Day/Night (Rotation)

NGSS Science Standard: 5-ESS1-2
Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year.

Student Learning Objectives:
Students will learn the vocabulary terms rotation, axis, and solar day. They will learn that the earth’s rotation speed of one thousand miles per hour results in a solar day of twenty-four hours and that the earth’s temperature is affected as it rotates.

MISCONCEPTION: The summer season is warmer due to the earth being closer to the sun. Mozart question 14. What happens as summer changes to fall?

Possible Preconceptions/Misconceptions:
- The earth is larger than the sun.
- The sun disappears at night.
- Day and night are caused by the sun moving from east to west across the sky.
- The amount of daylight increases each day throughout the summer.
BRIEF LESSON DESCRIPTION:

Concept statement - Students will model the rotation of the earth to learn about day and night (a solar day). They will use toy tops to observe rotation around an axis point. They will make a paper model of the earth and the sun and will rotate the earth to simulate day and night.

Vocabulary

Tier 2:
- rotation - a circular movement of an object around a center or axis
- axis - the line about which a rotating body, such as the earth, turns
- hemisphere - half of a sphere such as the earth
- patterns - the regular and repeated way in which something happens or is done
- constant - an event that happens all the time or very often over a period of time

Tier 3:
- orbit - (noun) a path of an object as it circles around another object in outer space
- revolve - a circular movement of an object around another object
- solar day - one complete rotation of the earth resulting in day and night, a period of 24 hours
- circumference - the complete distance around a circle
- counter clockwise - in the opposite direction of the movement of the hands of a clock

Background Information:

The axis of the earth, an imaginary line around which it rotates, is tilted at an angle of 23.5 degrees. Sunlight striking the earth results in the observable pattern of day and night. A twenty-four hour period, one complete rotation, is called a solar day. The earth is rotating from east to west at a speed of about 1,000 mph. Out in space looking down at the North Pole one would observe that the earth is rotating in a counter clockwise direction. The rotation of the earth results in many weather patterns. The lit side of the planet warms as the dark side cools causing movement of the atmosphere. Rotation also results in oceanic tides along the coasts. The earth began rotating at the formation of the solar system and continues to rotate. The speed of rotation at the equator is 1,037 miles per hour.
Materials

Per student:
- Copies of “Night and Day” worksheet (copied on heavy paper if available)
- Small paper fasteners
- Scissors
- Crayons or markers

Per group:
- Small toy tops (available at party favor stores and novelty stores)

Per class:
- Styrofoam ball
- Barbeque skewer
- Globe or large balloon (dark colored)
- Flashlight

Engage

- Show students a picture of Earth depicting day and night.
- **Ask**, why does the earth experience day and night? (These images can be found using a Google search titled “The earth showing day and night.”)

- Write student comments on the white board or chart paper, allow dialogue where students table talk and explore ideas. Introduce the term hemisphere and encourage the students to use the word hemisphere in their responses.
- Ask students: Why is it important that earth experiences daytime and night each day? Possible answers, if the earth didn’t have day and night one half (hemisphere) of the planet would be too hot or too cold. Without sunlight, plants couldn’t grow on the dark side of the earth.
**Explore/Lesson Procedures (30 minutes):**

**Inquiry questions.**

*What causes day and night?*
*What would happen if the earth was not rotating?*

**Part A:**

1. **Ask** the inquiry questions to get students thinking about day and night.
2. Teacher demonstration: Take a wooden skewer and push it through the styrofoam ball to illustrate the earth’s axis.
3. Define axis to students as: a line about which a rotating body, such as the earth, turns.
4. Hold the ball by the axis and rotate it.
5. Define rotation: A circular movement of an object around a center point or axis.
6. Show a toy top. **Ask,** *What part of the top would be the axis?* Answer, the handle that is pushed down or spun to make it spin.
7. Spin the top to show how it rotates around the axis. If a large toy top is available it would work better for demonstration purposes.
8. **Ask** student groups to make a list of several things that rotate. (Teacher writes a list on white board or chart paper) Examples: a fan, the dish in a microwave etc. Encourage each group to share some examples describing the speed of their example’s rotation and the axis point of the rotation.
9. Give a toy top or two to each group of students. Have students spin the toy tops to show how fast they rotate. Have the students take turns rotating the tops. **Ask** students, *what happens when the top slows down?* (Answer, it wobbles and eventually stops due to friction at the point where the top touches the table.)
10. Discuss that the earth began spinning at the beginning of the solar system and has been spinning (rotating) ever since.
11. **Ask** students, *why is it important that earth rotates?* Answer, rotation causes day and night which helps regulate the earth’s temperature. *What would happen if it stopped rotating?* Answer, the hemisphere in darkness would be extremely cold and the hemisphere in light would be extremely hot.

**Note,** many students think that if the earth stopped rotating they would fly off into space. This is a common **misconception.** If the earth were not rotating the mass of the earth and its gravitational pull would still exist and people would not fly out into space.

