The Sun's Effect on Climate
Lesson 7a: Use and Apply—Team Challenges

Grade 6	**Length of lesson:** 50 minutes	**Placement of lesson in unit:** 7a of 7 two-part lessons on the Sun's effect on climate
Unit central question: Why are some places on Earth hotter than others at different times of the year?		**Lesson focus question:** How can we use what we've learned about the Sun's effect on climate to answer the unit central question?
Main learning goal: Because of Earth's curved surface and consistent tilt, the angle of sunlight hitting the surface varies at different times of the year, causing uneven heating. While latitude is a key factor that influences climate on Earth, other factors are involved, such as elevation and proximity to large bodies of water.		
Science content storyline: Some places on Earth are hotter than others at different times of the year because of variations that result from the tilt of Earth on its axis, the angle of sunlight (solar radiation) striking Earth's curved surface at different latitudes, and Earth's orbit around the Sun. First, the angle of sunlight, and thus the intensity of solar radiation, varies depending on latitude—the distance north or south from the equator. Second, the angle and intensity of sunlight vary by time of year. For example, when a hemisphere is tilted away from the Sun in the winter, the Sun's rays strike the surface at a less direct angle, spreading solar energy over a larger area, which results in less heating and cooler temperatures. When a hemisphere is tilted toward the Sun in the summer, sunlight strikes the surface at a more direct angle, resulting in more concentrated solar energy, increased heating, and higher temperatures. This produces seasonal temperature variations in the Northern and Southern Hemispheres. While latitude is a key factor influencing regional climates, other factors, such as elevation and proximity to large bodies of water, can cause variations in temperature patterns at the same latitude. All of these factors contribute to the uneven heating of Earth's surface, causing variations in temperature patterns and regional climates.		
Ideal student response to the focus question/unit central question: Some places on Earth are hotter than others because they're closer to the equator. Temperatures vary depending on how far north or south a place is from the equator. Places are warmer closer to the equator and cooler moving toward the poles. Because Earth's surface is curved, the Sun's rays hit more intensely at the equator and spread out more as you move away from the equator. Earth's consistent tilt as it orbits the Sun causes more intense sunlight in some places at certain times of the year, causing these places to experience summer. At other times of the year, the sunlight is less intense in these places, and they experience winter. Temperatures are also affected if a place is close to a large body of water or is located at a higher elevation. All of these factors make some places on Earth hotter than others at different times of the year.		

Preparation

Materials Needed • Science notebooks **Student Handouts** • 7.1 Team Challenges—Why Are Some Places on Earth Hotter Than Others at Different Times of the Year? (1 per student)	**Ahead of Time** • Review the SEC content background document as needed. • *Optional:* You could cut apart the team challenges and glue them on index cards so you can distribute one challenge at a time to each team. Or have students put a star next to their assigned challenge on their own handouts. • *ELL support:* Identify challenging terms in the lesson and review them in advance with ELL students. The following terms may be problematic for students: *vary*, *depending*, *affects*, *more or less direct*, *modeled*, *distinct*, *best answer*, *variability*.

