



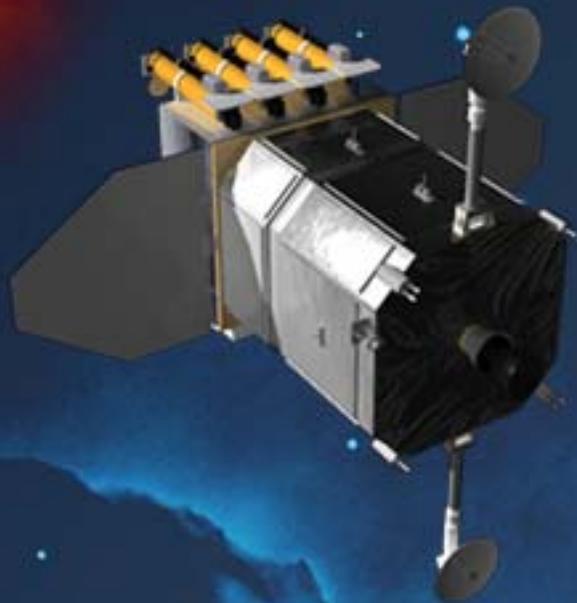
OUR EYE ON THE SUN

THE SCIENCE OF THE SUN

Secondary Learning Unit

Educational Product	
Educators	Grades 7-12

EG-2010-01-032-GSFC



SDO | solar dynamics observatory

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Kinesthetic Astronomy

Grades:

5 - 8

Objectives:

- Students will be able to explain the spatial relationship between Earth and the Sun.
- Students will be able to model the movement of Earth around the Sun.
- Students will be able to define Solstice and Equinox.

Description:

Students act out the motions of Earth around the Sun over the course of one year, including the tilt, solstice and equinox.

Suggested Timing:

25 – 30 minutes.

National Standards

Content Standard D: As a result of their activities in grades 5 – 8, all students should develop an understanding of Earth in the solar system, 4: Seasons result from the variations in the amount of the Sun's energy hitting the surface, due to the tilt of Earth's rotation on its axle and the length of day.

Vocabulary:

- Solstice
- Equinox
- Vernal
- Autumnal
- Rotation
- Revolution
- Orbit

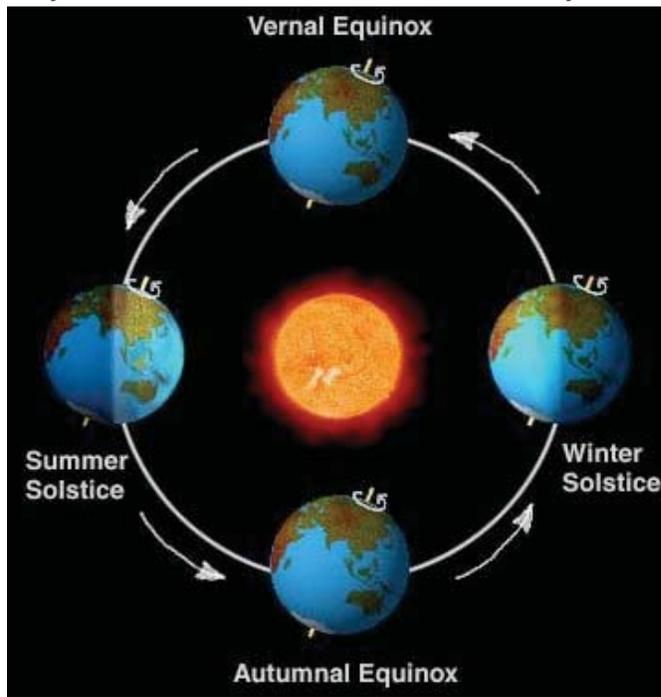
Materials: (One per group)

- Signs, one of each month.
- Object to represent the Sun
- Globe(s)
- Flashlight
- Object or sign to represent Polaris
- Optional: “East” and “West” popsicle sticks
- Optional: Zodiac constellation signs
- Optional: NASA Solar Pizza

Background Information:

Earth revolves around the Sun once per year. The seasons on Earth are caused by the tilt of Earth on its rotation axis, which is approximately 23.5 degrees with respect to its plane of orbit. As Earth revolves around the Sun its axis is continually tilted in the same direction. If you extended the line of the axis into space it would touch Polaris, or the North Star. As Earth rotates around its axis Polaris appears to remain in the same place while all the stars rotate around it.

