

Summer Solstice — Why Days Get Longer

Bloom's Level: Analyze

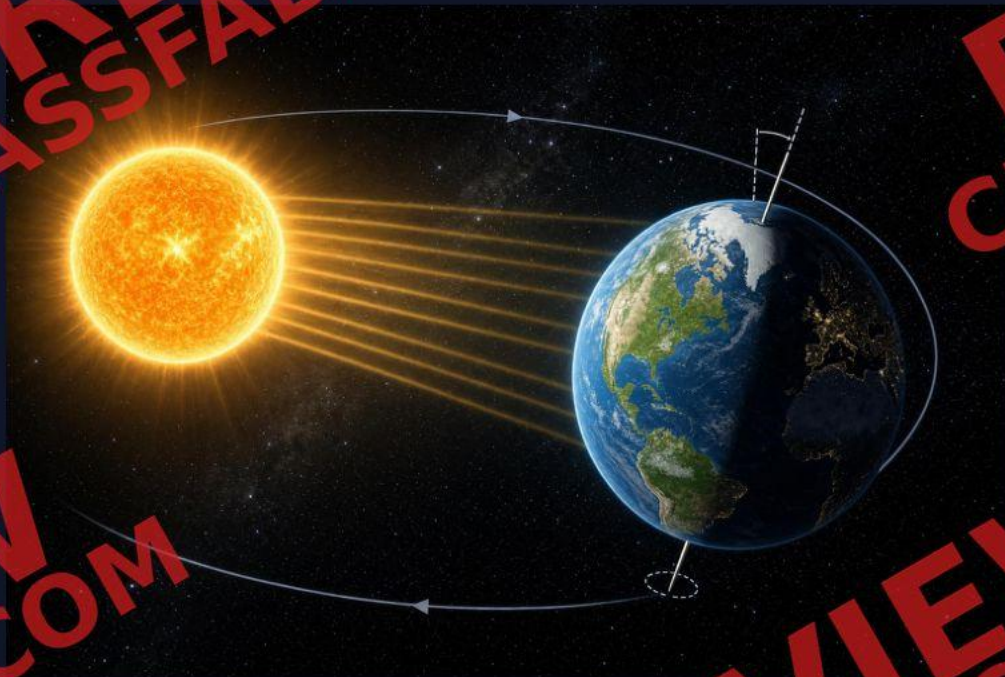
Standard:

5-ESS1-1 — Earth's Place in the Universe

NGSS.5-ESS1-2 — Earth's Place in the Universe

TEKS §112.19(b)(11)(B) — Seasons and Earth's Tilt

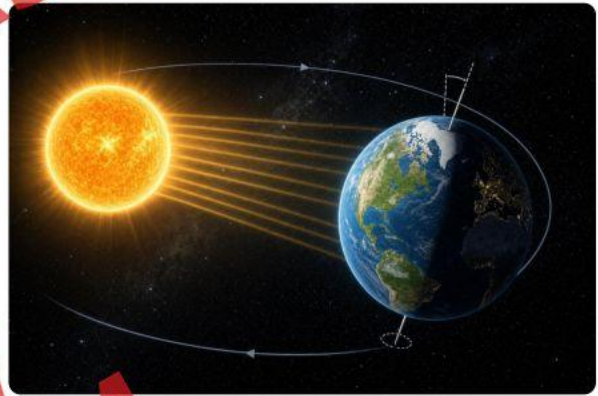
STUDENT EDITION



Earth's 23.5-degree axial tilt causes the Northern Hemisphere to receive more direct sunlight in June — this is what creates the summer solstice, not Earth's distance from the sun.

Why June 21 Is the Longest Day of the Year — And What Most People Get Wrong

Imagine standing in Fairbanks, Alaska, on June 21 at midnight — and the sun is still above the horizon. Meanwhile, someone in Ecuador barely notices any change in daylight at all. How can two places on the same planet experience such dramatically different days at the exact same moment? The answer lies in one of astronomy's most fascinating phenomena: the summer solstice.