**Part B:**

1. Using a globe or a dark colored balloon, darken the room, then shine the flashlight on a globe or balloon to simulate how the sun only shines on half of the earth (one hemisphere) at a time. This shows how one side of the earth has daylight and the other has night. Slowly rotate the globe from east to west (counter clockwise) showing the movement of the earth and how light illuminates our planet. Point out the axis of the globe. **Ask,** *why does the earth have day and night?* Answer, because it is rotating.
2. Pass out the worksheet “Night and Day”. Students will construct a model that represents the earth’s rotation which results in night and day.

3. Directions for using the “Night and Day” worksheet:
   - **Step 1.** Use crayons to color the earth, as described on the worksheet. Color the rectangle labeled “Night” black.
   - **Step 2.** Students should cut off the strip of paper to the right of the sun with the coloring directions and the earth then cut out the earth just inside the dotted lines.
   - **Step 3.** Cut along the dotted lines of the portion labeled “color black” to create a slot for the half of the earth that would be in darkness. Be sure to leave the tab under the X connected to it. Only cut on the dotted line.
   - **Step 4.** Use a sharp pencil to poke a hole through the X on the earth and on the tab. Use a small paper fastener and push it through the X on the earth. Then attach the earth to the worksheet by sliding the earth half way into the slit and then push the fastener through where the circled X is located on the tab. See sample.
**Step 5.** When the model is complete, have the students practice rotating the earth, counterclockwise, so that half of the planet, one hemisphere, is in darkness and half, the other hemisphere, is in daylight. Tell students that the children pictured on the globe are in the Western Hemisphere and when the Western Hemisphere has daytime the Eastern Hemisphere has night.

**Step 6.** Discuss that a car can go over 60 miles per hour on a highway. **Ask, how fast is the earth rotating?** Discuss that the circumference of the earth is over 24,000 miles (24,901) and the earth is rotating at just over 1,000 miles per hour. The speed of this rotation creates one solar day which is twenty-four hours long.

**Step 7.** Have students rotate the earth so that the children’s feet are facing noon. Note - this model depicts the earth as it would be if an observer was looking down from above the North Pole.

**Step 8.** **Ask,** how long would it take for these children to complete one rotation? (Answer: 24 hours for a solar day). Have them rotate the earth one complete rotation so that the children are again facing noon. Emphasize that the earth’s rotation which results in day and night is a constant repeating pattern.

**Step 9.** Have students rotate the earth to show the number of rotations that would be equal to three days and nights. The children must pass noon three times. Emphasize that it is the earth’s rotation that causes day and night. **Ask,** is the sun moving across the sky from east to west during the day that causes day and night? Answer, no, the sun only appears to move across the sky as the earth rotates. The earth’s rotation causes day and night.

**Step 10.** When the children are facing noon again, ask students to rotate the model to show one and a half days.

**Step 11.** **Ask,** would the children be in daylight or darkness in one and a half days? (Answer: darkness, midnight). Take responses from several students. **Ask,** in the paper model what vocabulary word does the paper fastener represent? Answer, Earth’s axis.
Earth Systems Grade 5 Changes in Seasons - STEM Lessons

The Earth
Color the land brown and green.
Color the water blue.

Night and Day
Sun (color yellow)
Day (color light blue)
Noon
Night (color black)
Part C:

1. Show the first nine seconds of the video “Earth’s Rotation Animation” (http://www.youtube.com/watch?v=GiVQrx59640). Pause the video when the Western Hemisphere and the United States are center screen.
2. Ask, why is one hemisphere or half of the earth in daytime? Where would the sun be in this screen? (Answer: To the left.)
3. Show students where the United States is on the globe in the video.
4. Have students watch the remainder of the video and ask them to count and determine how many solar days are shown for the United States. Ask, how can you tell how many rotations the earth has made? Students should observe that the United States went through three complete rotations (days and nights) which resulted in three solar days.

Evaluate

Have students write in their science journals and ask students to write their understanding of a solar day, how long it takes, and why it occurs. Encourage students to use academic vocabulary in their explanations.

ELL Modification: Encourage table talk in teams. Hearing language and listening to how academic vocabulary is used, are valuable strategies for ELL students. Encourage students to work with a partner as they write their explanations.

ELL Modifications:

Write vocabulary words on the board or butcher paper to create a word bank.
Use student partners at each table group to practice vocabulary during group work. Have the students copy and complete the sentence frames in their journals to aid students’ understanding of the vocabulary.

1. When the earth is spinning, we say that it is ______________________ (rotating).
2. Earth spinning on its __________________________ (axis) causes __________________ (day) and __________________ (night).
3. The earth is rotating toward the _______ (east) at _________ mph. (1,000).
4. When the earth rotates for 24 hours we call that a _________ _________ (solar day).
5. If the earth did not rotate then _________________________.
6. When the _________ Hemisphere has daylight, the _________ Hemisphere has night. (Western, Eastern) or (Eastern, Western)