

## The Sun's Effect on Climate

### Lesson 1b: Temperature Patterns and Time of Year

<b>Grade 6</b>	<b>Length of lesson:</b> 40 minutes	<b>Placement of lesson in unit:</b> 1b of 7 two-part lessons on the Sun's effect on climate
<b>Unit central question:</b> Why are some places on Earth hotter than others at different times of the year?		<b>Lesson focus question:</b> What temperature patterns can you find on Earth at different times of the year?
<b>Main learning goal:</b> Temperatures on Earth's surface vary according to latitude and time of year.		
<b>Science content storyline:</b> The Sun's light energy—solar radiation—heats the surface of Earth. In general, temperatures on Earth vary according to latitude and time of year. Related to latitude, temperatures generally increase as latitude decreases (from the poles toward the equator) and generally decrease as latitude increases (from the equator toward the poles). Related to the time of year, temperatures are higher in the Northern Hemisphere from about June through September and in the Southern Hemisphere from about December through March. In other words, Earth's surface heats unevenly at different latitudes and times of the year.		
<b>Ideal student response to the focus question:</b> There are temperature patterns on Earth that vary according to latitude (how close a location is to the equator) and the time of year. Closer to the equator, temperatures are typically higher, and it feels warmer. Closer to the poles, temperatures are typically lower, and it feels cooler. From June through September, temperatures are higher in the Northern Hemisphere and lower in the Southern Hemisphere. From December through March, the temperatures are higher in the Southern Hemisphere and lower in the Northern Hemisphere. Temperatures vary at different latitudes at different times of the year.		

#### Preparation

<p><b>Materials Needed</b></p> <ul style="list-style-type: none"> <li>• Science notebooks</li> <li>• <i>Optional:</i> Inflatable globes (1 per group)</li> </ul> <p><b>Student Handouts and Teacher Masters</b></p> <ul style="list-style-type: none"> <li>• 1.2 Average Temperatures around the World: January and July (from lesson 1a)</li> <li>• 1.3 World Map Record Page (2 per pair of students from lesson 1a)</li> <li>• 1.4 Bar Graph of January Temperatures (1 per pair of students)</li> <li>• 1.5 Bar Graph of July Temperatures (1 per pair of students)</li> <li>• 1.6 Map of Average Yearly Temperatures on Earth (Teacher Master) (for display; see Ahead of Time)</li> </ul>	<p><b>Ahead of Time</b></p> <ul style="list-style-type: none"> <li>• Review sections 1–4 in the SEC content background document.</li> <li>• Prepare handout 1.6 for display on a document reader or Smart Board.</li> </ul>
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### Lesson 1b General Outline

Time	Phase of Lesson	How the Science Content Storyline Develops
10 min	<b>Link to previous lesson:</b> Students share their observations about temperature patterns from the previous lesson. Then they review the focus question and the unit central question from last time.	<ul style="list-style-type: none"> <li>• There is a relationship between latitude and temperature patterns on Earth.</li> </ul>
1 min	<b>Lesson focus question:</b> The teacher introduces the focus question, <i>What temperature patterns can you find on Earth at different times of the year?</i>	
3 min	<b>Setup for activity:</b> The teacher introduces bar graphs as another way of representing temperature data from around the world.	<ul style="list-style-type: none"> <li>• Around the world, temperature patterns generally vary according to latitude and the time of year.</li> </ul>
10 min	<b>Activity:</b> Students use bar graphs to analyze temperature data and identify patterns in various locations at different times of the year.	<ul style="list-style-type: none"> <li>• Related to latitude, temperatures on Earth generally increase as latitude decreases (from the poles toward the equator) and generally decrease as latitude increases (from the equator toward the poles). Related to the time of year, temperatures are higher in the Northern Hemisphere from about June through September and in the Southern Hemisphere from about December through March.</li> </ul>
10 min	<b>Follow-up to activity:</b> Students share the temperature patterns they observed using all of their content representations (data table, world maps, and bar graphs). Then they relate these patterns to latitude and time of year.	<ul style="list-style-type: none"> <li>• There are temperature patterns on Earth that vary according to latitude and time of year. Closer to the equator, temperatures are typically higher, and it feels warmer. Closer to the poles, temperatures are typically lower, and it feels cooler. From June through September, temperatures are higher in the Northern Hemisphere and lower in the Southern Hemisphere. From December through March, temperatures are higher in the Southern Hemisphere and lower in the Northern Hemisphere.</li> </ul>
5 min	<b>Synthesize/summarize today’s lesson:</b> Students write down two patterns they think are most important in describing temperatures on Earth. Then the teacher summarizes key science ideas from the lesson.	<ul style="list-style-type: none"> <li>• Earth’s surface heats unevenly at different latitudes and times of the year.</li> </ul>
1 min	<b>Link to next lesson:</b> The teacher previews the next lesson.	