Earth's 23.5-degree axial tilt causes the Northern Hemisphere to receive more direct sunlight in June — this is what creates the summer solstice, not Earth's distance from the sun.

The Common Misconception: Distance vs. Tilt

Here's a question most people answer incorrectly: Why do we have seasons?

The most common answer is, "Because Earth gets closer to the sun in summer." This sounds logical — but it's wrong. In fact, Earth is actually farther from the sun in June than it is in January. So distance cannot explain seasons.

The real cause is **Earth's axial tilt** — approximately 23.5 degrees. Earth doesn't orbit the sun standing perfectly upright. It leans. That lean stays pointed in the same direction throughout the year, which means different parts of Earth receive sunlight at different angles depending on where Earth is in its orbit.

When you compare summer and winter, you're not comparing distance — you're comparing angle and duration of sunlight. These are two completely different variables, and mixing them up leads to the classic misconception. Can you identify why confusing these two variables would lead someone to the wrong conclusion?

Breaking Down the Solstice: What's Actually Happening

On June 21, the Northern Hemisphere is tilted **toward** the sun at its maximum angle. This creates two measurable effects worth examining separately:

1. Sun angle: Sunlight strikes the Northern Hemisphere more directly — closer to 90 degrees. Direct light concentrates energy into a smaller area, making it more intense. Think of shining a flashlight straight down versus at a steep angle — the angled beam spreads out and weakens. Notice how changing just one variable (the angle) produces a completely different result.

2. Daylight duration: Because of the tilt, the sun traces a longer arc across the sky. The Northern Hemisphere spends more time in sunlight and less time in Earth's shadow. In Fairbanks, Alaska (latitude $\sim 64^\circ\text{N}$), this effect is so extreme that the sun barely sets at all — nearly 22 hours of daylight.

Now contrast this with the equator. Because the equator sits at Earth's "middle," it receives relatively consistent sunlight year-round — roughly 12 hours every day, regardless of season. The tilt affects it far less dramatically. This pattern reveals a clear relationship: **the farther from the equator, the more extreme the seasonal daylight differences.**

Organizing the Patterns: A Comparison

Location	June 21 Daylight	December 21 Daylight
Equator (0°)	~ 12 hours	~ 12 hours
New York (40°N)	~ 15 hours	~ 9 hours
Fairbanks, AK (64°N)	~ 22 hours	~ 4 hours

Examine this table carefully. What pattern do you notice as latitude increases? How would you describe the relationship between a location's distance from the equator and the size of the gap between its June and December daylight hours? The relationship isn't random — it's a predictable, measurable pattern driven entirely by geometry. Differentiating between locations helps reveal how tilt and latitude interact to produce these results.

Real-World Connection: Ancient Cultures Knew This

Long before telescopes or satellites, ancient peoples carefully observed these patterns. At **Stonehenge** in England, massive stones were deliberately aligned so that on June 21, the rising sun shines directly through a specific gap in the

monument. Archaeologists believe Stonehenge served partly as an astronomical calendar — a way to track the solstice with precision.

Similarly, the ancient Egyptians, Maya, and many Indigenous cultures built structures and held ceremonies tied to solstice timing. Why? Because the solstice marked critical moments for agriculture — knowing when days would start getting shorter helped communities plan planting and harvesting cycles. Consider what this reveals: these civilizations were analyzing the same astronomical patterns you just examined in the table above, using only careful observation over generations. Astronomy wasn't just science; it was survival.

Conclusion: Tilt Changes Everything

The summer solstice isn't magic — it's geometry. By examining Earth's 23.5-degree tilt, you can explain why Alaska gets nearly 24 hours of sunlight in June, why the equator stays consistent year-round, and why ancient civilizations built monuments to track this exact moment. The key is learning to differentiate between distance and angle — two variables that are easy to confuse but produce completely different effects. Next time someone says seasons happen because Earth gets closer to the sun, you'll know exactly how to set the record straight.

