As the World Turns, Rotates, and Revolves

Overview Students investigate the rotation and revolution of Earth.

Related Standards of Learning 3.8a

Objectives

The students should be able to

- explain how some events in nature occur in a pattern or cycle, such as the seasons and day and night;
- recognize that the relationships that exist between and among the Earth, sun, and moon result in day and night and seasonal changes;
- model and describe how Earth's rotation causes day and night;
- model and describe how the sun's rays striking Earth at various angles cause seasons.

Materials needed

- Globe of the Earth (See Optional Globe Preparation below.)
- Clear 100-watt light bulb
- Lamp
- "Rotate" and "revolve" signs (see pp. 5 and 6)
- Tiny piece of a sticky note
- A room that can be darkened

Instructional activity

Content/Teacher Notes

- This lesson is an adaptation of an activity from the Science Museum of Virginia's, "Earth in Space" teaching module. This activity, "EIS Workshop 2: As the World Turns," as well as others that cover the Earth/Space Systems and Cycles strand, can be found at http://www.smv.org/pubs/EarthInSpaceMenu.htm.

- Optional Globe Preparation: You can use a regular globe for this demonstration, but a white globe creates a much more dramatic effect. The colors on a regular globe have different abilities to absorb and reflect light, which makes it hard to see and understand how the light is hitting the globe's surface. You can make a "white globe" in a couple of ways. If possible, find an old, out-of-date globe that you can paint. Outline the continents and the equator with the kind of puff paint that children use for decorating T-shirts. Let the puff paint dry for about 24 hours. Next, paint the surface of the globe with several coats of white acrylic paint. Once the globe is dry, experiment with shining a strong light on the surface of the globe, aiming the light at the equator. This setup should provide a very dramatic division between "night" and "day."

Introduction

1. Position your light source so that you can move the globe around it during the discussion. Draw a human figure on the tiny portion of a sticky note. Dim the lights in the room for the demonstration. Use your own version of the following conversation to get the class ready for the "As the World Turns" demonstration.
2. "Let's look at this globe. What things do you notice about this globe? (It's a special kind of map. It shows us where the oceans and landmasses are on the Earth's surface.) Let's find where we

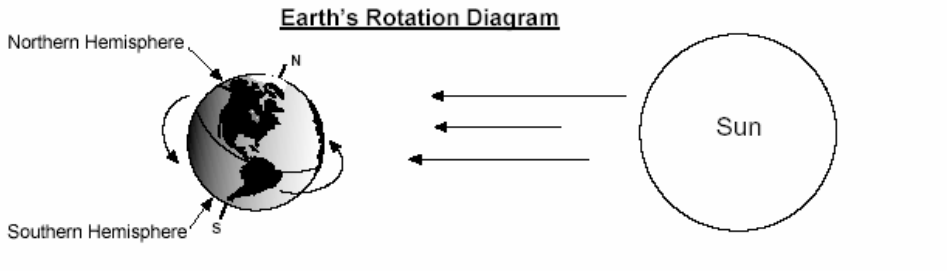
live on this globe. (Point out Virginia on the globe. Attach the tiny sticky note with the figure drawn on it to Virginia. Make sure that the little figure is looking toward the North Pole.)

3. "This little figure is going to represent *us* as we talk about the globe. Why do you think the North Pole is at the top of the globe? There is actually no reason that we couldn't put the South Pole at the top. If the first mapmakers had lived in Australia, we might be studying a globe that had the South Pole at the top! However, most of the early explorers and mapmakers came from the top half of the Earth, so globes have north at the top.
4. "As we talk about the movements of the sun and Earth, we will pretend that we are standing in Virginia and facing the North Pole. This is our 'point of view' or 'frame of reference.'"

