

2nd Grade Solar Energy Lesson

NC State Science Standards:

- 2.E.1.1** Summarize how energy from the Sun serves as a source of light that warms the land, air, and water
- 2.E.1.3** Compare weather patterns that occur over time and relate observable patterns to time of day and time of year.

Essential Questions:

- What type of energy does the sun provide for the Earth?
- What happens to that light energy when it reaches the Earth?
- What patterns can we observe about the weather and what influences these patterns over time?

Brief Lesson Description:

Students will explore the concept of light energy from the sun and its role in heating the planet by observing the heating of different materials placed in the sun. Students will also explore how this heating is uneven due to the angle at which it reaches the tilted earth as it revolves around the Sun. Students will collect data as well as use data collected from scientists to see how this uneven heating affects North Carolina, specifically.

Performance Expectation(s) and Specific Learning Outcomes:

- Students will be able to explain how energy from the Sun serves as a source of light that heats the earth.
- Students will be able to collect and analyze data showing solar energy heats materials such as the Earth.
- Students will be able to apply their knowledge of solar energy to explain why we see a pattern of uneven heating on Earth in a yearly cycle.
- Students will be able to use data to explain how this uneven heating affects yearly cycles in North Carolina.

Prior Student Knowledge:

- The earth is warm because of the sun.
- Temperatures change with the seasons.
- We wear different clothing in the winter than in the summer.

Possible Preconceptions/Misconceptions:

- The Earth is closer to the Sun in summer and farther from the Sun in winter.
- The Sun heats the earth directly instead of light energy from the Sun being absorbed by the Earth materials and atmosphere. The Earth receives light from the Sun, not heat.

Materials:

- Items from the Supplemental Materials section
- Thermometers
- Cups
- Soil
- Water
- Small rocks or pebbles

LESSON PLAN - 5-E Model

ENGAGE: Opening Activity - Access Prior Learning / Stimulate Interest / Generate Questions:

Time: 30 Minutes

Engage Question: Why is it warm sometimes during the year and cold other times during the year? I'm planning a trip and I don't know what clothes to take with me, can you help?

1. Explain to students that you have a problem that you need their help with. You are planning a trip to Great Smoky Mountain National Park in June and you don't know what clothes you should bring.
 - a. Show students a picture of GSMNP in June and ask students to think about the weather according to the picture.
 - b. Ask students if they can figure out what the general weather will be during that time so you can pack accordingly.
 - c. Ask students what might we need to know to answer this question?
 - d. Brainstorm ideas with students and put the ideas on a brainstorm map. *Keep this as an anchor chart for later use in the lesson*
2. Read aloud a book about seasons. *We suggest The Seasons of Arnold's Apple Tree by Gail Gibbons. The book is a story about a boy and his apple tree as the seasons change. The book does not give much information about the why of seasons but instead allows students to ask questions about what is happening as the changes occur. Please see the book list in the supplemental materials for other potential books to use here.*
 - a. Ask students what changes they notice as you read the book. *These can be visible changes, but encourage students to infer non visible changes (i.e. the temperature is getting colder because the boy is wearing a coat).*
 - b. Ask students why might we be seeing the changes that are happening in the book. *Hopefully, students will point out that the temperature is changing between seasons.*
 - c. Ask students why the temperature changes and what causes the Earth to warm and cool. *Students should respond with various answers, but some will have prior knowledge that the Sun has something to do with it.*
 - d. Tell students they are going to get to explore this idea of sunlight heating and cooling the Earth in the next part of the lesson!

EXPLORE: Lesson Description – Materials Needed / Probing or Clarifying Questions:

Time: 90 Minutes

**Note: Ideally this part of the lesson would be done outside on a sunny day; however cups can be placed on a windowsill and a dark place in the classroom if it is cold outside.*

1. Explain to students that they will be investigating if the Sun is the source of energy that causes the Earth to heat and cool.
2. Show students the egg frying video: <https://youtu.be/0MPNgCo9auk>
 - a. Ask students what observations did they make about the video. Were they able to fry the egg completely?
 - b. This video was in Arizona where it gets really hot, do you think we can fry an egg on the concrete in North Carolina? Why or why not?
 - c. The people in the video were using concrete and metal, is earth covered in concrete and metal? What other materials are on the surface of the Earth? *Hopefully, students will give various responses such as water, soil, rocks, grass, etc. This is a great time to point out that concrete is actually a rock!*
3. Ask students how they might investigate if earth materials heat up in sunlight. Students will give various answers. Explain that you will be giving them some of the Earth’s materials to use in their investigation.
4. Divide students into groups of 2- 3.
5. Distribute 6 cups, enough soil, rocks, and water for each cup, 1 plastic beaker, and 6 thermometers to groups.
 - a. Ask students for suggestions on what to do with the cups if we wanted to see if the sunlight heats the materials we put in them. *Students may say to put all the cups in the sunlight, some may suggest putting some in the shade. This would be a good time to talk about how to perform an investigation.*
6. Have students use the beaker to add equal amounts of soil to two cups, water to two cups, and rocks to two cups. *You may tell the students the amount of materials to put in the cups or you can let them choose as long as the amount is the same across each cup.*
7. Tell students to label 3 of the cups with soil, water, and rocks in them as “SUN” and the other 3 cups as “SHADE”.
8. Have students record or glue a copy (printable copy in the Supplemental Materials Section) of the following table in their notebooks:

	Sun Cups			Shade Cups		
Temperature (°F)	Soil	Rocks	Water	Soil	Rocks	Water
0 min						
60 min						

9. Have students place their “SUN” cups in a sunny location and their “SHADE” cups in a shaded location.
10. Have students read their thermometers and record the temperature at time 0 minutes.
11. Explain to students that the cups will sit for 60 minutes and then they will take the temperatures again.