Lesson Objective

In this lesson, you will investigate why Earth experiences seasons and why the length of daylight varies by location. You will examine how Earth's 23.5-degree axial tilt — not its distance from the sun — drives seasonal changes and solstice patterns. By the end, you will be able to distinguish between common misconceptions and the real astronomical evidence behind these phenomena.

Standard: 5-ESS1-1 — Earth's Place in the Universe; NGSS.5-ESS1-2 — Earth's Place in the Universe; TEKS §112.19(b)(11)(B) — Seasons and Earth's Tilt

Bloom's Level: Analyze

Bloom's Goal: Students will analyze the relationship between Earth's axial tilt, latitude, and seasonal daylight patterns by comparing data across locations and differentiating between the variables of distance and sun angle.

Explanation: Analyzing requires students to break down information into its parts and examine how those parts relate to one another. In this lesson, students move beyond simply recalling facts about the solstice — they compare data across latitudes, identify patterns in a table, and distinguish between two easily confused variables (distance vs. tilt angle) to build a deeper, evidence-based understanding.



Stonehenge in England was built so that sunlight aligns perfectly through its stones on the summer solstice — proof that ancient cultures carefully tracked Earth's astronomical patterns.

Application Questions

Read each question carefully, use evidence from the article to support your thinking, and write a complete response.

1. The article explains that many people believe seasons are caused by Earth getting closer to the sun in summer. Analyze why this explanation is incorrect, and identify the two variables that actually determine how much heat a location receives during a season.

Think about: Think about what the article says about where Earth actually is in its orbit during June, and then consider the two measurable effects of axial tilt described in the 'Breaking Down the Solstice' section.

2. Using the data table in the article, analyze the relationship between latitude and the difference in daylight hours between June 21 and December 21. What pattern do you notice, and what does it reveal about how Earth's tilt and a location's distance from the equator interact?

Think about: Look at the gap between June and December daylight hours for each location in the table. How does that gap change as you move from the equator toward higher latitudes, and what geometric reason does the article give for this pattern?

3. Ancient cultures like the builders of Stonehenge tracked the summer solstice with great precision. Analyze what this tells us about their understanding of Earth's astronomical patterns, and explain how their reasons for tracking the solstice were both scientific and practical.

Think about: Consider what the article says about why ancient civilizations cared about the solstice. How does their use of careful observation over generations connect to the same patterns described in the data table and the explanation of axial tilt?

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Data Table & Analysis

Study the data table below, which shows daylight hours at different latitudes on the June and December solstices. Then answer the three analysis questions using evidence from the data.

Experiment: Scientists measure daylight duration at various latitudes to study how Earth's 23.5-degree axial tilt affects different locations throughout the year. The data below compares daylight hours on the June 21 solstice and the December 21 solstice at four locations ranging from the equator to high northern latitudes. These measurements reveal predictable patterns driven by Earth's tilt and each location's distance from the equator.

Location (N/A)	Latitude (degrees North)	June 21 Daylight (hours)	December 21 Daylight (hours)	Difference in Daylight (June minus December) (hours)
Equator	0	12	12	0
New York, NY	40	15	9	6
Fairbanks, AK	64	22	4	18
Stonehenge, England	51	17	7	10

1. Describe the pattern you observe between a location's latitude and the difference in daylight hours between June 21 and December 21. Use at least two specific data points from the table to support your answer.

2. The equator shows 0 hours of difference between June and December daylight. Using what you know about Earth's axial tilt, explain why the equator is affected so much less by the solstice than Fairbanks, Alaska.

3. Some people incorrectly believe that seasons are caused by Earth getting closer to the sun. Based on the data in the table, identify one piece of evidence that challenges this misconception and explain your reasoning.

Hypothesis Builder

Read the context below carefully. Then complete each component to build a scientific hypothesis about Earth's axial tilt and its effect on daylight hours. Use evidence from what you have learned about the summer solstice to support your reasoning.