Lesson 7a General Outline

Time	Phase of Lesson	How the Science Content Storyline Develops
5 min	**Link to previous lessons:** Students review key science ideas about the Sun's effect on climate and seasons from previous lessons.	• Temperatures on Earth vary according to latitude. Because Earth is a sphere, sunlight hits the surface at different angles based on latitude, causing variations in the intensity of solar energy. In addition, Earth's consistent tilt as it orbits the Sun produces opposite seasons in the Northern and Southern Hemispheres. Other factors, such as elevation or proximity to large bodies of water, influence climate as well.
3 min	**Unit central question and lesson focus question:** The teacher reviews the unit central question—*Why are some places on Earth hotter than others at different times of the year?*— and introduces the focus question, *How can we use what we've learned about the Sun's effect on climate to answer the unit central question?*	
5 min	**Setup for activity:** The teacher sets up four team challenges that will help students apply everything they've learned to answer the unit central question.	• Various factors cause some places on Earth to experience hotter temperatures than others at different times of the year. These factors include the curved surface of Earth, its consistent tilt, its orbit around the Sun, and the angle of sunlight (solar radiation) striking Earth's surface at different latitudes. Other factors, such as elevation and proximity to large bodies of water, have a moderating effect on temperatures.
15 min	**Activity:** Students work in teams on one or more challenges for answering the unit central question and write their ideas and explanations in their science notebooks.	• The angle of sunlight, and thus the intensity of solar radiation reaching Earth's surface, varies depending on latitude—the distance north or south from the equator. The angle and intensity of sunlight also vary by time of year. For example, when a hemisphere tilts away from the Sun in the winter, sunlight strikes the surface at a less direct angle, spreading solar energy over a larger area, which results in less heating and cooler temperatures. When a hemisphere tilts toward the Sun in the summer, sunlight strikes the surface at a more direct angle, resulting in more concentrated solar energy, increased heating, and higher temperatures. Elevation or proximity to large bodies of water can also influence climate and have a moderating effect on temperatures.
15 min	**Follow-up to activity:** Students share their ideas and explanations with another team that worked on the same challenge(s) and then revise their ideas.	
6 min	**Synthesize/summarize today's lesson:** Students work in teams to identify and record key science ideas from this unit that helped them solve their challenge(s).	• Temperatures on Earth vary according to latitude—the distance north or south from the equator. Because Earth is a sphere, the Sun's rays hit the surface more directly near the equator and less directly moving toward the poles. The consistent tilt of Earth as it orbits the Sun causes different locations to receive more intense light energy (solar radiation) at certain times of the year (summer) and less intense light energy at other times of the year (winter). Elevation and proximity to large bodies of water also affect temperature patterns.
1 min	**Link to next lesson:** The teacher previews the final lesson and encourages students to think about their challenges in the interim and see if they come up with even better ideas.	

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5 min	**Link to Previous Lessons** **Synopsis:** Students review key science ideas about the Sun's effect on climate and seasons from previous lessons. **Main science idea(s):** • Temperatures on Earth vary according to latitude. Because Earth is a sphere, sunlight hits the surface at different angles based on latitude, causing variations in the intensity of solar energy. In addition, Earth's consistent tilt as it orbits the Sun produces opposite seasons in the Northern and Southern Hemispheres. Other factors, such as elevation or proximity to large bodies of water, influence climate as well.	Link science ideas to other science ideas.	**Show slides 1 and 2.** Throughout this unit, we've been collecting and analyzing data about how the Sun affects climate and temperature patterns on Earth. What did you learn about each of these factors and how they affect temperatures? • The angle and intensity of sunlight hitting Earth's curved surface at different latitudes • The consistent tilt of Earth on its axis • Earth's orbit around the Sun • Other factors, such as elevation and being near a large body of water **Turn and Talk:** First, review key science ideas from this unit that you recorded in your notebooks and then discuss this question with a partner. **Whole-class share-out:** So what have you learned in this unit about how the angle of sunlight hitting Earth at different latitudes affects temperatures? **NOTE TO TEACHER:** *You may want to record these ideas and post them where students can easily refer to them throughout the lesson.* **CONTENT NOTE TO TEACHER:** *Students should understand that the Sun's energy is more direct near the equator and*	The angle of sunlight hits Earth more directly at the equator, so there's more light, and it's hotter. The angle of sunlight is less direct at the North and South Poles, so there's not as much solar radiation there, and the temperatures	What do you mean by "more light"?

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			more dispersed (less concentrated) toward the poles. If they refer to "more light," clarify that the light is more direct, or more concentrated and intense, in those locations.	are cooler. The temperatures are opposite in the Northern and Southern Hemispheres because the angle of sunlight is more direct in one hemisphere and less direct in the other at different times of the year.	What do you mean by "not as much solar radiation"? Tell me more about temperatures being "opposite."
			What did you learn from the model of Earth's orbital path around the Sun that helped you understand how Earth's tilt and the four positions of Earth's orbit affect temperature patterns?	Earth is tilted on its axis and leans toward the Sun. Earth always tilts toward the North Star, so it doesn't always lean toward the Sun.	Does anyone want to add to this idea? Does anyone agree or disagree with this idea?
			What about other factors, like elevation and being near the ocean, that influence climate at specific locations? **NOTE TO TEACHER:** *Allow students to share four or five science ideas they remember from this unit. This discussion is designed to jog their memories of key science ideas, not to elicit detailed*	Places at higher elevations, like in the mountains, are colder than other places.	What evidence do we have from our data for this claim?

