Kinesthetic Astronomy: The Meaning of a Year

GRADE LEVEL	3^{rd} -8^{th}; Content Standards for 3^{rd}, 5^{th}, 6^{th} – 8^{th}
SUBJECTS	Earth & Space Science, Using Models
DURATION	Preparation: 20 minutes Activity: 20 minutes
SETTING	Classroom

Objectives

In this activity students will
1. Understand the astronomical meaning of an earth year.
2. Learn the difference between a rotation and an orbit.

Materials

- A lamp to represent the Sun at the center of the circle
- Twelve Zodiac Signs and Four Seasons Signs from **Kinesthetic Astronomy: Set Up**
- Painter's tape (if you are taping these signs to chairs or walls)

Scientific Terms for Students

Rotation: a single complete turn

Orbit: the path described by one celestial body in its revolution about another

Orbital period: the time taken for a given object to make one complete orbit about another object; the earth takes 365 days to orbit the sun.

Solar System: a sun with the celestial bodies that revolve around it in its gravitational field

Astronomical Unit: The average distance from the Earth to the Sun; used to compare distances to the planets

Background for Educators

This lesson uses kinesthetic techniques to introduce Earth's orbit around the Sun and to construct the meaning of "orbital period." *NSF Indicators of Science & Engineering 2002* reports that about 50% of a representative sample of the U.S. public are unaware that it takes one year for Earth to orbit the Sun.

There is also a common confusion between use of the terms "rotation" and "orbit". "Rotation" is often mistakenly used to describe the motion of Earth orbiting the Sun. It is important to make the distinction between these terms very clear. Each day Earth *rotates* once on its axis; each year Earth *orbits* the Sun.

Our day and year are based on Earth's periodic motion: one Earth rotation on its axis equals one Earth day; one Earth orbit around the Sun equals one Earth year. Other planets in the solar system have different rotational and orbital periods, so the length of a day or year is different on each planet:

Planet	Distance from Sun (Astronomical Units)	Orbital Period (1 planetary year)	Rotational Period (1 planetary day)
Mercury	0.4 AU	87.96 Earth days	58.7 Earth days
Venus	0.7 AU	224.68 Earth days	243 Earth days
Earth	1 AU	365.26 days	24 hours
Mars	1.5 AU	686.98 Earth days	24.6 Earth hours
Jupiter	5 AU	11.862 Earth years	9.84 Earth hours
Saturn	9.5 AU	29.456 Earth years	10.2 Earth hours
Uranus	19 AU	84.07 Earth years	17.9 Earth hours
Neptune	30 AU	164.81 Earth years	19.1 Earth hours

This lesson is adapted from the Kinesthetic Astronomy program developed by the Space Science Institute, 2004.

Teacher Prep

- Print out the materials listed above
- Follow the instructions in **Kinesthetic Astronomy: Set Up** to set up your kinesthetic circle

Activity Procedure

1. Have students stand in the Kinesthetic Circle around the Sun. Ask the following questions:
   a. Who has a birthday closest to today?
   b. How many trips around the Sun have you (the birthday person) made in your life?
   c. Allow time for everyone to reflect on this question, making the connection between their age in years and the time it takes Earth to make a trip around the Sun.
   d. Poll the other students in the room- i.e. “How many have made 10 trips?”

2. Tell students that Earth’s trip around the Sun is called an orbit.
   a. “What is the shape of Earth’s orbit around the Sun?” [An almost perfect circle.]
   b. This means Earth is always about the same distance from the Sun. (NOTE: Actually, Earth is a tiny bit closer to the Sun in Northern Hemispheric winter, but this does not cause the seasonal changes.)

3. Define and demonstrate the difference between “orbit” and “rotation”. How many times does Earth *rotate* around its axis during one *orbit* around the Sun?” [365 times = 365 days.] (NOTE: Ask the question in this way to connect “time” and Earth’s motions.)

4. Pose the following questions and give students time to discuss and discover with a partner.
   a. Which way does Earth orbit around the Sun?
   b. HINT: After the New Year, you would see Taurus in the night sky, and then later in the year you would see Leo in the night sky. Still later you would see Scorpio.
   c. How many say Earth orbits clockwise around the Sun? How many say counterclockwise? [Confirm that Earth’s orbit is counterclockwise around the Sun.]

5. Have the students walk through one full orbit. Start with rotation and then begin to move in orbit around the Sun as well. Ensure all students are rotating and orbiting in the proper sense. Enjoy their smiles. Contain students who are moving recklessly.

6. Allow time for recovery and re-focus attention by reviewing what students have learned.
   a. How long does it take Earth to orbit the Sun? [1 year = 365 days]
   b. Define the term "Orbital Period" as the *time* it takes one body to orbit another body.
   c. What is Earth's orbital period? [1 year or 365 days]

Extensions

Use the chart in the teacher background information to compare and contrast the astronomical meaning of a year and a day for the different planets in our solar system. Have them write a story about how living on those planets might be different from living on Earth.

California Science Content Standards

Grade Three
Earth Science
3d. Students know that Earth is one of several planets that orbit the Sun and that the Moon orbits Earth.

Next Generation Science Standards

Fifth Grade
5-ESS1-2: Represent data in graphical display to reveals patterns of daily changes in length and direction of shadow, day and night, and seasonal appearance of some stars in the night sky.

Middle School
MS-ESS1-1: Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.