Once a year Earth’s northern hemisphere is tipped toward the Sun. Once a year it is tipped away from the Sun. These days are called Solstices – the longest and shortest day of the year. In the northern hemisphere the longest day of the year falls on June 21st. This is the day when the Sun illuminates the largest area of the northern hemisphere, resulting in more hours of daylight as Earth rotates. The shortest day of the year is December 21st. This is the day the Sun illuminates the least surface area and the northern hemisphere receives the fewest hours of daylight.



Twice a year Earth’s orientation in relation to the Sun is perpendicular. These days are called Equinoxes – meaning equal day and equal night. All areas of the northern and southern hemisphere are equally illuminated because of this perpendicular orientation. On these two days of the year there are 12 hours of light and 12 hours of darkness everywhere on earth. The autumnal, or fall, equinox occurs on September 22nd, and the vernal, or spring, equinox occurs on March 20th.

Source: http://science.nasa.gov/headlines/y2002/21jun_shadows.htm

Content:**Predict:** (Engagement and assessing prior knowledge)

- What is a year?
- Draw how Earth moves around the Sun.
- What is a day?
- What does Earth's orbit look like?

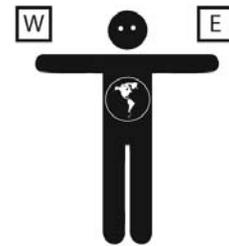
Method: (Body of the lesson)

Have students stand in a circle with an object or light bulb in the center of the room to represent the Sun. Give each student two popsicle sticks, one with an E and the other with a W. (Students can also make an "E" and "W" with their fingers.) Hold a globe in front of you (a t-shirt with a map on it works well too.)

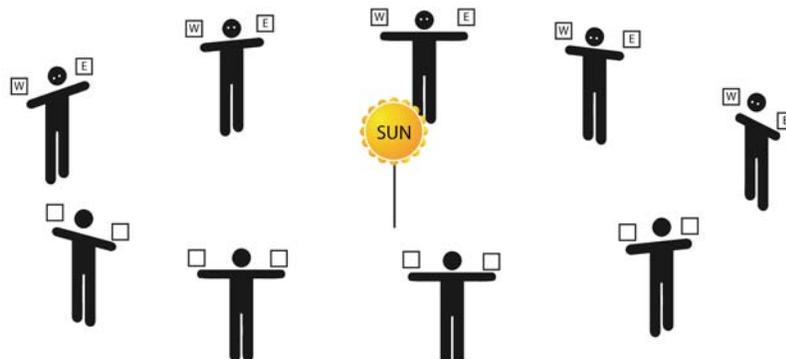
Explain to students that they are going to pretend that they are Earth.

Ask: If you are Earth, where is your north pole? (On top of your head)

Ask: Using the globe as a reference, which hand should hold the East stick and which hand should hold the West stick? Remember that North is up and South is down. (Left = East, Right = West)



Ask: Based on our observations, we know that the Sun rises in the east and sets in the west. Imagine there is a man standing on Mt. Nose (your nose). Which way should you rotate so that the Sun rises to the east of Mt. Nose and sets to the west? (Counterclockwise)

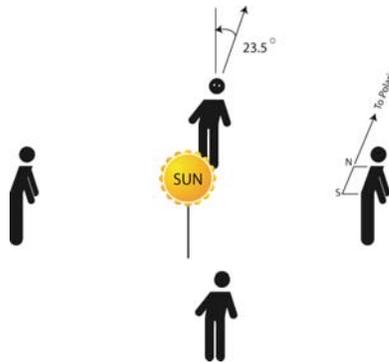


Instruct students to stand so that its Sunrise, noon, Sunset, then midnight on Mt. Nose. Have them do this several times.