Procedure

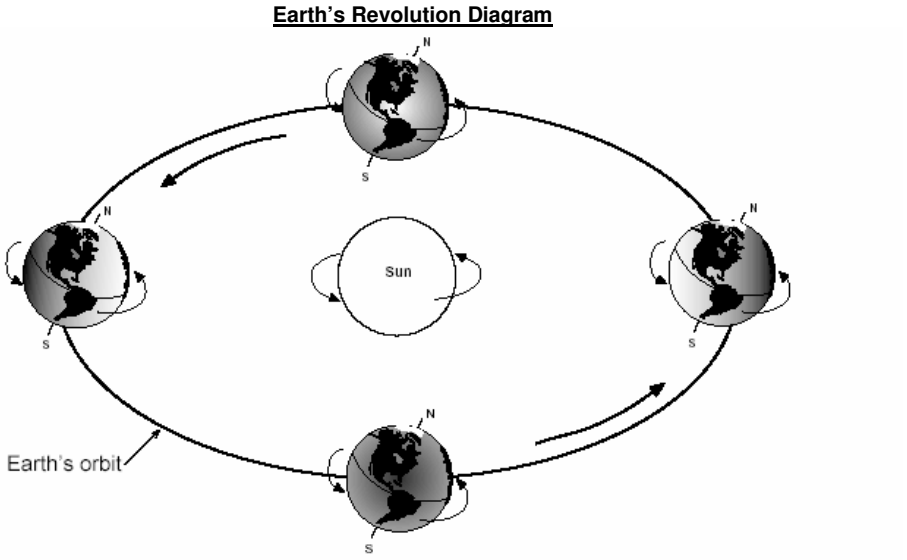
Rotation of the Earth Demonstration

1. Ask the students, "Can anybody tell me what the word *rotate* means?" (To spin around an imaginary line called an *axis*.) Ask all of the students to rotate, and have one student be the "rotate" sign holder, holding up the sign every time you say the word *rotate*. Turn the globe slowly counterclockwise, and explain that Earth rotates in a *counterclockwise* direction.
2. Ask, "What do we mean by the term *counterclockwise*?" Ask the students to make circles with an arm in the direction in which the hands on a clock move — clockwise. Then, have them make circles in the opposite direction — counterclockwise. "When we say that Earth turns in a counterclockwise direction, remember that we are looking at Earth from above the North Pole. Ask all of the students to rotate in a counterclockwise direction, using their arms to represent their axis of rotation. Have the "rotate" sign holder hold up the sign.)
3. Say, "This light we have set up represents the sun. As you rotate, imagine that your nose is *you* and the top of your head is the North Pole. Notice that your nose goes through a repeating cycle — night (away from light) – day (facing light) – night – day – night – day, and so on. Also, the sun seems to rise in the east and set in the west, but it's really you who is moving, not the light (sun)." Let the students sit down for a few minutes, as you don't want "dizzy" planets!
4. Demonstrate the same phenomenon — the sequence of night and day — using the globe. Be sure to point out the little figure that represents "us." Follow the little figure through several cycles of night and day. "Where is the sun when the little figure sees the dawn start?" (Just appearing in the east) "Where is the sun when the little figure is ready for lunch around noon?" (Close to overhead in the sky) "Where is the little figure when it's sunset?" (Just disappearing in the west) "Where is the little figure when it's night?" (On the far side of Earth, which is in shadow) Depending on the ability level of your students, you may want to add that this is why the stars, moon, and planets also appear to rise and set. Emphasize that these objects aren't really moving across our sky from east to west, but that Earth's rotation in the opposite direction, west to east, makes all of these objects look like they are moving — rising and setting.
5. The diagram below shows why the sun appears to move across the sky because of Earth's rotation. (The Earth and sun are not drawn to scale.) "Can anyone tell how long it takes Earth to rotate once on its axis, from noon to noon?" (One day, or 24 hours)



Revolution of the Earth Demonstration

1. Say, "Now, we're going to learn about another movement that Earth makes. It has a special word too. At the same time that Earth is rotating on its axis, it's making a circle — or *revolution* — around the sun. We say that Earth revolves around the sun." Have a student be the "revolve" sign holder, holding up the sign every time you say the word *revolve*. Make sure everyone gets the idea of revolving.
2. The diagram below is designed to show the movement of Earth around the sun. (The sizes of the sun and the Earth and the distances between them are not drawn to a single scale. Also, Earth's orbit is viewed from the side. This orbit is actually fairly close to a circle.)



3. Say, "Let's do one last movement around the sun! I want everyone to make one revolution around the sun and rotate on your axis at the same time. Go slowly so that you don't get too dizzy! Can anyone tell me how long it takes for Earth to revolve around the sun one time? (One year)

Observations and Conclusions

1. Have students make observations and answer questions throughout activity.

Sample assessment

- Have students draw diagrams to depict the seasons and day and night with respect to the position of the sun and Earth.
- Ask students to describe in their own words the difference between rotation and revolution, including which one causes the seasons and which one causes day and night.

