scientific observations about what a "day" is and understand what is really happening at sunset, noon, and sunrise. Kids will begin to see that night is not just what time it is… it is "where you are!"

Background

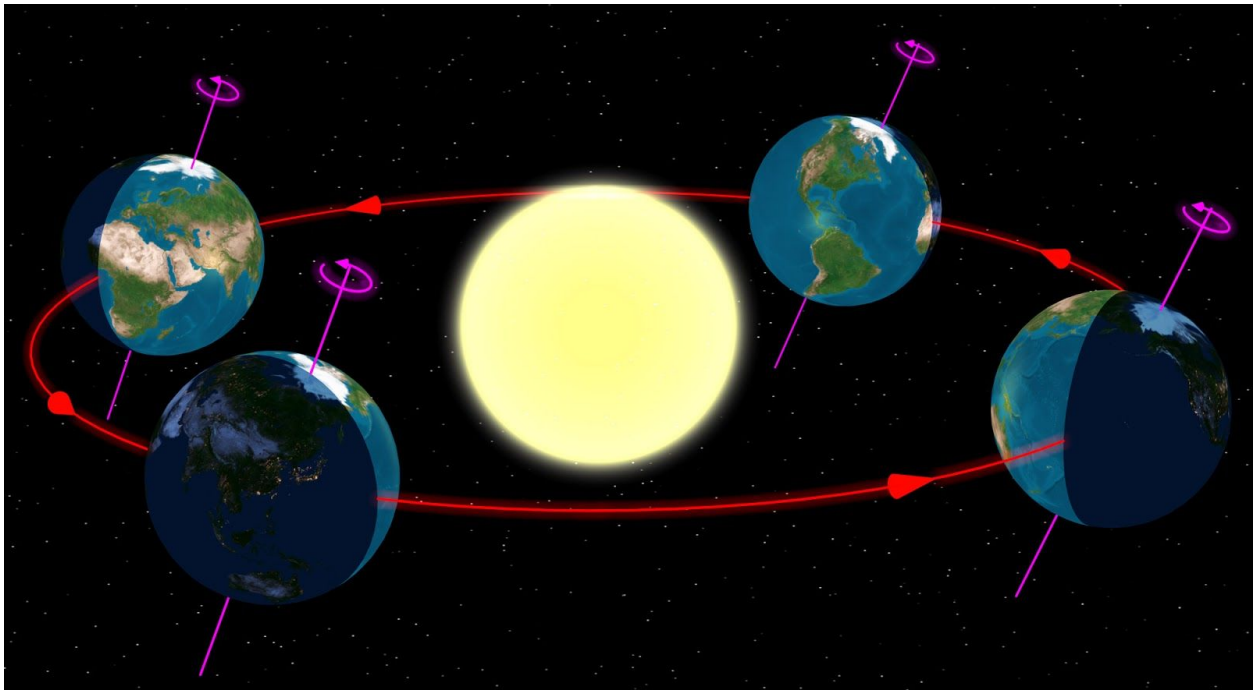
Every day, the Sun shines in some part of the Earth's sky. The Sun "moves" across the sky from east to west. But actually, the Sun only *appears to move*. The Sun "moves" in the sky only because the Earth moves. We live on the Earth and we are *carried under the Sun* each day.

The Earth moves in two main ways that cause "observable patterns" in sunlight and shadow:



Earth rotating on its axis (showing axis pointing to the North Star)

1. The Earth rotates about an axis that goes between its north and south poles - this is what causes day and night and makes sunrise and sunset occur each day.



Earth orbiting the Sun

2. The Earth travels in an orbit (a roughly circle-shaped path through outer space) around the Sun - the orbit of the Earth causes monthly and yearly changes to the visible positions of the Sun, Moon, and stars.

The Sun is always shining - even at night! We know this because we can speak to other people on the Earth who are facing the Sun at the same time that we are facing away from the Sun.

Each day and each year the motions of the Earth repeat in an observable pattern.

Set up and ideas

The Earth globe. Place the rigid velcro dots (the side of the velcro dot that is not soft) on a few parts of the Earth. Some suggestions: your home location, a country at the equator (Ecuador is a good choice since its name means equator!), the North Pole, a country on the opposite eastern/western hemisphere to your home (in the USA, you could choose China or India), and a country in the opposite northern/southern hemisphere (Australia is good because of all the unique animals that live there).

The peg people. Place the soft part (the fabric) of the velcro dot on the bottom of the peg people. You can decorate these peg people as you like or ask kids to do it!

The Sun. Choose a free standing lamp, a window, or just use the Sun itself to "be" the Sun.

Process

This activity can be done at any time of day. Before introducing the peg people who live on this globe, hold the globe up and show the kids all the interesting parts: the countries, the oceans, the north and south poles, the equator, (maybe the lines of latitude and longitude and the lines of Tropic of Cancer and Tropic of Capricorn for advanced kids).