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10 min	<p><b>Link to Previous Lesson</b></p> <p><b>Synopsis:</b> Students share their observations about temperature patterns from the previous lesson. Then they review the focus question and the unit central question from last time.</p> <p><b>Main science idea(s):</b></p> <ul style="list-style-type: none"> <li>• There is a relationship between latitude and temperature patterns on Earth.</li> </ul>	Highlight key science ideas and focus question throughout.	<p><b>Show slide 1.</b></p> <p>Last time we looked at some interesting data. What kind of data did we examine?</p> <p><b>NOTE TO TEACHER:</b> <i>Make sure students have their science notebooks and handouts 1.2 and 1.3 from the previous lesson.</i></p> <p>Exactly! We examined temperature data for different locations and recorded this information on our world maps. We also noted the location, or latitude, of each of these places.</p> <p><b>Show slide 2.</b></p> <p>Our focus question from yesterday’s lesson was <i>What temperature patterns can you find on Earth at different latitudes?</i></p> <p>At the end of the lesson, we compared temperature data for four locations:</p> <ul style="list-style-type: none"> <li>• Lagos, Nigeria</li> <li>• Jakarta, Indonesia</li> <li>• Nome, Alaska</li> <li>• Rothera Point, Antarctica</li> </ul>	<p>We looked at temperatures for January and July in different places around the world.</p> <p>And we looked at where each place was located on a world map.</p>	

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		Engage students in analyzing and interpreting data and observations.	<p>Which of these places are near the equator?</p> <p>Which are farther away from the equator?</p> <p><b>Show slide 3.</b></p> <p>After comparing the data, you completed two sentences about the temperature patterns you observed that might help us answer our focus question.</p> <p>What patterns did you observed in the January and July temperature data when a place was closer to the equator. What about when a place was farther away from the equator?</p> <p>Let’s hear some of your observations.</p> <p><b>NOTE TO TEACHER:</b> <i>Ask a few students to share their sentences and encourage others to add to or revise them. Help students construct the science idea that temperatures vary significantly around the world according to latitude. Temperatures will be higher closer to the equator and lower farther away. In this opening discussion, students may mention differences in temperature at different times of the year, but don’t spend a lot of time on this idea, since it will be</i></p>	<p>Lagos and Jakarta.</p> <p>Nome and Rothera Point.</p> <p>The temperatures in places closer to the equator are warm in both January and July. They don’t change very much all year!</p> <p>The average temperature in Alaska in January was colder than the temperature in Antarctica. I didn’t think that could be right.</p>	<p>Why do you think this couldn’t be right?</p>

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		Summarize key science ideas.	<p><i>developed during the lesson. For now, keep the focus on temperature patterns related to latitude.</i></p> <p><b>Show slide 4.</b></p> <p>A key science idea to keep in mind from our data is that temperatures on Earth vary according to latitude, or how far a location is from the equator, both north and south.</p> <p><b>Show slide 5.</b></p> <p>Throughout this series of lessons, we'll also keep thinking about our unit central question, <i>Why are some places on Earth hotter than others at different times of the year?</i></p>		
1 min	<p><b>Lesson Focus Question</b></p> <p><b>Synopsis:</b> The teacher introduces the focus question, <i>What temperature patterns can you find on Earth at different times of the year?</i></p>	Set the purpose with a <u>focus question</u> or goal statement.	<p><b>Show slide 6.</b></p> <p>Yesterday we looked at the relationship between temperature and latitude. In this lesson we'll consider how the time of year influences temperature patterns on Earth.</p> <p>Our focus question today is <i>What temperature patterns can you find on Earth at different times of the year?</i></p> <p>Write this question in your science notebooks and draw a box around it.</p>		