A student wants to investigate how a location's latitude affects the number of daylight hours it receives on June 21, the summer solstice. She plans to compare daylight hour data from three cities: one near the equator, one at a mid-latitude location, and one near the Arctic Circle. She knows that Earth is tilted at approximately 23.5 degrees and that this tilt stays pointed in the same direction as Earth orbits the sun. She wonders whether cities farther from the equator will experience more extreme differences in daylight on the solstice.

Independent Variable

What is the one factor the student is intentionally changing or comparing across the three cities? Identify the variable she is testing.

Dependent Variable

What is the student measuring or observing as a result of the independent variable?
What outcome is she collecting data on?

If

State the condition being tested. Begin with 'If' and describe how the independent variable is being changed or compared.

Then

Predict what will happen to the dependent variable. Begin with 'then' and describe the expected outcome based on your understanding of Earth's tilt.

Because

Explain the scientific reasoning behind your prediction. Begin with 'because' and connect Earth's 23.5-degree axial tilt to why latitude affects daylight hours on the solstice.

Claim-Evidence-Reasoning (CER)

Read the phenomenon below carefully. Then complete each component of the Claim-Evidence-Reasoning (CER) framework by responding to the guiding prompt for that component. Your responses should demonstrate your ability to analyze scientific data and explain patterns using evidence.

Phenomenon: On June 21, Fairbanks, Alaska (latitude 64°N) experiences nearly 22 hours of daylight, while the equator experiences approximately 12 hours of daylight – the same amount it receives every day of the year. At the same time, Earth is actually farther from the sun in June than it is in January. Many people incorrectly assume that seasons are caused by Earth's changing distance from the sun.

Claim

What is the actual cause of the dramatic difference in daylight hours between Fairbanks, Alaska and the equator on June 21? Write a clear, testable claim that identifies the scientific cause – not just a description of what happens.

Evidence

Using specific data from the daylight comparison table and details from the article, provide at least two pieces of evidence that support your claim. Include specific numbers, locations, or observations that directly back up your statement.

Reasoning

Explain how your evidence connects to your claim. Why does Earth's axial tilt — rather than its distance from the sun — cause the differences in daylight hours and seasonal temperatures? Be sure to address why the equator is less affected than higher latitudes, and explain why distance alone cannot account for the observed pattern.

Independent / Dependent Variable Analysis

Read the experimental scenario below carefully. Then, for each component, answer the guiding question in complete sentences. Use evidence from the scenario to support your answers.

Scenario: A 7th-grade science class wants to investigate how latitude affects the number of daylight hours on June 21, the summer solstice. Students collect data from five cities located at different latitudes: the equator (0°), 20°N , 40°N , 55°N , and 64°N . For each city, they record the total number of daylight hours on June 21 using data from a reliable astronomy website. All data is collected for the same date and year, and the same method is used to record daylight hours for every city. The students keep Earth's axial tilt (23.5 degrees) and the date constant throughout the investigation.

Independent Variable

What is the one factor the students are deliberately changing across the five cities in this investigation? Explain why this factor qualifies as the independent variable.

Dependent Variable

What is the factor being measured or observed as a result of the change the students made? Explain how this variable responds to changes in the independent variable based on the scenario.

Control Variables

What factors are kept the same across all five cities to make this a fair test? Identify at least two control variables and explain why keeping them constant is important.

Operationalized Definition

How are the students specifically measuring the dependent variable in this investigation? Write an operationalized definition that describes exactly how daylight hours are being observed and recorded.

Cause & Effect Map

Read each cause carefully. Analyze the contributing factors listed, then explain the effect and describe the cause-effect relationship in your own words. Use evidence from the lesson article to support your reasoning.

1. Cause: Earth's axis is tilted at approximately 23.5 degrees and maintains that tilt as it orbits the sun.

Effect: Different parts of Earth receive sunlight at different angles and for different durations throughout the year, producing the seasons.

