THINKING AND ACTING LIKE A SCIENTIST

TEACHER'S GUIDE

The Days of Our Lives

What patterns do we find by observing sunrise and sunset times throughout the year?

GRADE 5

Earth & Space

VAN ANDEL EDUCATION INSTITUTE
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INQUIRY-BASED SCIENCE

Earth & Space

The Days of Our Lives

Grade Level/Content	5/Earth and Space Science
Lesson Summary	In this lesson, students use secondary resources to collect data on sunrise times and sunset times throughout the year. They will use this information to identify patterns in the monthly changes of daylight and nighttime hours.
Estimated Time	2, 45-minute class periods
Materials	Internet Access, Sunrise/Sunset data, Observation Form
Secondary Resources	Ask an Astronomer What causes day and night? *The Next Time You See a Sunset* by Emily Morgan
NGSS Connection	**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.
Learning Objectives	• Students will use secondary sources to collect sunrise and sunset times for their local area. • Students will represent sunrise and sunset times to reveal patterns of monthly changes in daylight hours. • Students will provide evidence for how and why daylight hours change throughout the year.
Cross-Curricular Project Connections	Must Love Dogs, Australia or Bust!

What patterns do we find by observing sunrise and sunset times throughout the year?

There is nothing more predictable than the appearance and disappearance of the sun throughout the day. At first the Greeks imagined the sun as the god Helios or Apollo, driving his chariot into the sky during the day and back down at night for his horses to rest. It wasn't until 450-200BC that scientists like Eratosthenes began making actual observations and measurements. He calculated the distance the Earth is from the sun (93,000,000 miles).

The Greek astronomer Ptolemy (85-165AD) used measurements of the sky to create his geocentric model of the solar system. This Earth-centered model lasted quite a long time. It wasn't until 1543AD, when Nicolaus Copernicus published his work *De Revolutionibus Orbium Coelestium (On the Revolutions of the Heavenly Bodies)* that the heliocentric model was brought to life.

In this lesson, students will collect sunrise and sunset data for their local area over a year. They will discover how daylight hours change during the year and explain what accounts for those predictable changes.

Investigation is based on the Van Andel Education Institute (VAEI) Instructional Model for Inquiry-Based Science. In all investigations:

Students don't know the "answer" they are supposed to get.

Students play a driving role in determining the process for learning.

Teachers and students construct meaning together by journaling.

Students are working as hard as the teacher.

Part 1

INVESTIGATION SETUP

Divide your class into four teams, one for each year 2013, 2014, 2015, and 2016. Students will need:

- Internet access
- Access to Sunrise/Sunset data for various years
- Observation Form (or have students make their own)
- Journal

Part 2

INVESTIGATION FACILITATION

Question

Introduce the investigation question.

What patterns do we find by observing sunrise and sunset times throughout the year?

Personal Knowledge

Students capture what they already know about day length.

- Find out what students already know about sunrises, sunsets, and the impact the time of year has on them.
- Create a class list. *(List may include: the earth spins, the sun doesn't move, the sun moves down during a sunset and up during a sunrise, the sun is larger than the earth, the sun spins, the sun moves around the earth, the earth moves around the sun, the earth moves in a circle around the sun, etc.)*

CRITICAL THINKING

One way to collect personal knowledge is to start a word wall. Give each student a few sticky notes and have them brainstorm everything they know about sunrises, sunsets, and the impact the time of year has on them. They place their sticky notes on the word wall (whiteboard, chart paper, etc.). Together, organize the ideas the students wrote.

RISK-TAKING

If a misconception surfaces in this process, still add it to the list. Often other students will question it. Circle it or place a question mark or some other symbol by it and state that it will be returned to later. Be sure to address the misconception at the appropriate time in the investigation. This could be during the investigation, observation, data analysis, or explanation. The best time to revisit it is whenever this misconception can naturally be confronted with evidence the students are collecting and/or other knowledge they are gaining through secondary knowledge throughout the investigation.

Prediction

Students predict what the results will be, based on their prior knowledge.

- Ask students to predict the answer to the question using the "I predict _____ because_____" prompt. *(An example student response might be: I predict that days will get longer in the summer and shorter in the winter. I know this because when it gets dark earlier and I have to come home earlier.)*

RISK-TAKING

It's important that students not feel that there is a "correct" prediction. When they return to their prediction in their explanation, they will have the opportunity to see how their prediction is supported or challenged by their evidence.

Investigation Plan

Students record sunrise and sunset times to see patterns during the year and between years.