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			<p><b>NOTE TO TEACHER:</b> <i>Post this question at the front of the classroom and refer to it often throughout the lesson.</i></p>		
3 min	<p><b>Setup for Activity</b></p> <p><b>Synopsis:</b> The teacher introduces bar graphs as another way of representing temperature data from around the world.</p> <p><b>Main science idea(s):</b></p> <ul style="list-style-type: none"> <li>• Around the world, temperature patterns generally vary according to latitude and the time of year.</li> </ul>	<p>Make explicit links between science ideas and activities <b>before</b> the activity.</p>	<p>Today you'll pair up again and examine the same temperature data from last time, but this time you and your partner will use bar graphs to represent the data. This new content representation will help you see temperature patterns more clearly in terms of latitude and time of year.</p> <p><b>Show slide 7.</b></p> <p>For today's activity, you'll need your data table and world maps from the last lesson, so take those out now.</p> <p>Find the equator on your world maps and circle the labels that say "Equator."</p> <p>What is the degree of latitude at the equator?</p> <p><b>NOTE TO TEACHER:</b> <i>Circling the equator label on the map might make it easier for students to see the temperature variations north and south of the equator. After students mark the equator, distribute handouts 1.4 and 1.5—Bar Graph of January Temperatures and Bar Graph of July Temperatures—and orient students to the new content representation. Help them see that the bar graphs use the same</i></p>	<p>The latitude is 0 degrees at the equator.</p>	

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			<p><i>data as the data table and world maps from the previous lesson, but the graphs organize and display the information in different ways. You might post all the content representations on the board so you can highlight which ones you're referring to at different points in the activity.</i></p> <p>Next we're going to examine two bar graphs and see if we can identify temperature patterns at different latitudes and times of the year.</p>		
10 min	<p><b>Activity</b></p> <p><b>Synopsis:</b> Students use bar graphs to analyze temperature data and identify patterns in various locations at different times of the year.</p> <p><b>Main science idea(s):</b></p> <ul style="list-style-type: none"> <li>• Related to latitude, temperatures on Earth generally increase as latitude decreases (from the poles toward the equator) and generally decrease as latitude increases (from the equator toward the</li> </ul>	Select content representations and models matched to the learning goals and engage students in their use.	<p><b>Show slide 8.</b></p> <p>First, let's look at the bar graph of January temperatures.</p> <p>What do the bars on the graph represent?</p> <p>How are the <i>x</i>- and <i>y</i>-axes labeled?</p> <p>Where does the latitude of the equator appear on the graph?</p>	<p>The bars show how hot or cold it is.</p> <p>The <i>x</i>-axis shows the degrees of latitude for the Southern and Northern Hemispheres, and the <i>y</i>-axis shows the temperature.</p> <p>The latitude of the equator is in the middle of the bar graph, between the North and South Hemispheres.</p>	What do the bars have to do with latitude?

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	poles). Related to the time of year, temperatures are higher in the Northern Hemisphere from about June through September and in the Southern Hemisphere from about December through March.	Highlight key science ideas and focus question throughout.	<p>Next, compare the bar graphs for January and July with the world maps for these months.</p> <p>What do you notice about the temperatures on each bar graph compared to the map for the same month?</p> <p>What data sources do we have so far to help us answer today’s focus question, <i>What temperature patterns can you find on Earth at different times of the year?</i></p>	<p>The North Pole is always cold.</p> <p>It’s almost the same temperature in Jakarta, Indonesia in January and July. I don’t understand that.</p> <p>In Sydney, Australia, it’s warmer in January than it is in July. That’s confusing.</p> <p>The bar graphs.</p>	<p>Can anyone add to that idea?</p> <p>Where is it hotter in January? How do you know that?</p> <p>Tell me what you’re wondering about.</p> <p>How does that relate to latitude?</p> <p>Say more about why you’re confused.</p>




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		<p>Make explicit links between science ideas and activities <b>during</b> the activity.</p>	<p><b>Think-Pair-Share:</b> Think for a moment about how this collection of data sources can help us answer our focus question. Then pair up and share your ideas with your partner.</p> <p><b>NOTE TO TEACHER:</b> <i>Circulate around the room and listen to students' conversations. Once you feel students are comfortable with the content representations and understand how they complement each other, invite them to search for patterns in the temperature data.</i></p> <p><b>Show slide 9.</b></p> <p>Now that you've compared the different ways temperature data can be organized, I'd like you to search for patterns in the data using the bar graphs for January and July. When you think you've discovered a pattern, record it in your science notebooks.</p> <p>For example, see if you can find any</p>	<p>The world maps from the last lesson.</p> <p>The table of temperature data from yesterday's lesson.</p>	

