

# Kinesthetic Astronomy: Earth's Rotation

GRADE LEVEL	3 <sup>rd</sup> -8 <sup>th</sup> ; Content Standards for 3 <sup>rd</sup> and 5 <sup>th</sup>
SUBJECTS	Earth & Space Science, Using Models
DURATION	Preparation: 20 minutes      Activity: 15 - 30 minutes
SETTING	Classroom

## Objectives

In this activity students will:

1. understand why the sun rises in the east and sets in the west
2. understand how the earth rotates and how long it takes for the earth to rotate
3. discover that the stars appear to rise and set just like the sun does

## Materials

- An object to represent the Sun at the center of the circle (i.e. lamp, yellow balloon, etc.)
- 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)
- Globe or inflatable Earth to show the distribution of continents on planet Earth
- Copies of the continents (1 set per student)

## Scientific Terms for Students

**Axis:** the center around which something rotates

**Constellation:** an identifiable configuration of stars as seen from earth

**Rotation:** a single complete turn

**Rotational Period:** The amount of time a planet requires to make one complete spin about its axis. The earth has a 24 hour rotational period.

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

**Sunrise:** the daily appearance of the sun

**Sunset:** the daily disappearance of the sun

## Background for Educators

This activity begins with students turning themselves into the earth and then physically moving their bodies and engaging in critical thinking in order to figure out how the earth rotates. The activities aim to engage students in a kinesthetic understanding of the solar system.

*Kinesthetic* describes a sensation of bodily position, presence, or movement. Putting a spoonful of soup in our mouth is an everyday example of using a kinesthetic sense. We know where our mouth is even though we do not see it or touch it. We kinesthetically sense the presence and position of our mouth so

that the soup spoon makes it in. You can kinesthetically sense the position and movement of other body parts as well.

Many people have a hard time interpreting drawn diagrams and understanding how the earth moves in relationship to the sun. In a 2008 California Academy of Sciences Survey we discovered that many adults don't know that the earth takes 365 days to travel around the sun. This concept was also shown in the Harvard- Smithsonian Center for Astrophysics in the 1987 [Private Universe](#) study that looked at why students have a hard time learning astronomy.

Some of the common misconceptions that students have are outlined in the paragraphs below with a follow up explanation for helping to correct that perception.

- **How many stars are in a solar system?** Many people believe that there is more than one star in our solar system and that the Solar System is the entire Universe. For example, many wrongly believe that Polaris (the Pole Star or North Star) is within the Solar System and closer than the planet Pluto. In reality Polaris is about 876,000 times more distant from our sun than Pluto.
- Many people have not perceived that stars (at all but polar latitudes) appear to rise and set just as the Sun does (due to Earth's rotation about its north-south axis). For some urban dwellers, even sunrise and sunset are uncommon experiences. **Stars rise and set just like the sun.**
- There is 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. **Rotation is how a planet spins on its axis.**
- When asked whether people in China will see the same stars tonight as people in the US (if both are located at about the same latitude), many people answer "no". Earth's rotation makes noon change to midnight, and this takes only twelve hours. Earth's orbit around the Sun slowly changes the direction Earth's night side faces out into space. Meanwhile, in 12 hours Earth has not moved very much in its orbit around the Sun, and so the night side in China is facing almost the same direction out into space as the night side in the US. Thus the people in China will see the same stars tonight. **People looking at the sky at the same latitude on earth will see the same stars even if they are on opposite sides of the world.**

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

- To mark the floor with where students should stand, use the painters tape or some other marker to put down a circle. Use 12 pieces of tape to represent each earth month

### Activity Procedure

1. Give students printouts of the earth's continents and have them tape them to their shirts with North America towards the top left. Explain that they are going to be the earth and will be hanging out in space for the rest of the activity.
2. Once the students have become the earth, ask questions such as...
  - a. Where is your equator? – around their belly
  - b. Touch your north pole – head
  - c. Where is your home? Is that in the northern hemisphere?
  - d. What is on the other side of the earth from North America? – Asia
3. Have your students stand around the kinesthetic circle and discuss the following questions with a partner.
  - a. Which way is east and which way is west? [east is to the left, west is to the right]
  - b. How does the Sun appear to move in the sky? [Rises in the east; Sets in the west]
4. Have students face directly toward the symbolic Sun. Gesture with your hand from the middle of your face down along the front of you.
  - a. What time would it be along a line that runs down the middle of your front? [Noon]
  - b. Why is it noon? [The Sun is midway between east and west.]
5. Have students face directly away from the Sun.
  - a. Is the Sun on North America now? [No]
  - b. What time is it now?" [Midnight] "What do you see? [Stars]
  - c. What time is it along a line that runs along the middle of your back? [Noon]
  - d. What would people there see in the sky? [The Sun]
6. Call students' attention to how it can be different times at different places on Earth, and how there are 12 hours between their front and back.
7. Have the students hold up their hands alongside their eyes to create a horizon line. Explain that what is behind their hands is out of sight.
8. Have students make a 90-degree turn toward their east.
  - a. What is low in your east? [stars]
  - b. What is low in your west? [The Sun]

- c. What time of day is this when the Sun is low in your west? [Sunset]
  - d. Why is this sunset? [Because the Sun is disappearing in the west.]
  - e. Why does the Sun seem to disappear in the west? [Because I turn away from it.]
9. Return to noon and ask: "So which way does Earth turn so that the Sun appears to set in the west and rise in the east." Give students time to work out the answer, using trial and error.
10. Now guide everyone in rotating through a complete day. Start with the noon position, facing the Sun. Command students in sequence:
  - a. Turn to sunset- what do you see? [the sun low in the west]
  - b. Turn to midnight-- What do you see in your sky? [Stars]
  - c. Come to sunrise- What do you see in your sky? [The Sun low in the east]

### Wrap-Up

1. What do we call the turning of Earth that causes the Sun to rise and set? [Rotation]
2. How long does it take Earth to rotate around one time? [24 hours = 1 day]
3. Do people in Asia see the same stars that people in North America do? [Yes!]
4. What is today's date in the US at 3pm? What would be the date in central China where it is 3am? [Tomorrow's date]

### Extensions

Use the same kinesthetic set-up and combine this activity with other activities such as the Astronomical Meaning of a Year, Reasons for the Seasons, Moon Phases, Birthday Stars, Mars Opposition Dance.

### California Science Content Standards

#### Grade Three

##### Earth Sciences

- 4a. Students know the patterns of stars stay the same, although they appear to move across the sky nightly, and different stars can be seen in different seasons.
- 4e. Students know the position of the Sun in the sky changes during the course of the day and from season to season.

#### Grade Five

##### Earth Sciences

- 5a. Students know the Sun, an average star, is the central and largest body in the solar system

## 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.