Contributing Factors:

- Earth's axial tilt remains pointed in the same direction throughout its entire orbit
- The angle at which sunlight strikes a surface determines how concentrated and intense the energy is
- Distance from the sun does not change enough between seasons to cause temperature differences

2. Cause: On June 21, the Northern Hemisphere is tilted toward the sun at its maximum angle, causing the sun to trace a longer arc across the sky.

Effect: Locations in the Northern Hemisphere, especially those at high latitudes like Fairbanks, Alaska, experience dramatically more hours of daylight than in winter.

Contributing Factors:

- The Northern Hemisphere spends more time facing the sun and less time in Earth's shadow during this tilt
- Higher latitudes are more strongly affected by axial tilt than locations near the equator
- Fairbanks, Alaska at approximately 64 degrees north receives nearly 22 hours of daylight on the summer solstice

3. Cause: The equator sits at Earth's middle and is minimally affected by the planet's axial tilt throughout the year.

Effect: Locations near the equator, such as Ecuador, experience approximately 12 hours of daylight every day regardless of the season, with very little variation.

Contributing Factors:

- The equator's position means it receives relatively consistent sunlight angles year-round
- The farther a location is from the equator, the more extreme its seasonal daylight differences become
- Latitude and axial tilt interact geometrically to determine how much a location's daylight hours change between seasons

Multiple Choice

Read each question carefully and select the best answer from the choices provided. Use what you have learned about Earth's axial tilt, the solstice, and seasonal patterns to support your thinking.

1. A student claims that Earth experiences summer because it moves closer to the sun during that time of year. Which piece of evidence best shows that this explanation is incorrect?
 - A. Earth's orbit is a perfect circle, so its distance from the sun never changes.
 - B. Earth is actually farther from the sun in June than it is in January, yet the Northern Hemisphere experiences summer in June.
 - C. The sun produces more energy during summer months, which warms Earth regardless of distance.
 - D. Earth rotates faster in summer, which causes temperatures to rise in the Northern Hemisphere.
2. On June 21, sunlight strikes the Northern Hemisphere at a more direct angle than in December. How does this difference in angle affect the energy received at Earth's surface?
 - A. A more direct angle spreads sunlight over a larger area, reducing its intensity.
 - B. A more direct angle concentrates sunlight into a smaller area, increasing its intensity.
 - C. The angle of sunlight has no effect on energy intensity; only duration matters.
 - D. A more direct angle causes Earth to reflect more sunlight back into space.

3. Compare the daylight hours in Fairbanks, Alaska (64°N) and New York (40°N) on June 21. What does the difference between these two locations reveal about the relationship between latitude and seasonal daylight?

- A. Locations closer to the equator always experience more daylight than locations farther away.
- B. Latitude has no consistent relationship with daylight hours; differences are caused by local weather.
- C. The farther a location is from the equator, the more extreme its seasonal differences in daylight hours.
- D. Locations at higher latitudes receive less total sunlight over the course of a full year.

4. The equator receives approximately 12 hours of daylight on both June 21 and December 21. Which explanation best accounts for this pattern?

- A. The equator is closest to the sun, so it always receives maximum sunlight regardless of Earth's tilt.
- B. The equator sits at Earth's middle and is not significantly affected by the directional lean of Earth's axial tilt.
- C. The equator experiences two solstices per year, which balance out the daylight hours.
- D. Earth rotates more slowly near the equator, which extends the amount of time in sunlight.

5. Earth's axial tilt is approximately 23.5 degrees and remains pointed in the same direction throughout its orbit. How does this consistent tilt produce opposite seasons in the Northern and Southern Hemispheres at the same time?

- A. When the Northern Hemisphere is tilted toward the sun, it receives more direct sunlight, while the Southern Hemisphere is tilted away and receives less.
- B. The two hemispheres orbit the sun at different speeds, causing them to experience different seasons simultaneously.
- C. The Southern Hemisphere is always farther from the sun than the Northern Hemisphere, causing it to have colder seasons.
- D. Earth's tilt reverses direction every six months, which switches the seasons between hemispheres.