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			<p>patterns in the temperature data related to the month of the year. Then compare the January and July temperatures at various latitudes on Earth and see if you can find any patterns related to the Northern and Southern Hemispheres.</p> <p>After you've written down the patterns you observed in the bar graphs, use all of your data sources to look for any patterns you might have missed, and record them in your notebooks. By comparing the different content representations, you might discover a pattern you didn't notice earlier.</p>		
10 min	<p><b>Follow-Up to Activity</b></p> <p><b>Synopsis:</b> Students share the temperature patterns they observed using all of their content representations (data table, world maps, and bar graphs). Then they relate these patterns to latitude and time of year.</p> <p><b>Main science idea(s):</b></p> <ul style="list-style-type: none"> <li>There are temperature patterns on Earth that vary according to latitude and time of year. Closer to the</li> </ul>	Engage students in	<p><b>Show slide 10.</b></p> <p><b>NOTE TO TEACHER:</b> <i>Post the bar graphs of January and July temperatures on the board or display them on a document projector so that students can see them during the class discussion.</i></p> <p><b>Whole-class share-out:</b> What temperature patterns did you find in your data sources related to latitude and time of year at various locations on Earth?</p> <p><b>NOTE TO TEACHER:</b> <i>Ask one pair of students to share their observations and reasoning with the class.</i></p> <p>Listen as your classmates tell us about a</p>		

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	<p>equator, temperatures are typically higher, and it feels warmer. Closer to the poles, temperatures are typically lower, and it feels cooler. From June through September, temperatures are higher in the Northern Hemisphere and lower in the Southern Hemisphere. From December through March, temperatures are higher in the Southern Hemisphere and lower in the Northern Hemisphere.</p>	<p>communicating in scientific ways.</p>	<p>pattern they noticed in the data. Be thinking of whether you agree or disagree with the proposed pattern, or whether you have a question or something to add. Remember to communicate in scientific ways!</p> <p>So what pattern did you observe in the data?</p> <p><b>NOTE TO TEACHER:</b> <i>If students disagree with the proposed pattern, ask them to give their reasoning and include evidence from the temperature data. Help students develop their arguments by reminding them how to communicate in scientific ways. For example: I agree/disagree with [student's name] because _____.</i></p> <p><b>Optional:</b> <i>As students explain the patterns they observed in the temperature data, you might have them use an inflatable globe to help the class visualize what they're describing.</i></p>	<p>It's hotter in July in the Northern Hemisphere, and it's colder in July in the Southern Hemisphere.</p> <p>It's hot by the equator and cold at the poles.</p> <p>The seasons are opposite north of the equator and south of the equator.</p>	<p><i>Questions to ask pairs:</i></p> <p>What is your evidence?</p> <p>What are your reasons for that statement?</p> <p>What do "by the equator" and "at the poles" mean? How close or how far from the equator?</p> <p>Did anyone else observe this pattern? Why?</p> <p>Does anyone disagree or want to add to this idea?</p> <p>What do you mean by "seasons"?</p>

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		<p>Highlight key science ideas and focus question throughout.</p> <p>Link science ideas to other science ideas.</p>	<p><b>Show slide 11.</b></p> <p>Now let’s consider four questions that relate specifically to latitude and time of year:</p> <ol style="list-style-type: none"> <li>1. What happens to the temperature if a location is closer to the equator?</li> <li>2. What happens to the temperature if a location is farther away from the equator?</li> <li>3. How do temperatures in various locations differ in January and July?</li> <li>4. Are these temperature patterns the same in the Northern and Southern Hemispheres?</li> </ol> <p><b>NOTE TO TEACHER:</b> <i>If students are having difficulty seeing the patterns, you could have them answer these questions in a Think-Pair-Share activity. Give students time to think about their responses and then share their ideas with</i></p>	<p><i>Possible responses:</i></p> <p><i>Question 1:</i> Cities closer to the equator have higher temperatures.</p> <p><i>Question 2:</i> Cities farther away from the equator have lower temperatures.</p> <p><i>Question 3:</i> The temperatures seem backward in different places in January and July.</p> <p><i>Question 4:</i> The Southern Hemisphere doesn’t have summer at the same time the Northern Hemisphere does.</p>	<p>Does anyone disagree with this pattern? Why?</p> <p>Does anyone want to add to this idea?</p> <p>Tell me how you know that. What is your evidence?</p> <p>What do you mean by “backward”?</p> <p>When it’s summer for us in the United States, what season</p>