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			explanations, so don't spend a lot of time probing students' thoughts. As students share their ideas, note any misconceptions or confusion to address later in this lesson.	Places close to oceans have similar temperatures throughout the year. They're more steady and don't go up and down as much.	What do you mean by "similar temperatures"? Would anyone else like to add to this idea?
3 min	**Unit Central Question and Lesson Focus Question** **Synopsis:** The teacher reviews the unit central question—*Why are some places on Earth hotter than others at different times of the year?*—and introduces the focus question, *How can we use what we've learned about the Sun's effect on climate to answer the unit central question?*	Set the purpose with a focus question or goal statement.	**Show slide 3.** In this series of lessons, we've collected a lot of data to help us answer our unit central question, *Why are some places on Earth hotter than others at different times of the year?* **Show slide 4.** Today we'll put all of our science ideas together to answer this focus question: *How can we use what we've learned about the Sun's effect on climate to answer the unit central question?* Write this question in your science notebooks and draw a box around it. **NOTE TO TEACHER:** *Post the focus question where students can easily refer to it throughout the lesson.*		
5 min	**Setup for Activity** **Synopsis:** The teacher sets up four team challenges that	Make explicit links between science ideas and activities **before**	**Show slide 5.** In this lesson, you'll work in teams to solve one or more challenges related to our unit		

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	will help students apply everything they've learned to answer the unit central question. **Main science idea(s):** • Various factors cause some places on Earth to experience hotter temperatures than others at different times of the year. These factors include the curved surface of Earth, its consistent tilt, its orbit around the Sun, and the angle of sunlight (solar radiation) striking Earth's surface at different latitudes. Other factors, such as elevation and proximity to large bodies of water, have a moderating effect on temperatures.	the activity.	central question. For each challenge, you'll use everything you've learned about the Sun's effect on climate to explain why some places on Earth are hotter than others at different times of the year. As you work on these challenges, you'll need to keep in mind the science ideas from this unit. First, I'll divide the class into groups of three and assign a challenge to each team. Then we'll go over the instructions for each challenge to make sure everyone understands what to do. **NOTE TO TEACHER:** *Divide students into groups of three. Then distribute handout 7.1 (Team Challenges: Why Are Some Places on Earth Hotter Than Others at Different Times of the Year) and assign one challenge to each team. Alternatively, you could cut apart the handout and give one challenge to each team (see overview page). Read through each challenge to make sure teams understand their assigned tasks. As time allows, assign additional challenges to teams that complete their initial challenge.* As your team begins the assigned challenge, follow the steps on the slide: 1. Discuss what your challenge is about. 2. Share your ideas for solving the challenge. Make sure to support your		

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			explanations with evidence from previous lessons. 3. Decide as a team which science ideas are most important for solving the challenge. 4. Write your explanations in your science notebooks. Make sure to use complete sentences to clearly express your ideas. Also include labeled diagrams or drawings to help explain your ideas. You can look at your handouts from previous lessons and anything you wrote in your science notebooks that might help you develop your explanations and evidence.		
15 min	**Activity** **Synopsis:** Students work in teams on one or more challenges for answering the unit central question and write their ideas and explanations in their science notebooks. **Main science idea(s):** • The angle of sunlight, and thus the intensity of solar radiation reaching Earth's surface, varies depending on latitude—the distance north or south from the equator. The angle and intensity of sunlight also vary by time of year. For example, when a	Engage students in using and applying new science ideas in a variety of ways and contexts. Ask questions to	So are you ready to tackle these challenges? Make sure to use the science ideas and data you've gathered throughout this unit to help you solve your challenge! To refresh your memories, look through your handouts and notes from previous lessons. Try to express your ideas as clearly and completely as you can, and don't forget to illustrate them with drawings. **NOTE TO TEACHER:** *Continue displaying slide 5 throughout the challenge. Allow students to use the Earth-Sun model if it will help them picture what might be happening in each challenge scenario.* *Circulate around the room as students work and check their writings and drawings for*		

