Around the Sun in 365 Days

Summary

Through inquiry science, students will be able to answer these essential questions:
What causes the seasons? (3rd and 4th Grade)
How does the heat of the sun change through the year?(3rd Grade)
What data would help us predict air temperature? (4th Grade)

Additional Core Ties

English Language Arts Grade 3
Reading: Informational Text Standard 3
English Language Arts Grade 4
Reading: Informational Text Standard 3
Mathematics Grade 3
Strand: OPERATIONS AND ALGEBRAIC THINKING (3.OA) Standard 3.OA.8
Mathematics Grade 4
Strand: OPERATIONS AND ALGEBRAIC THINKING (4.OA) Standard 4.OA.3

Time Frame

3 class periods of 45 minutes each

Group Size

Small Groups

Materials

- Blow up earth (beach ball)
- Flashlight (for each group)
- Globe
- Tape measures
- Putty or clay
- Toothpicks or matchstick
- Masking tape
- Strong work light/ camping lantern
- Graph paper
- iPod or iPhone with the free LuxMeter App.
- Protractors
- Markers or crayons
- Shop light

Background for Teachers

Seasons are caused by the revolution, or orbit, of earth around the sun. The tilt of the earth angles any given location on earth's surface toward or away from the center of the sun's rays.
As the rays of the sun spread out from that central point, they must cover a larger area and their intensity is diminished. The lower intensity of the sun's light and heat combined with the shorter daytime hours delivers less heat to the portions of earth that are angled away from the sun, creating lower temperatures.
A general misconception is that the cooler temperatures are a result of the angled area being farther

away from the sun. While a particular location on earth's surface may be farther from the sun than another, the difference in the distances is so small as to not have a measurable effect on temperatures.

Vocabulary

3rd Grade:

- Axis
  : an imaginary line that goes through the center of a planet
- Model
  : a small sized copy of something
- Orbit
  : the path an object in space follows as it revolves around another object
- Revolution
  : one orbit of an object in space around another object in space
- Rotation
  : the spinning of an object (planet) around its own axis
- Sphere
  : round like a ball

4th Grade

:

- Air temperature
  : how hot or cold it is
- Atmosphere
  : air around earth
- Freezing
  : temperature at or below 0° C or 32° F
- Seasonal
  : normal for the time of year
- Thermometer
  : device used to measure temperature

Student Prior Knowledge

Students will have a general understanding of the way Earth rotates on its axis. They will be able to measure using a ruler. Students can explain that the sun gives us heat and light. Students can explain what the earth's axis is.

Intended Learning Outcomes

2. Manifest Scientific Attitudes and Interests

c. Pose questions about objects, events, and processes.

4. Communicate Effectively Using Science Language and Reasoning

a. Record data accurately when given the appropriate form and format (e.g., table, graph, chart).

b. Report observation with pictures, sentences, and models.

Instructional Procedures

Day 1:

Where is your shadow? Shine a strong flashlight or work light on a student at an angle that simulates morning. Measure the shadow that is created. Move the light to a higher angle and measure again. Do measurements to simulate midmorning, noon, afternoon, and sunset. You may have to adjust where you hold the light to make a manageable shadow. Demonstrate how

to graph these measurements. Discuss how the light from the flashlight is like our sun. Remind students that the sun doesn't move. Our rotation on Earth is what causes it to look like it moves across the sky. When do students think the sun would feel the warmest? The coolest? Try using a LuxMeter to measure the changes in light intensity. The meter should stay in one place (like resting on a table) while you move the light as you did over the student. Does the intensity of the light change as the flashlight is moved? Why do you think it does that? Higher numbers mean more intensity and more light is focused on the meter. Lower numbers mean less intensity and less light is focused on the meter.

Math: Demonstrate how to graph these measurments. Use the graphing worksheet that is attached, or create one of your own.

Discuss how the light from the flashlight is like our sun. When do students think the sun would feel the warmest? The coolest? What is moving when we see the sun change position in the sky? (The earth is rotating.)