- Divide the class into four different teams.
- Decide with your class which teams will observe local sunrise and sunset data from which year: 2013, 2014, 2015, or 2016.
- Show students where to find the data for local sunrise and sunset times using the Sunrise/Sunset Data website.
- Students will record the sunrise and sunset times for the **first day of every month**.
- Note that during Daylight Savings Time, the times may adjust one hour, but the number of daylight hours should not be affected.

CURIOSITY

Encourage the students to record questions or wonderings as they collect their data in their journals.

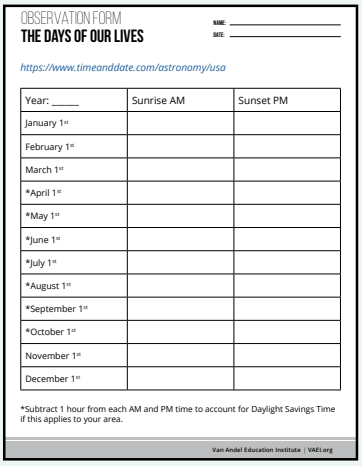
COLLABORATION

Within their teams, students will need to decide who is going to collect what data. They will need to work together to find the sunrise and sunset times for the first of every month.

Observation

Students document their observations.

- Ask students to record observations in the Observation Form. Students can also create their own form in their journal.



OBSERVATION FORM

THE DAYS OF OUR LIVES

NAME: _____

DATE: _____

https://www.timeanddate.com/astronomy/usa

Year: _____	Sunrise AM	Sunset PM
January 1st		
February 1st		
March 1st		
*April 1st		
*May 1st		
*June 1st		
*July 1st		
*August 1st		
*September 1st		
*October 1st		
November 1st		
December 1st		

*Subtract 1 hour from each AM and PM time to account for Daylight Savings Time if this applies to your area.

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Observation Form

Part 3

INVESTIGATION ANALYSIS AND DEVELOPMENT OF CLAIM

Data Analysis

Students make sense of their data by organizing it and representing it visually.

Have students analyze their data. They may wish to use the Data Analysis prompt as a guide.

- Have students **evaluate** their data for trustworthiness. Have students highlight data they wonder about.
- Then, have them analyze their data to find patterns and trends. They may **organize** the data and/or **represent** it visually to construct meaning. Encourage students to decide how they will organize and represent their data. Possible ways students can organize and represent their data may include:
  - Students use math to find the length of day in hours and minutes (i.e. 9h 4m) and in just hours (9.06h). They can also calculate the monthly change in daylight hours, or calculate percentage of daylight vs. nighttime.
  - They can represent their work (bar chart, line graph, etc.) by showing the length of day for each month, monthly change in daylight hours, and/or sunrise and sunset times.
- Have students **interpret** what the identified patterns or trends mean.

CREATIVE AND CRITICAL THINKING

Encourage students to pursue a variety of ways to evaluate, organize, and represent their data. As students decide how to organize and represent their data, they need to determine the most effective organization and representations. They will need to ask questions of themselves as to how best to interpret and summarize their data.

DISCOURSE

Ensure students have enough data that it can be used as evidence to support their claim. Have each team share their representations and interpretations. Students can use this information in the reasoning portion of their claim.

Secondary Knowledge

Students use secondary sources to help understand patterns in sunrise and sunset times.

- Share what you know (or find a video or article) about daylight patterns throughout the year. Have students read the information provided below (or your own resources) about the role of the Earth's axis in the daylight patterns:
  Ask an Astronomer
  What causes day and night?
  The Next Time You See a Sunset by Emily Morgan
- From these resources, students should learn how daylight patterns change throughout the year and the role of Earth's axis in these changes. Students use this information in the reasoning portion of their explanation.

Explanation

Students write a claim and provide evidence and reasoning to support it.

- Have students use what they've discovered from their analyzed data to write an explanation that answers their investigation question. Students may wish to use the Explanation prompt as a guide. Have them write their explanation in their Lab Journal.
- Have students develop a **Claim** to answer the question: What patterns do we find by observing sunrise and sunset times throughout the year?
- Then, have them add **Evidence** (the analyzed data) to support their claim.
- Finally, have them add **Reasoning** to their claim. Reasoning should include the information obtained from this investigation as well as science principles they have learned.

Claim

We claim that there are several different patterns. The length of day increases during the first half of the year and decreases during the second half. The shortest day occurs in January and the longest day is in July. The months with the greatest amount of change in day length are March and October and the months with the least amount of change are June and December. Interestingly, these months are six months apart.

Evidence

December and January have the least amount of daylight. December has 9.23 hours of daylight and January has 9.06 hours of daylight. June and July have the most hours of daylight. June has 15.15 hours of daylight and July has 15.28 hours of daylight. The amount of daylight increases from 9.06 hours in January to 15.28 hours of daylight in July. The amount of daylight decreases from 15.28 hours in July to only 9.23 hours in December. There is only .08 hour difference in the change of daylight between July and August. There are 1.51 hours difference in the hours of daylight between February and March.

