5E Integrated STEM Lesson Plan

Lesson Title: *How does the day length change over the course of a year?*

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Topic:

- What causes the seasons?
- How does the movement of the Earth around the sun cause patterns in the length of day?

Targeted Grade Level: Grade 5

Time Needed: 3-4 Days

Subject Integration: Science, Math, ELA

Justification:

This lesson would be part of a larger group of lessons focusing on Earth Science. Specifically, exploring patterns caused by the movement of the Earth around the sun. This lesson gives students an opportunity to look at data from Alaska and then apply that knowledge to local data, which is collected and then graphed.

This lesson links directly to exploring the coordinate plane in math and provides students practice with precision when graphing.

Since the lesson begins with a picture book read aloud, students will have an opportunity to explore science vocabulary and discuss one type of informational text structure.

Standards:

- SEP-4. Analyzing and Interpreting Data
    - Students will be collecting data about sunrise and sunset times in Alaska and will use this to determine length of day. (Explain)
    - Students will then use that data to look for patterns in day length over the span of a year. (Explain)
- SEP-7. Engaging in Argument from Evidence

    - Students will be making a claim and supporting that claim with evidence. (Evaluate)
- 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.
    - Students will be graphing the length of day in their hometown. (Elaborate)
- CCSS.MATH.5.G.A.2. Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.
    - Students will be graphing the length of day in their hometown. This graph will be set-up similar to the first quadrant of the coordinate plane and will give students an opportunity to recognize that the coordinate plane doesn't just make appearances in math. (Elaborate)
- CCSS.ELA-LITERACY.RI.5.4. Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a *grade 5 topic or subject area*.
    - During the read-aloud portion of the lesson, teacher will discuss science vocabulary with students. (Explore)
- CCSS.ELA-LITERACY.RI.5.5. Compare and contrast the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in two or more texts.
    - After finishing picture book, there will be a class discussion about the structure of the book and what purpose the structure serves. (Explore)

NGSS Performance Expectations

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts:
Analyzing and Interpreting Data ○ Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and	ESS1.B: Earth and the Solar System ○ The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis	Patterns ○ Similarities and differences in patterns can be used to sort, classify, communicate and analyzes simple rates of

conducting multiple trials of qualitative observations. Engaging in Argument from Evidence ○ Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to analyze the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).	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. (5-ESS1-2)	change for natural phenomena. (5-ESS1-1)

Common Core State Standards:

Math:

- CCSS.5.G.A.2. Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.

ELA:

- CCSS.RI.5.4. Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade 5 topic or subject area.
- CCSS. RI.5.5. Compare and contrast the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in two or more texts.

Measurable Student Learning Objectives:

- SWBAT summarize how the tilt of the Earth causes the seasons.
- SWBAT use sunrise and sunset times to calculate elapsed time/length of day.
- SWBAT create a graph, using sunrise and sunset times over the course of a year, to visually display day and night.
- SWBAT analyze data to make a claim and support that claim with evidence.

Engaging Context/Phenomena:

The phenomena used in this lesson to hook the students are real-life photographs and images from NASA. Although this phenomenon is not specifically from one of the resources from our class, it still meets the essential elements of using phenomena:

- A natural, observable event
- Allows students an opportunity to figure out why this phenomenon occurs
- Allows for opportunity to come back to and reflect on phenomenon throughout lesson

Data Integration:

Images from NASA will be included in the "Engage" portion of the lesson, which show Solar Radiation on the Summer and Winter Solstices:

- https://earthobservatory.nasa.gov/images/6125/winter-and-summer-solstice

Throughout the lesson, students will be collecting data from other sources (picture book and website), analyzing that data and then using it to create a graph.

If time permits, after students create their graph, the opportunity might present itself for students to compare their completed Length of Day graphs to a NASA graph, showing sunrise and sunset times at the South Pole:

- https://www.nasa.gov/analogs/nsf/sunrise_sunset

Real-Life Connection:

If you were to ask Michiganders what they like most about the summer, a high percentage of people would say they love how late it stays light in the evening. This lesson gives students the opportunity to explore why it stays so light at night in Michigan during the summer and is something that the majority, if not all of my students, have experienced.