Introduce the peg people. They live on the globe. Place the first peg person on the home location.

Basic - Earth location "creates" day and night

- It's easiest to start with the peg person at home at noon - imagine what the peg person will see in the sky. At noon, the Sun is high in the sky (visible to the south for people who live in the northern hemisphere).
- They look up at the sky, see the Sun.
- Then, time speeds up and the Earth carries the person (counter-clockwise) into the night.
- "How did it get so dark, so quickly?" the peg person might wonder aloud.
- "I guess I'll go to sleep now." Earth spins and carries the peg person back into the day.
- "Wow! The Sun came up quickly, that was a short sleep!"

Intermediate - Earth location creates sunrise and sunset

At the edge of day and night on the globe, the peg person will see the Sun low in the sky. At sunrise, the person will look eastward and see the Sun appear above the horizon and climb to noon. At sunset, the person looks westward and sees the last rays of sunlight before being carried into the night side of the globe.

Advanced - Earth location creates summer and winter

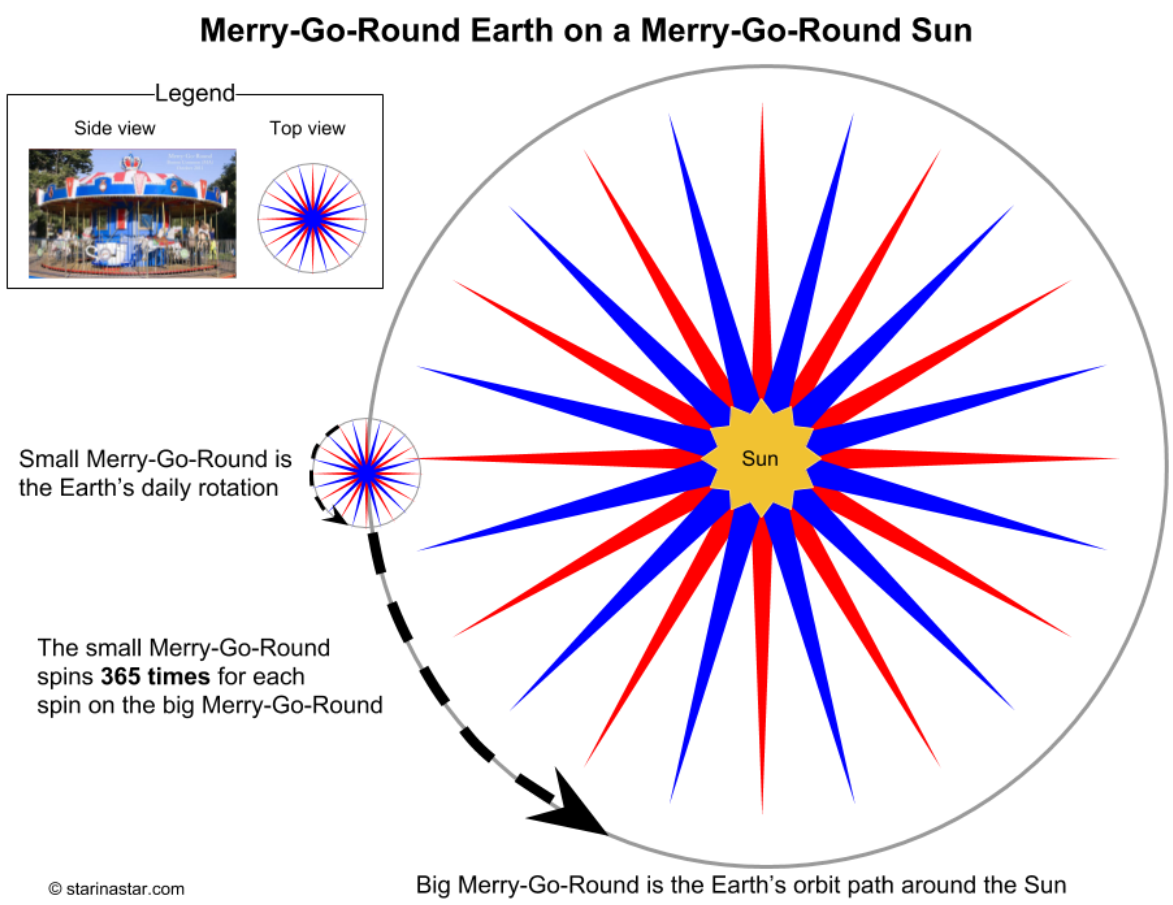
The Earth is tilted toward the Sun at summer and away from the Sun at wintertime. Tilting towards the Sun means we are receiving more direct heat from the Sun in summer. Tilting away from the Sun means we are getting less direct heat from the Sun and the Sun appears low in the sky.