6. Examine the data table from the article. A student notices that the gap between June and December daylight hours is much larger in Fairbanks than in New York. What is the most accurate analysis of this pattern?

- A. Fairbanks has a larger gap because it is in a colder climate, and cold air causes longer nights.
- B. The larger gap in Fairbanks is caused by its greater distance from the equator, which makes it more sensitive to Earth's axial tilt.
- C. New York has a smaller gap because it is closer to the ocean, which moderates its daylight hours.
- D. The gap is larger in Fairbanks because it receives more total sunlight over the course of a year.

7. Ancient cultures such as the builders of Stonehenge aligned their structures to mark the June 21 solstice. Which conclusion about these civilizations is best supported by this evidence?

- A. Ancient peoples believed the sun moved around Earth and built monuments to worship it.
- B. These civilizations had access to modern astronomical tools that allowed them to predict solstices accurately.
- C. Ancient peoples carefully observed and analyzed patterns in the sun's position over many generations to track the solstice.
- D. Stonehenge was built to protect communities from extreme weather that occurred during the solstice.

8. A flashlight shining straight down onto a surface produces a small, bright circle of light. When the flashlight is tilted at a steep angle, the light spreads into a larger, dimmer oval. How does this model help explain why summer is warmer than winter in the Northern Hemisphere?

- A. In summer, Earth is tilted so sunlight strikes at a more direct angle, concentrating energy like the straight-down flashlight beam.
- B. In summer, Earth spins faster, so the flashlight beam covers more ground and heats a larger area.
- C. In winter, the flashlight beam is brighter because Earth is closer to the sun, making winters warmer than summers.
- D. The flashlight model shows that the angle of light does not affect temperature, only the duration of light matters.

9. Two variables that affect how much solar energy a location receives are the angle of sunlight and the duration of daylight. On June 21 in the Northern Hemisphere, how do both of these variables work together to produce the warmest time of year?

- A.** The angle of sunlight decreases while the duration of daylight increases, creating a balance that produces mild temperatures.
- B.** Both the angle and duration of sunlight increase in the Northern Hemisphere, combining to deliver more solar energy to the surface.
- C.** The duration of daylight increases, but the angle of sunlight decreases, so only one variable contributes to summer warmth.
- D.** The angle of sunlight increases, but the duration of daylight stays the same as in winter, so only angle matters.

10. If Earth had no axial tilt and orbited the sun perfectly upright, which of the following outcomes would most likely result?

- A.** Seasons would become more extreme because Earth's distance from the sun would have a greater effect.
- B.** The Northern Hemisphere would always experience summer because it faces the sun more directly.
- C.** All locations on Earth would experience roughly the same amount of daylight and similar temperatures year-round, with no distinct seasons.
- D.** Only the equator would be affected; higher latitudes would still experience seasons due to their distance from the equator.

True / False

Read each statement carefully. Decide whether the statement is True (T) or False (F) based on what you have learned about Earth's axial tilt, the solstice, and seasonal patterns. Write T or F for each item.

1. Earth is closer to the sun in June than in January, which is why the Northern Hemisphere experiences summer.
 True False
2. Earth's axial tilt of approximately 23.5 degrees is the primary cause of the changing seasons.
 True False
3. On June 21, the Northern Hemisphere is tilted toward the sun at its maximum angle, resulting in the longest day of the year.
 True False
4. A location at the equator experiences roughly 12 hours of daylight every day, regardless of the season.
 True False
5. Fairbanks, Alaska, experiences less extreme seasonal daylight differences than New York City because it is closer to the equator.
 True False
6. When sunlight strikes Earth at a more direct angle, it concentrates energy into a smaller area and is more intense than angled sunlight.
 True False

7. The farther a location is from the equator, the smaller the difference between its June and December daylight hours.

True False

8. Ancient structures like Stonehenge were aligned with the summer solstice, suggesting that early civilizations carefully analyzed patterns of Earth's movement.

True False

9. During the summer solstice in the Northern Hemisphere, the sun traces a longer arc across the sky, resulting in more hours of daylight.