In teams brainstorm different reasons for more or less sunlight in our city over time. If students don't come up with it on their own, suggest changing seasons as a reason.

Sentence frames for student discussion:

In _____ we have more sun.

In _____ we have less sun.

When there is/are _____ we have less sun.

When there is/are _____ we have more sun.

Day 2:

Seasons: Show a globe and have students attach a small matchstick or toothpick to our city with some clay. Mark four places around a 10' circle. Hold the flashlight at the center of the circle. Have a student walk the globe around this "Sun" making sure the matchstick faces the Sun. Stop at each mark and measure the height of the shadow the toothpicks casts. Use the LuxMeter to measure the amount of light that falls at each location on the globe. Does the intensity of the light change as the shadow grows or shrinks?

Math: Have students graph these heights. What does their graph look like? What is wrong with our model? We need to tilt the earth!

Sentence frames for student discussion:

I noticed that _____.

The graph is the same because _____.

Help students tilt the earth to the appropriate 23.5 degrees. Attach a "North Star" to a fixed point in the room like the whiteboard or a window. Have students tilt the earth model toward that point and remind them that it needs to be kept angled this direction. Repeat the walk around the circle and the measurements.

What happened this time? Why? What was the difference in the size of the shadow from the longest to the shortest? How did you find that difference? Did some of the measurements seem to match up?

Have students discuss these questions in teams and come up with a short description of what happened and why they think it happened.

Sentence frames for student discussion:

I noticed the shadow was longest when _____.

I noticed the shadow was shortest when _____.

I noticed that the shadows looked the same when _____.

I think the shadows are different because _____.

Discuss the seasons and how the earth's movement around the sun while tilted makes the seasons. Do we know why that tilt causes the cold of winter or the warmth of summer? Does the same amount of sunlight fall on earth every day?

Walk the globe around again and look to see that the same amount of sunlight hits earth, but it is not concentrated in the same places.

Day 3:

Give each team a piece of graph paper, tape, a protractor, a marker, and a flashlight. Tape one end of the paper to the tabletop. Using a protractor hold the paper at a 90° angle perpendicular to the table. Have a student hold the light source 1 foot from the paper. Another student draws a ring on the graph paper around the edges of the light. Now tilt the paper to 67° and repeat the procedure. Do a final reading at 35°.

Math: As a team figure out a good way to determine how many squares are in each circle, and what the difference is between the three. Ask teams to explain how they solved the problem.

Why do you think the light looked different? Did the amount of light from the flashlight change? How does this relate to the seasons?

Have student teams discuss these questions and come up with a short written explanation. Share what teams found.

Sentence frames for student discussion:

I think the light looked different because _____.

When the light hit the paper at _____ degrees, it is like the season of _____.

The light is _____. The change comes from _____.

Remind students that we have seen how light spreads out when it is angled. What about heat? Have students place their hand near a strong light or blow dryer at a 90° angle, then at a 67° angle. When did they feel the most heat? Why? How does this relate to the seasons?

Wrap up: What causes the seasons?

Work with students to make a list of some reasons we have seasons.

How does the sunlight change throughout the year? Help students craft a statement to answer the question based on what they have learned.

What data would help us predict air temperature?

Make a list of data students would want to have to predict air temperature (such as time of year, time of day, amount of sunlight) and why they would want that data.

Strategies for Diverse Learners

Provide an illustrated word bank for key vocabulary

Use included sentence frames for English learners

For students with disabilities, have teams where each person had an assigned task (one that could complete on their own)

Partner students

Provide for physical limitations (ex. Access to the board, partner to help scribe, etc.)

Allow students to verbally or physically explain if they are unable to produce writing

Extensions

Magnifying glass to concentrate the sun.

Assessment Plan

Informal formative assessment throughout the lesson as you observe oral discussion and short written responses.

Summative assessment at the end -- Identify seasons and explain why.

Bibliography

Authors

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