12. Underneath their table have students make predictions about what will happen to each of their cups in the shade and the sunlight.
 - a. It might be helpful to use this time to have students make observations about how their bodies feel in the sunlight versus the shade, or how different materials (concrete, grass, etc.) feel in the sunlight vs. the shade, reinforcing that the sunlight is absorbed and converted into heat energy.
13. After 60 minutes have passed have students take the temperatures of all of their cups again.
 - a. Have students create a bar graph for their data. *This can be done together as a class or it can be done individually depending on the level of the students*
 - b. Ask students to compare the before and after numbers.
 - c. What has changed for each cup? Did it get colder or warmer or did it not change at all?
 - d. Ask students what they might infer about the changes that occurred.

EXPLAIN: Concepts Explained and Vocabulary Defined:

Time: 60 Minutes

1. Remind students of their experiment from the day before.
 - a. Ask students what caused the materials to warm up in the sunny location versus the shady location.
2. Read a book about the sun. *We suggest Sun! 1 in a Billion by Stacy McAnulty. The book gives good facts about the sun, but in a fun, interesting way for students. Please see the book list in the supplemental materials for other potential books to use here.*
 - a. Use the reading strategy located in the Supplemental Materials section. Stop every few pages of the book (if you are doing a read-aloud) and ask students if they want to add anything to their sun graphic.
3. Work through the Earth/Sun graphic organizer located in the Supplemental Materials section with students.
 - a. Be sure to have students label the diagram. The lines going from the sun to the earth should have the terms reflect and absorb.
 - b. Ask students what happens when the light is absorbed by the Earth's materials. Make the connection back to their investigation.

Vocabulary: Solar radiation, absorption, reflection, energy, heat

ELABORATE: Applications and Extensions:

Time: 60 Minutes

1. Tell students we know from our previous investigation that sunlight reaches the Earth, and when it is absorbed by the Earth's materials it is converted into heat energy.
 - a. Ask students to reflect on the book about Arnold's apple tree and your dilemma about what to pack for your trip. They may refer back to their brainstorm map from the beginning of the lesson.
 - b. Ask students to brainstorm why we don't just stay the same temperature all year round. Add these ideas to the brainstorm map.
2. Demo the Earth's tilt using a globe and flashlight.
 - a. Get students involved to help you.

- b. Point out where North America is on the globe and that we are in the Northern Hemisphere (we will focus there). *Be sure to emphasize how the light becomes more direct when the top half of the Earth is tilted towards the sun (flashlight) and more indirect when it is tilted away from the Sun. Note: It is a common misconception among students that it is warmer in the summer because the Earth is closer to the Sun and colder in the winter because the Earth is farther from the Sun. The Earth only gets slightly closer to the Sun during its revolution, but this actually happens when the Northern Hemisphere is in winter.*
 - c. Point out that one full revolution around the Sun is one year and we go through each season in one year. *Although not part of this lesson, it might be helpful to point out the reason for day and night time here. This is a good reference video for teachers; however, the demo would be best for students. (<https://www.youtube.com/watch?v=b25q4nZTHvM>).*
3. Explain to students that they will now investigate the various temperatures that can occur during the seasons based on how much solar energy the Earth is receiving.
 - a. Pass out the hot and cold thermometers and the temperature cards to students. Have students sort the cards based on how hot or cold they think the temperatures are. *You may choose to use the fahrenheit side or the celsius side of the cards. You may also use both to explain the relationship between the imperial and metric systems.*
 - b. Once students have their temperatures arranged correctly, pass out the season cards. Have students place the seasons cards under the appropriate temperatures. Students may only use one of each, but encourage them to think about overlapping temperatures between the seasons.
 - c. Lastly, pass out the seasonal clothing cards. Have students place the clothing cards under the appropriate season. *It's important to point out that students may have different answers for this part of the sort. Some students may prefer long sleeves even in the warmer weather or others may prefer short sleeves in the cooler weather. This could be a good point for discussion about other reasons we choose to wear certain clothes at certain times of the year.*
 - d. Have students share out their card sorts if they feel comfortable.
 4. Circle back to the brainstorm board with students.
 - a. Discuss if they learned what they needed to know to answer the initial question about the trip.
 - b. Ask students if they feel like they can now make a recommendation for what you should take on your trip. *Students may want to use their card sort to help them in giving evidence for their recommendation.*

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EVALUATE:

Time: 30 Minutes

Formative Monitoring (Questioning / Discussion):

1. Formative assessment should be conducted throughout the lesson through student discussions, use of manipulatives, and graphic organizers.

Summative Assessment (Quiz / Project / Report):

1. Give students a piece of white paper. Have students divide their paper in half.
 - a. Ask students to draw a diagram of what the Earth and the Sun would look like in **June** in the Northern Hemisphere on one half of the page.

- b. Ask students to draw a picture of themselves (and maybe family) enjoying a hike in Great Smoky Mountain National Park on a day in **June**.
- c. Ask students to think about what they would wear based on the season it would be in **June**.
2. If time, allow students to present their pictures/diagrams.
 - a. Discuss their suggestion for the original question of what you should pack for your trip.
 - b. Allow students to make suggestions and ask why they suggested them.
 - c. Ask students what they might pack if they were going on the same trip, but in **February**.
 - d. Encourage students to make connections to the tilt of the Earth and the solar radiation being received by the Earth.

Elaborate Further / Reflect: Enrichment:

Time: 30 Minutes

1. Have students write a story similar to *The Seasons of Arnold's Apple Tree*, but using a different object than the apple tree.
 - a. They may use a swing set, a rock, a garden, etc.
 - b. Have students describe what might happen to that object as they experience the changes in the seasons. Will they heat up, cool down, what will change around them, how might the main character change how they interact with them, etc.