Explain that earth revolves around the Sun in the same direction as it rotates on its axis: Counterclockwise, as seen from above the north pole.

Instruct students to walk in a circle counterclockwise, making one trip around the Sun and ending back where they started.

Explain that earth is tilted on its axis towards Polaris, or the North Star. Have students tilt themselves so their heads are lined up with a spot/poster/sign on the wall representing Polaris.



Instruct students to repeat a day's rotation, maintaining their tilt. (Make sure their heads are always pointed towards Polaris, this can be tricky for some students.)

Instruct students to repeat the year's revolution, adding in tilt, and then add in the day's rotation. (Note: Some kids might get dizzy and fall down, be prepared.) At this point have students stop and pass the globe around the circle, being careful to maintain its tilt.

Ask: What do you notice about Earth as it revolves around the Sun? Take several observations, and guide students to the realization that at one time it is pointing towards the Sun, and at another time it is pointing away from it.

Instruct students to observe the tilt of Earth on opposite sides of the Sun.

Ask: Where are two places where Earth's tilt compared to the Sun is the same? Where are two places where its tilt compared to the Sun is opposite?

Explain that these places are called the Solstice and Equinox. Introduce the terms Vernal and Autumnal. Pass the globe around again.

Optional: Put up signs labeling the locations of the Solstices and Equinoxes.

Instruct students to make one revolution around the Sun and each time they pass a solstice to raise their hand. Do the same with equinox.

Ask: We have a summer solstice, where the northern hemisphere gets the most hours of daylight, and when summer officially starts. Use the flashlight at this point to illustrate which hemisphere is getting the most direct Sunlight.

Which solstice is the summer solstice? Which month do you think this occurs in?

Where is the winter solstice?

You may want to take this opportunity to talk about what causes seasons.

Ask: Where in earth's orbit is June? Where is December? Label these points on the wall.

Instruct students to find the spot around earth's orbit where their birthday would be located. Remind them that Earth rotates counterclockwise and where they decided that the summer and winter solstices are located.

Optional: Place signs for the months around the room in the correct spot. Add zodiac constellation signs as well.

To conclude have students repeat the motions of a year once more.

Optional: Solar Pizza Activity

Stand at one end of a hallway and have students guess where Earth would be if the Sun were the size of the solar pizza. Give students time to space themselves out, and then pace off the correct distance.

Have students draw a diagram of Earth's orbit around the Sun then correctly label the axis, solstices and equinoxes.

Live-It: (Assessment questions)

- (Knowledge) What is a year?
- (Comprehension) Describe how Earth orbits around the Sun.
- (Application) Use classroom materials to construct a 3D image showing a Solstice or Equinox.
- (Analysis) Compare and contrast Solstice and Equinox.
- (Synthesis) Use what you have learned to make a poster to teach someone about Solstice or Equinox.
- (Evaluation) Pluto's axis is tilted at an angle of 97 degrees. Describe what seasons would be like on Pluto **and** compare them to seasons on earth.

Extension:

Have students create a four-page booklet, one page per season, showing the orientation of Earth, a seasonal landscape (Sunshine and trees in full foliage for summer), and a short poem about the activities that occur in that season.

Resources:

Extensive worksheets created by SDSC

http://education.sdsc.edu/teachertech/downloads/k_astronomy.pdf

Carl Sagan's video called "The Pale Blue Dot." Find it at www.youtube.com

Seasons Animation:

[http://highered.mcgraw-](http://highered.mcgraw-hill.com/sites/007299181x/student_view0/chapter2/seasons_interactive.html)

[hill.com/sites/007299181x/student_view0/chapter2/seasons_interactive.html](http://highered.mcgraw-hill.com/sites/007299181x/student_view0/chapter2/seasons_interactive.html)