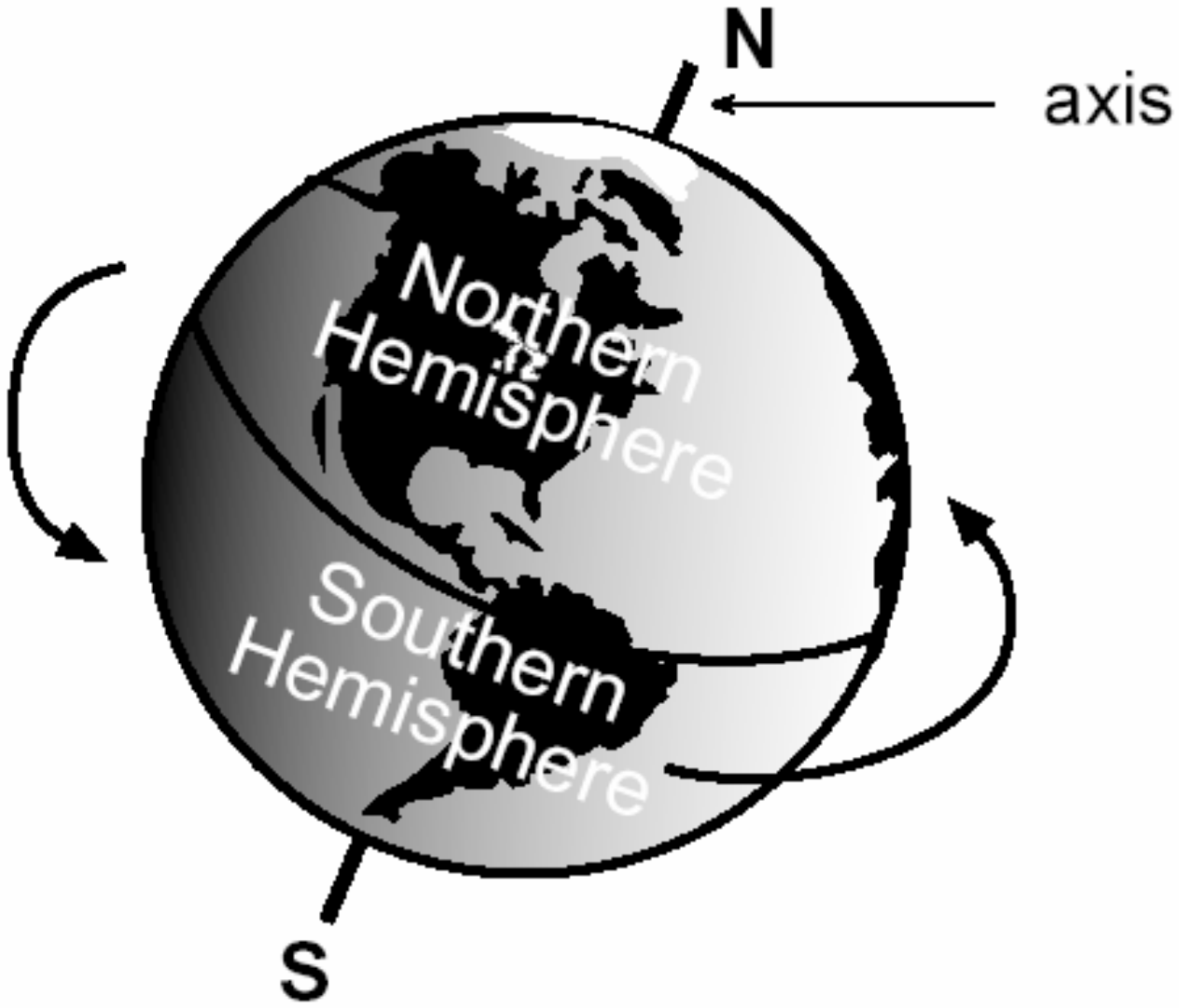
Follow-up/extension

- See the "Earth in Space" teaching module for more lessons regarding the seasons.
- Ask students to make a drawing that shows the early morning or late afternoon sun in the sky. East should be on the right side of the picture and west on the left side of the picture. (This activity puts east on the right because the students will associate east and west with standard map orientations. Astronomers in the Northern Hemisphere usually view the sky while facing south, but younger students may have trouble understanding the reversal of viewpoint. Noon is omitted from the student options because at our latitude, the sun would be behind the student high in the sky, and objects would cast their shadows toward the north, which would be directly behind the objects from the students' point of view.) Remind students to include the shadows that the objects in the drawing cast on the ground and to write the time of day in the lower right hand corner of the drawing.

Resources

- *Connections: Connecting Books to the Virginia SOLs.* Fairfax County Public Schools and The College of William and Mary. http://www.fcps.edu/cpsapps/connections. Presents a database of more than 1,000 works of children's literature and their connection to the Virginia Standards of Learning.
- *Earth in Space: Teacher Training Module.* http://www.smv.org/pubs/EarthInSpaceMenu.htm. This module is a professional development resource of the Virginia Department of Education that was developed by the Science Museum of Virginia for astronomy in grades 1 through 6.
- *The NASA SCIence Files™.* NASA Center for Distance Learning at Langley. http://scifiles.larc.nasa.gov/educators/index.html.
- *NASA Web Page for Educators.* http://www.nasa.gov/audience/foreducators/k-4/features/index.html.
- *National Data Buoy Center: Center for Excellence in Marine Technology.* http://www.ndbc.noaa.gov/educate/seasons.shtml. Offers a demonstration of the seasons.
- *Outstanding Science Trade Books for Students K–12.* National Science Teachers Association (NSTA). http://www.nsta.org/ostbc.
- *Science Museum of Virginia.* http://www.smv.org.
- *Search for Literature: Literature for Science and Mathematics*. California Department of Education. http://www.cde.ca.gov/ci/sc/ll/ap/searchlist.asp. Offers a searchable database.
- "Understanding Moon Phases: Waning Gibbous Moon." *Earth & Sky Radio Series.* http://www.earthsky.com/skywatching/moonphases-wangib.php.

rotate



revolve