Possible Misconception:

One of the biggest misconceptions is that the Earth is closer to the sun in the summer. This is an important misconception to address in this lesson. Showing models of the Earth's revolution around the sun, including the tilt, is key to helping students understand how the tilt of the Earth is the main reason for the seasons. In addition, investigating the ways in which the angle of the sunlight hits the Earth can be impactful.

Teacher Background:

- It would be essential for teachers to understand how the Earth's tilt causes the seasons. This would also include know about how the angle of the sun hitting the Earth causes heat and light.
- Additionally, teachers should know efficient strategies for figuring out elapsed time when working with am and pm times.
- Teachers should have a solid understanding of the solstices and equinoxes.
- Finally, teachers should understand why the length of day changes of the course of a year.

5E Model	5E Objectives
Engage	**Procedure** 1. Teacher will show photos of 10:00pm in Alaska, Michigan and Florida. a. *What observations can you make about these three photos?* b. *What are some similarities? Differences?* c. *What do you think causes these similarities and differences?* 2. Teacher should give opportunities for student think time and an opportunity for students to talk with their neighbor(s) before discussing these questions as a class. 3. Teacher would then show NASA photos of Solar Radiation from Summer and Winter Solstices without showing the title of the pictures. a. *What do you notice?* b. *What are you wondering about?* c. *What information do you think might be represented by these images?* 4. Teacher would then share the actual information about the two images from NASA and allow students to share what might have changed about their thinking. **Formative/Summative Assessments** • Although there is no formal assessment during this phase, teacher should take note of student comments, understanding and misconceptions. **Resources** • Length of Day Photos

Explore	**Procedure** 1. Students set up a data table in their Science Journals with the following column headings: a. Date b. Sunrise Time c. Sunset Time d. Average Low Temperature e. Average High Temperature f. Total Amount of Daylight 2. Teacher will read aloud the book *Arctic Nights, Arctic Lights* by Debbie S. Miller. As the teacher reads, students will take notes in Columns A-E in their Science Journal using the information from the picture book. Each page in the book provides the information for Columns A-E. 3. During read aloud, teacher will provide opportunities for students to discuss science vocabulary. 4. After completing the read aloud, teacher will discuss with students the structure of the book. *a. What purpose did the structure serve in the book? Why do you think the author chose to organize the book in this manner?* **Modifications** • Students may need help and guidance setting up their data table. If needed, students could work with a partner to set up the table in their Science Journal. For some students, it may be necessary to provide them with a pre-constructed data table. • Teacher should read aloud the first few pages slowly, ensuring all students have the correct data in their table. After reading a page and taking notes, students could check with their partner to make sure the correct data has been recorded. **Standards Addressed** • SEP-4 • CCSS.RI.5.4 • CCSS. RI.5.5

	Formative/Summative Assessments • After reading the picture book, students can meet in small groups to ensure everyone has collected the correct data. During these small groups, students should discuss noticings and wonderings about the data. • Teacher will check on groups during this time to see that all students have a completed data table and make observations about groups discussions. **Resources** • Student's Science Journals • Pencil • Ruler or straight-edge • *Arctic Lights, Arctic Nights* by Debbie S. Miller
Explain	**Procedure** 1. Teacher gives two random times. For example, teacher could find the sunrise and sunset times for their given location on that exact day. For example, 6:18am and 9:03pm. 2. Ask students to talk with their neighbor(s) about how to use the sunrise and sunset times to determine the total length of daylight in hours and minutes. After students have brainstormed, ask groups to share strategies. 3. Depending on methods shared, teacher may also introduce other efficient methods for determining elapsed time. Teacher can use examples from the data collected during the read aloud to demonstrate. 4. Once students have an understanding of how to determine elapsed time, students should calculate Column F "Total Amount of Daylight" in their data table. 5. After all students have the correct data in their table, discuss what students are noticing and wondering about the data. a. *What patterns do you see in the data? What do you think is the reasoning for these patterns?* b. *Why do you think some of the values repeat?*