Basic Earth motion - Rotation creates day and night

Every day we go for a ride under the Sun. The Earth rotates around its axis and carries us along for the ride. The Earth rotates counter-clockwise once per day. On average half the time is spent in the direct sunlight (day) and half the time in the shadow of the Earth (night).

Advanced Earth motion - Orbit creates slower, visible changes in the sky

In addition to daily rotation, the Earth also moves along a giant, roughly circle-shaped, orbit path around the Sun. After about 365 days (1 year) the Earth gets back to where it started. The Earth is both rotating and orbiting at the same time as if you placed a merry-go-round on the edge of another larger merry-go-round!



Explanation - The Science

The peg people experience day.

Let's talk about daily rotation of the Earth! Here are some science facts we can learn and observe.

- The Earth rotates once per day. Rotate means we face towards the Sun (day) then we slowly turn away from the Sun (sunset), then we keep turning (night) until we face the Sun again (sunrise). This repeats every day!
- The circumference of the Earth at the equator is a little more than 24,000 miles. The day is 24 hour long - this is a neat coincidence!
- Every hour of every day and night the Earth carries people at the equator 1000 miles (1600 km)! Around New York this is about 760 miles per hour (the further from the equator, the slower you go). So in 24 hours the Earth carries us 24*760 = 18,240 miles!
- Part of that time we travel under the Sun and the Sun shines on us (this is called day).
- The Earth carries us eastward, so the Sun appears to rise in the east and travel west.

    - You can have the kids “see” this by having them face towards a light (this will be the Sun) then turn (their body or just their head) to the right until they can just still see the light out of the left side of their vision - this is sunrise.
    - Now, have them turn back left until they are facing the light again - this is noon.
    - Then keep turning left until the light is only visible out of the right side of their vision - this is sunset.
- The Sun is always shining on some part of the Earth - it’s not always our part!
- When we look “up” in the sky during the day, we are actually looking “out” into space towards the Sun.

The peg people experience a month and a year.

Let’s talk about yearly orbit of the Earth. Here are some science facts we will learn and observe ourselves.

- The Earth orbits once per year. Orbit means we travel in a large, roughly circular path around the Sun.
- Every day the Earth moves a little bit further along on that giant pathway (orbit) - 1.6 million miles (2.57million km) per day.
- It takes 6 months to go halfway around the Sun. Hint: that is 6 times about 30 days of rotation.
- The orbit carries us “toward the dawn” (eastward) - the Earth (as seen from above the North Pole) orbits counter-clockwise (eastward) at the same time the Earth’s daily rotation carries us “toward the dawn” (eastward). When we look eastward, we see the Sun rise each day and we see the stars rise each night.
- Because of the orbit, stars rise a little bit earlier each night - you can show this by adding the orbit to the Soft Earth and orbiting a central Sun.
- The orbit combined with the tilt of the Earth
    - The Earth’s daily rotation is on a tilt.
    - Each season of the year a different part of the Earth is tilted toward the Sun.
    - Tilting toward the Sun makes the Sun appear higher in the sky (summer).
    - Tilting away from the Sun makes the Sun appear lower in the sky (winter).

“Sun tracking” the daily rotation combined with the orbit

These two motions together (with the tilt of the Earth) explain everything about the experience of day, night, month, and year.

Vocabulary

- Sun - A ball of hot gas that forms the center of gravity in our solar system. All the planets orbit the Sun. Because the Earth orbits the Sun, from the Earth, we see the main motion of the Sun as east to west. However, (over a longer time scale of weeks and months) the Sun also appears to move north and south.

- Earth - Where we live. It's a ball-shaped planet that rotates and orbits. These two movements make days, months, and years.
- Shadow - a darkened area some distance away from an object and a light source. A solid object blocks a light source and causes a shadow. Usually the shadow is the shape of the solid object.
- Rotation - The daily motion of the Earth. It spins counter clockwise on its polar axis.
- Axis - The center "pole" of a spinning object.
- North pole - TBD
- South pole - TBD
- Orbit - A (roughly circular) path that an object follows around another larger object.
- Outer space - a region of space that is not part of the Earth of another object in space.
- Time - Labels for moments. Time is a way of naming motion.
- Date - Labels for days, months, and years. Dates are a way of recording which day it is.

Prediction

Hour by hour motion. Before you start using the Soft Earth and peg people for the first time, tell the kids to get a rough idea of where the Sun is now (in their own sky). Then they will check again at least an hour later. Have the kids guess where the Sun is going to "be" in the sky in 1 hour.

Tips and hints

Place the velcro carefully so that you can demonstrate the motion of the Earth and how the peg people perceive it.

Follow up activities

Time zones - slices of Earth in roughly the same longitude stretching from the north to south pole. Every location in a timezone agrees to set their clocks to the same time. Discuss timezones in your country and on the entire globe.

References

Star In A Star - this guide and supporting materials: https://starinastar.com

https://www.nextgenscience.org/dci-arrangement/5-ess1-earths-place-universe