Reasoning

Investigation: We used the website provided to collect our data for each month. We made sure to account for Daylight Savings Time for April–October. We used the first day of the month for each of the readings. This could affect our data a little because of the difference in number of days in a month. We are also wondering if that gave us enough data. When comparing graphs and charts with my classmates we saw that the students studying the other years found the same pattern to the sunrise and sunset data as we did.

Science: We learned from our readings and class discussions that Earth is tilted about 23.5° and it orbits the sun. Our length of day gradually gets longer and then shorter throughout the year. If there was no tilt to Earth, all days would be of the same length of time.

Evaluation

Students reflect on the investigation.

- Ask students how confident they are in their results.
- Ask students what surprised them.
- Ask students what questions they have as a result of this investigation.

Part 4

INVESTIGATION ASSESSMENT AND EXTENSION

Application

Students demonstrate understanding of patterns in sunrise and sunset times by comparing their data to sunrise and sunset times in the Southern Hemisphere.

- Have students work in their groups to collect data for a location within the Southern Hemisphere. Have them answer the question: How do our sunrise and sunset times compare to the sunrise and sunset times for a location in the Southern Hemisphere? They would use the same observation form to collect their data and the same process to analyze their data. Have 1 or 2 groups present their findings using a Present and Defend.

DISCOURSE

Have students conduct a Present and Defend to develop presentation skills as well as audience participation. Research teams present a summary of their application to the class. The class analyzes the information presented and asks clarifying questions, challenges and/or supports the arguments made, and even presents alternative explanations as appropriate. Research teams defend their explanation with evidence and reasoning.

Assessment

- Students accurately represent sunrise and sunset times to reveal patterns of monthly changes in daylight hours.
- Students will provide an explanation (claim, evidence, and reasoning) describing how and why daylight hours change throughout the year.

Take This Lesson Across the Curriculum

Must Love Dogs

You have begged and begged for a dog, however, the only way your parents will agree to having a four-legged friend in the house is if you wake up each morning at sunrise to give Fido a walk. In order to make sure you can meet this requirement, you need to learn a little bit more about sunrises, sunsets, and how they change throughout the year.

Reading/Language Arts	Math	Science	Social Studies
Adventures in Dog Walking Keep a journal for a week describing the adventures you and Fido would have while you are on your early morning walks. CCSS.ELA-LITERACY.W.5.2	**Sleepy Time** Choose one of the weeks you are in school and calculate the amount of sleep you would get for that week if you go to sleep at sunset and wake up at sunrise. CCSS.MATH.CONTENT.5.MD.A.1	**The Days of Our Lives** Collect monthly local sunrise and sunset data for a year to determine how daylight hours change throughout the year. NGSS: 4-PS3-2	**Don't Get Lost** Construct a map representing the path you would take to walk Fido. Be sure to label all important landmarks and roads. NCSS: D2.Geo.1.3-5

Australia or Bust!

Your family has decided to visit Sydney, Australia for your next family vacation. They need you to find out when would be the best time to visit. They want to get in as much daylight hours as possible.

Reading/Language Arts	Math	Science	Social Studies
Just the Facts Read the book *Introducing Australia* to share important information (cultural, historic, geographic) to help in the planning of your trip. CCSS.ELA-LITERACY.RI.5.2	**TSA OK** Your sister needs to bring contact solution with her aboard the plane. The TSA allows 3.4 fluid ounces. She has a 100ml bottle. Will TSA allow this? CCSS.MATH.CONTENT.5.MD.C.4	**The Days of Our Lives** Collect monthly sunrise and sunset data for a year in Australia to determine how daylight hours change throughout the year. NGSS: 4-PS3-2	**Show Me the Money** You will need to make sure you have the correct type of money when you land in Sydney. Research what currency you need and what the exchange rate is. NCSS: D2.Eco.5.3-5

For additional lessons or to customize this lesson, go to www.nexgeninquiry.org.

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OBSERVATION FORM

THE DAYS OF OUR LIVES

NAME: _____

DATE: _____

https://www.timeanddate.com/astronomy/usa

Year: _____	Sunrise AM	Sunset PM
January 1st		
February 1st		
March 1st		
*April 1st		
*May 1st		
*June 1st		
*July 1st		
*August 1st		
*September 1st		
*October 1st		
November 1st		
December 1st		

*Subtract 1 hour from each AM and PM time to account for Daylight Savings Time if this applies to your area.