True False

10. Confusing the variable of Earth-sun distance with the variable of sunlight angle leads to the correct explanation for why seasons occur.

True False

Vocabulary

Study each term and its definition below. These words are key to understanding Earth's place in the universe and why we experience seasons. As you read, look for how each term connects to the others and to the patterns you observe in the lesson.

summer solstice

The day, around June 21, when the Northern Hemisphere is tilted most directly toward the sun, resulting in the longest period of daylight of the year.

Explain in your own words:

axial tilt

The approximately 23.5-degree lean of Earth's axis relative to its orbit around the sun, which is the true cause of Earth's seasons.

Explain in your own words:

Northern Hemisphere

The half of Earth located north of the equator, which experiences its longest days and most direct sunlight around June 21.

Explain in your own words:

sun angle

The degree at which sunlight strikes Earth's surface, with more direct angles concentrating energy into a smaller area and producing more intense heat.

Explain in your own words:

daylight duration

The total number of hours of sunlight a location receives in a single day, which changes throughout the year based on Earth's tilt and a location's latitude.

Explain in your own words:

latitude

A measure of how far north or south a location is from the equator, which determines how dramatically its daylight hours change between summer and winter.

Explain in your own words:

equator

The imaginary line that circles Earth at its middle, where daylight hours remain close to 12 hours year-round because Earth's tilt affects it the least.

Explain in your own words:

orbit

The curved path Earth travels around the sun over the course of one year, during which Earth's tilted axis continues pointing in the same direction.

Explain in your own words:

misconception

A false or incorrect belief, such as the common but wrong idea that Earth's seasons are caused by how close Earth is to the sun.

Explain in your own words:

Stonehenge

An ancient monument in England whose stones were deliberately aligned to mark the June 21 solstice sunrise, showing that early civilizations carefully tracked astronomical patterns.

Explain in your own words:

Exit Ticket

Answer both questions below in 1-2 sentences each. Use evidence and reasoning from the lesson to support your answers.

1. A classmate says, "Earth has seasons because it gets closer to the sun in summer." Using what you learned about Earth's axial tilt and sun angle, explain why this reasoning is incorrect and identify what actually causes seasons.

2. Look at the daylight data for the equator, New York, and Fairbanks on June 21. What pattern do you notice between a location's latitude and the number of daylight hours it receives, and what does this pattern tell you about how Earth's tilt affects different parts of the planet?