	c. *What do you notice about December 21? June 21? March 21 and September 21? What is special about these dates?* 6. As this lesson is part of a larger unit in which students explore the causes for the seasons, teacher would then review what the tilt of the Earth's axis is like on these "special" dates and the impact direct/indirect sunlight has on equinoxes and solstices. 7. Teacher would take this time to clarify any misconceptions about the distance between the Earth and the sun causing the seasons. 8. Teacher would then revisit photos from "Engage" portion and discuss the science behind the images. **Modifications** • The math activity of this portion could be a challenging concept for students. Depending on ability level, teacher may assign different partner groups to a few different dates and then have a whole class share out. • As students are working, teacher should monitor closely and have an extra mini-lesson, as necessary. • Using personal whiteboards and markers would allow students to easily erase and make changes to their math calculations. **Standards Addressed** • SEP-4 • 5-ESS1-2 **Formative/Summative Assessments** • Provide students with the correct "Total Amount of Daylight" for each date so changes can be made if necessary. **Resources** • Student's Science Journals • Personal whiteboards and markers

	• Model of Sun and Earth (Showing the location/tilt of the Earth during different seasons.)
Elaborate	**Procedure** 1. Students will now collect sunrise and sunset times for their location using the website https://sunrise-sunset.org/. a. This website also includes day length. However, there are other websites for finding sunrise and sunset times without day length. If a teacher wanted their students to have more opportunities to practice elapsed time, he or she may choose one of those websites. 2. Students will create a new chart in their Science Journals with sunrise and sunset times for their hometown for the 21st of each month for the previous year, as well as for day length. 3. Once students have completed this chart, they will use the data to make a graph showing length of day and length of night. a. Before students begin, teacher will ask in what ways does this graph look similar to the coordinate plane. *b. What would be our x-axis and y-axis?* *c. What data will be represented by the coordinates?* *d. How should we label our graph?* *e. Why do you think we're reviewing math concepts in science? What does this tell us about the role of graphs in math and in science?* **Modifications** • Since I work with academically talented students, I would encourage many students to take time to calculate the elapsed time instead of just copying it directly from the website. However, I always have a handful of students who struggle with math and would encourage those students to calculate the elapsed time for a few dates but then use the website to complete their data table. • Allowing students the opportunity to work with a partner would be helpful, as well.

	Standards Addressed • SEP-4 • 5-ESS1-2 • CCSS.5.G.A.2 **Formative/Summative Assessments** • Prior to the lesson, it would be beneficial for the teacher to have created his/her own graph. Then, as students are making their graph, it will be easy for teacher to see if students need to make any adjustments to their graphs. **Resources** • Devices • Student Science Journals • Ruler or straight-edge • Length of Day Graph • Blue and yellow crayon or colored pencils
Evaluate	**Procedure** 1. Teacher will inform students they will be making a claim about the data collected during this investigation. 2. At this time, it may be beneficial for class to review expectations for making a claim and supporting that claim with evidence. This review could be done with previous examples or an Anchor Chart. 3. Students will use the Alaska and Michigan data in their Science Journals, as well as their Length of Day graph, to make 2-3 claims about the information they have collected. a. *What do you notice about the relationship between the values in your data tables?* b. *How do the values change? Why?* c. *What do you notice about your graph? What patterns do you observe?*

	Modifications • Providing a visual for students may be helpful. This could include posting guiding questions on the board, as well as an example of a claim and evidence. • For some students, it may be helpful to provide a Claim-Evidence Graphic Organizer to help guide their thinking. **Standards Addressed** • SEP-4 • 5-ESS1-2 **Formative/Summative Assessments** • Teacher will assess Claim & Evidence Exit Tickets to ensure students are making accurate claims and supporting with reasonable evidence. • Teacher will check over completed Length of Day graphs for accurate labeling and plotting. **Resources** • C-E-R Anchor Chart/Previous Examples • Student Science Journals • Completed Length of Day Graph • Claim & Evidence Exit Ticket