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			<p><i>a partner.</i></p> <p> Listen to students' ideas. What's visible about student thinking?</p> <p><b>NOTE TO TEACHER:</b> <i>Make sure students understand that the concept of seasons is hemisphere dependent, and instead of having winter and summer as in the United States, some locations have rainy seasons and dry seasons. However, in this lesson series, the terms winter and summer are used in reference to cold and warm times of year.</i></p>	<p><i>Question 4:</i> I wonder if people in Australia have the same months we do, or if it's January for them when it's July for us.</p>	<p>are people experiencing in South America?</p> <p>Do you mean the calendar would be different in Australia? Tell me more about that.</p>
5 min	<p><b>Synthesize/Summarize Today's Lesson</b></p> <p><b>Synopsis:</b> Students write down two patterns they think are most important in describing temperatures on Earth. Then the teacher summarizes key science ideas from the lesson.</p> <p><b>Main science idea(s):</b></p> <ul style="list-style-type: none"> <li>• Earth's surface heats unevenly at different latitudes and times of the year.</li> </ul>	Engage students in making connections by synthesizing and summarizing key science ideas.	<p>In this lesson, we've been looking for temperature patterns in different locations around the world at different times of the year. Some of these locations are close to the equator, and some are farther away.</p> <p><b>Show slide 12.</b></p> <p>Think about what you've learned so far and answer these two questions in your science notebooks.</p> <ol style="list-style-type: none"> <li>1. What do you think is the <i>most important pattern</i> that describes temperatures on Earth <i>at different locations (latitudes)</i>? Why?</li> <li>2. What do you think is the <i>most important pattern</i> that describes</li> </ol>		

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			<p>temperatures on Earth <i>at different times of the year?</i> Why?</p> <p><b>NOTE TO TEACHER:</b> <i>If time allows, invite students to share their responses to these questions. Then close with a summary of the key science ideas from the lesson. As you describe temperature patterns, you might want to use an inflatable globe to help students visualize the patterns. Avoid leaning the globe in any particular direction and drawing attention to the idea of Earth’s tilt, since this will be covered in a later lesson. Introducing this concept prematurely may distract students from the main science ideas in this lesson.</i></p> <p><b>Show slide 13.</b></p> <p>To review how latitude influences temperature patterns, let’s look at a new map that shows average temperatures around the world.</p> <p>What temperature patterns do you observe as you look at this map?</p> <p><b>NOTE TO TEACHER:</b> <i>This map is also a teacher master—handout 1.6, Map of Average Yearly Temperatures on Earth. If desired, you may want to display it on a projector or document reader.</i></p>	<p>Temperatures near the equator are hot, and temperatures at the poles are cold.</p>	

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		Summarize key science ideas.	<p><b>Show slide 14.</b></p> <p>This slide summarizes three key science ideas about temperature patterns that are important to remember:</p> <ol style="list-style-type: none"> <li>1. Temperatures on Earth are warmer closer to the equator.</li> <li>2. Temperatures decrease as latitude increases. So as we move farther away from the equator, either north or south, temperatures will generally be cooler.</li> <li>3. Temperatures vary at different latitudes at different times of the year. For example, temperatures are higher in the Northern Hemisphere in July and higher in the Southern Hemisphere in January.</li> </ol>		
1 min	<p><b>Link to Next Lesson</b></p> <p><b>Synopsis:</b> The teacher previews the next lesson.</p>	Link science ideas to other science ideas.	<p><b>Show slide 15.</b></p> <p>In this lesson we looked for temperature patterns on Earth at different latitudes and times of the year.</p> <p>As we've talked about these patterns, have you wondered <i>why</i> temperatures are higher closer to the equator and lower farther away from the equator?</p>		

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			That's what we'll explore tomorrow!		