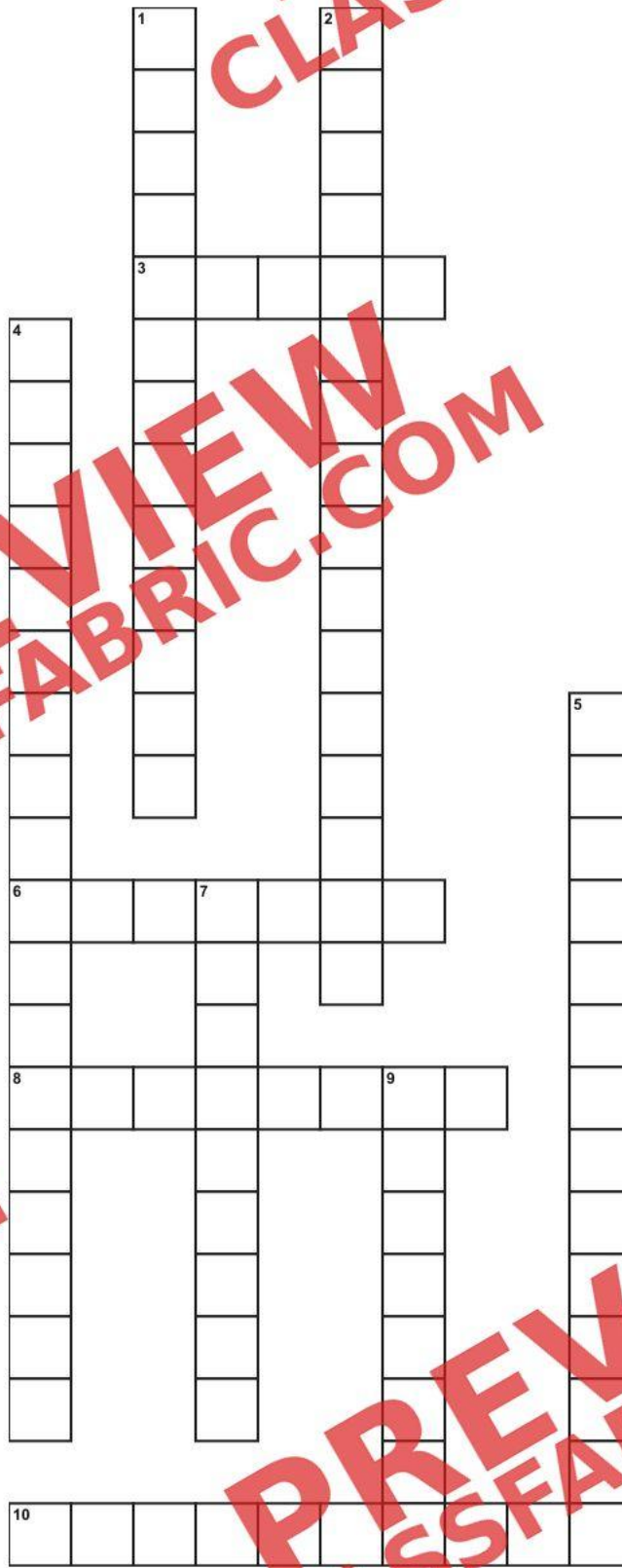
Earth's 23.5-degree axial tilt causes the Northern Hemisphere to receive more direct sunlight in June — this is what creates the summer solstice, not Earth's distance from the sun.



Stonehenge in England was built so that sunlight aligns perfectly through its stones on the summer solstice — proof that ancient cultures carefully tracked Earth's astronomical patterns.

Summer Solstice — Why Days Get Longer

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Summer Solstice — Why Days Get Longer

CROSSWORD PUZZLE

ACROSS

3. The curved path Earth travels around the sun over the course of one year, during which Earth's tilted axis continues pointing in the same direction.
6. The imaginary line that circles Earth at its middle, where daylight hours remain close to 12 hours year-round because Earth's tilt affects it the least.
8. The degree at which sunlight strikes Earth's surface, with more direct angles concentrating energy into a smaller area and producing more intense heat.
10. An ancient monument in England whose stones were deliberately aligned to mark the June 21 solstice sunrise, showing that early civilizations carefully tracked astronomical patterns.

DOWN

1. A false or incorrect belief, such as the common but wrong idea that Earth's seasons are caused by how close Earth is to the sun.
2. The total number of hours of sunlight a location receives in a single day, which changes throughout the year based on Earth's tilt and a location's latitude.
4. The half of Earth located north of the equator, which experiences its longest days and most direct sunlight around June 21.
5. The day, around June 21, when the Northern Hemisphere is tilted most directly toward the sun, resulting in the longest period of daylight of the year.
7. The approximately 23.5-degree lean of Earth's axis relative to its orbit around the sun, which is the true cause of Earth's seasons.
9. A measure of how far north or south a location is from the equator, which determines how dramatically its daylight hours change between summer and winter.

Summer Solstice — Why Days Get Longer

WORD SEARCH

U T F C U J F S K O T S M H A S O D V H L R Y A H Q
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Y L Y B A S O Y T C B L T L Q H E S Q E J X G Q R Q
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Q C P N Z P O F E T C J K V G X R L Z S R H C Q S Z
S M R F V F G R X C D W G P J E L L E T G T T S E R

FIND THESE WORDS

latitude
Northern Hemisphere
equator

sun angle
Stonehenge
misconception

summer solstice
axial tilt

orbit
daylight duration