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	hemisphere tilts away from the Sun in the winter, sunlight strikes the surface at a less direct angle, spreading solar energy over a larger area, which results in less heating and cooler temperatures. When a hemisphere tilts toward the Sun in the summer, sunlight strikes the surface at a more direct angle, resulting in more concentrated solar energy, increased heating, and higher temperatures. Elevation or proximity to large bodies of water can also influence climate and have a moderating effect on temperatures.	probe student ideas and predictions. Ask questions to challenge student thinking.	*clarity and scientific accuracy. Ask probe and challenge questions to help students clarify their thinking. Note any misconceptions or confusion that needs to be addressed later.* *After teams complete one challenge, give them a second and a third if time allows. Some of the challenges might not take as much time as others.* **ELL support:** If ELL students modeled or acted out their ideas in previous lessons, allow them to reenact their understandings in the same ways during this activity.		
15 min	**Follow-Up to Activity** **Synopsis:** Students share their ideas and explanations with another team that worked on the same challenge(s) and then revise their ideas. **Main science idea(s):** • The angle of sunlight, and thus the intensity of solar radiation reaching Earth's surface, varies depending on latitude—the distance	Make explicit links between science ideas and activities **after** the activity.	**Show slide 6.** In our final lesson, your team will share with the class your ideas and explanations for solving your assigned challenge. To help you prepare, you'll pair up with another team that worked on the same challenge and share your ideas and explanations. That way you can improve your explanations before presenting them to the entire class. The goal is to use your combined brain		

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	north or south from the equator. The angle and intensity of sunlight also vary by time of year. For example, when a hemisphere tilts away from the Sun in the winter, sunlight strikes the surface at a less direct angle, spreading solar energy over a larger area, which results in less heating and cooler temperatures. When a hemisphere tilts toward the Sun in the summer, sunlight strikes the surface at a more direct angle, resulting in more concentrated solar energy, increased heating, and higher temperatures. Elevation or proximity to large bodies of water can also influence climate and have a moderating effect on temperatures.	Engage students in communicating in scientific ways.	power to come up with the *best possible explanation* for your challenge. **Show slide 7.** This is a great opportunity to practice working together and talking about ideas like scientists do! So present your best arguments and evidence and listen carefully to the ideas and explanations of others. Someone else just might propose a better solution! Make sure to talk in scientific ways by agreeing, disagreeing, adding on, and asking questions. And be open to revising your ideas! After this discussion, you'll have an opportunity to revise your ideas and explanations. **Show slide 8.** Follow these guidelines as you share your ideas with another team: 1. Review your assigned challenge. 2. One team will go first, sharing a complete explanation, including any diagrams and drawings, without any interruptions from the other team. (The other team should take notes or jot down questions as the first team talks.) 3. Then the second team will share a complete explanation, without any interruptions, while the other team takes notes.		

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			4. Afterward, compare your teams' explanations and talk about areas where you agree and disagree. Use evidence to support your ideas and arguments during this discussion. 5. Decide how to revise your ideas to come up with an even better explanation for the challenge. 6. Record your new ideas and explanations in complete sentences in your science notebooks. (Keep in mind that scientists often revise their ideas when they gather new information or realize there's a better way to explain something.) **NOTE TO TEACHER:** *Exchanging ideas with another team is a great way to help students think about other ideas and explanations before they engage in a whole-class discussion. As you circulate among the teams, probe and challenge students thinking. Encourage students to rely on key science ideas and evidence from previous lessons to solve these challenges.*		
6 min	**Synthesize/Summarize Today's Lesson** **Synopsis:** Students work in teams to identify and record key science ideas from the unit that helped them solve their challenge(s). **Main science idea(s):** • Temperatures on Earth vary according to	Engage students in making connections by synthesizing and summarizing key science ideas.	**Show slide 9.** **Think-Pair-Share-Write:** Now I'd like you to think about a question that's similar to today's focus question: *How can we use what we've learned about the Sun's effect on climate to solve our team challenges?* Talk about this with your team and come up with one or two science ideas you think are most important or relevant for solving your		

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	latitude—the distance north or south from the equator. Because Earth is a sphere, the Sun's rays hit the surface more directly near the equator and less directly moving toward the poles. The consistent tilt of Earth as it orbits the Sun causes different locations to receive more intense light energy (solar radiation) at certain times of the year (summer) and less intense light energy at other times of the year (winter). Elevation and proximity to large bodies of water also affect temperature patterns.		challenge. When your team reaches an agreement, write these science ideas in your notebooks. You'll share them during team presentations next time.		
1 min	**Link to Next Lesson** **Synopsis:** The teacher previews the final lesson and encourages students to think about their challenges in the interim and see if they come up with even better ideas.		**Show slide 10.** In our final lesson in this unit, you'll present your team's explanation for your assigned challenge. In the meantime, spend some time thinking about your challenge and see if you can come up with an even better explanation using the science ideas you've learned!		