Kinesthetic Astronomy

Grades 3 – 9
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Objectives

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

National Standards

Content Standard D: As a result of their activities in grades K-4, all students should develop an understanding of:

Changes in earth and sky

1. Objects in the sky have patterns of movement. The sun, for example, appears to move across the sky in the same way every day, but its path changes slowly over the seasons. The moon moves across the sky on a daily basis much like the sun. The observable shape of the moon changes from day to day in a cycle that lasts about a month.

Vocabulary

- Solstice
- Equinox
- Rotation
- Revolution
- Orbit

Materials

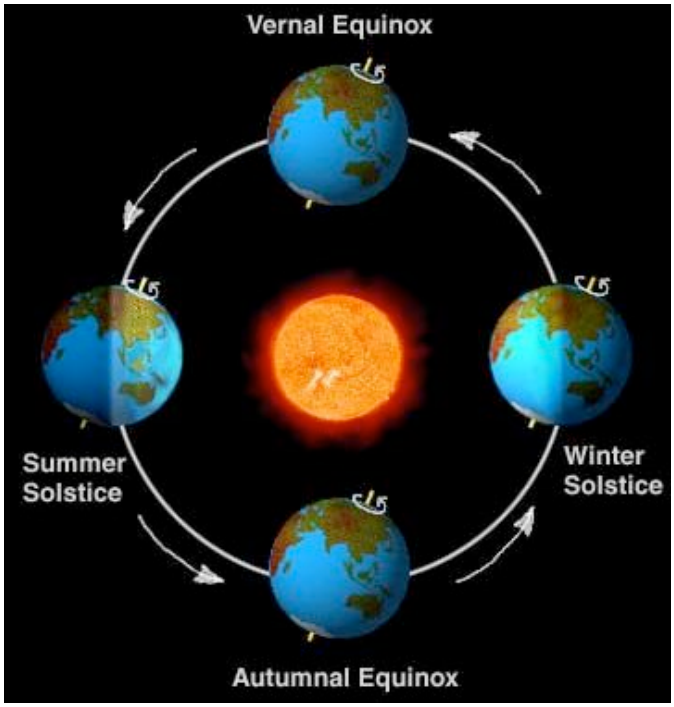
- Signs, one of each month, to post around the room.
- Object to represent the sun
- Globe(s)
- Flashlight
- Object or sign to represent Polaris
- Optional: “East” and “West” popsicle sticks
- Optional: Zodiac constellation signs
- Optional: Solar Pizza

Background

The Earth revolves around the sun once per year. The seasons on Earth are caused by the tilt of the Earth on its axis, which is approximately 23.5 degrees. As the 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 the earth rotates around its axis Polaris appears to remain in the same place while all the stars rotate around it.

Twice a year the earth is tilted directly toward or 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 the 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 the earth's tilt is neither towards nor away from the sun, it is perpendicular to the sun. These days are called Equinoxes – meaning equal day and equal night. All areas of the northern and southern hemisphere are equally illuminated. 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 the earth moves around the sun.
- What is a day?
- What does the 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.)

ASK: Using the globe as a reference, which hand should hold the East stick and which hand should hold the West stick? (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, and 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.

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 the 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 the earth on opposite sides of the sun.

ASK: Where are two places where the earth's tilt is the same? Where are two places where its tilt 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 the 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 a year with all motions once more.

Optional: Solar Pizza
Stand at one end of a hallway and have students guess where the 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.

Method Notebook Ideas:

- Have students draw a diagram of the 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 the 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.

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

Notes and Reflections

January

February

March

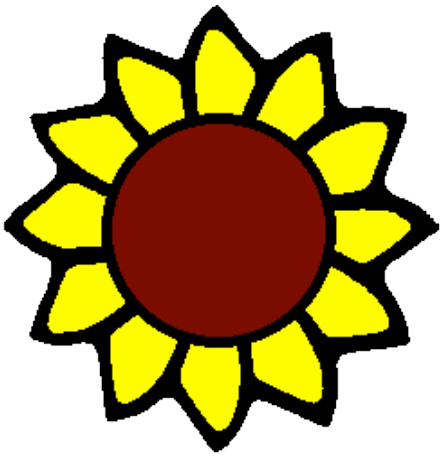
April

May

June

July

August



September

October

November

December

Solstice

Solstice

Equinox

Equinox

Polaris