

The Sun's Effect on Climate

Lesson 1a: Temperature Patterns and Latitude

Grade 6	Length of lesson: 40 minutes	Placement of lesson in unit: 1a 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: What temperature patterns can you find on Earth at different latitudes?
Main learning goal: Temperatures on Earth's surface vary according to latitude.		
Science content storyline: 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.		
Ideal student response to the focus question: Temperature patterns on Earth are related to latitude (how close a location is to the equator). 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. Temperatures vary significantly at different latitudes during different times of the year.		


Preparation

<p>Materials Needed</p> <ul style="list-style-type: none"> • Science notebooks • Chart paper and markers (for recording student ideas) • <i>Optional:</i> Inflatable globes (1 per group) <p>Student Handouts and Teacher Masters</p> <ul style="list-style-type: none"> • 1.1 Map of Average Temperatures in the United States, December–February (Teacher Master) (for display; see Ahead of Time) • 1.2 Average Temperatures around the World: January and July (1 per pair of students) • 1.3 World Map Record Page (2 per pair of students) 	<p>Ahead of Time</p> <ul style="list-style-type: none"> • Review sections 1–4 in the Sun's Effect on Climate Content Background Document. • Prepare handout 1.1 for display on a document reader or Smart Board. • Before you this unit, make sure your students have a good mental image of the following science ideas: <ul style="list-style-type: none"> • The Sun is at the center of our solar system. • Earth revolves (orbits) around the Sun every 365 days, which creates our calendar year
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Lesson 1a General Outline

Time	Phase of Lesson	How the Science Content Storyline Develops
4 min	Unit central question: The teacher introduces the unit central question, <i>Why are some places on Earth hotter than others at different times of the year?</i>	<ul style="list-style-type: none"> The Sun’s light energy—solar radiation—heats the surface of Earth.
5 min	Lesson focus question: The teacher introduces the focus question, <i>What temperature patterns can you find on Earth at different latitudes?</i> Students relate the focus question to US temperature data during the winter months.	<ul style="list-style-type: none"> In general, temperatures in the United States are warmer in the southern latitudes and cooler in the northern latitudes.
5 min	Setup for activity: Students review the focus question, paying special attention to the word <i>patterns</i> as they think about how temperatures might vary around the world based on latitude.	<ul style="list-style-type: none"> Temperatures on Earth vary according to latitude, or how far a location is from the equator, both north and south.
10 min	Activity: Students set up world map record pages using information from the temperature data table. Then they consider the relationship between latitude and temperature in various locations around the world.	<ul style="list-style-type: none"> 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).
5 min	Follow-up to activity: Students share the temperature patterns they observed at different latitudes.	<ul style="list-style-type: none"> There is a relationship between latitude and temperature patterns on Earth.
10 min	Synthesize/summarize today’s lesson: Students complete two sentences that summarize their ideas about temperature patterns related to latitude and distance from the equator.	<ul style="list-style-type: none"> Temperatures vary slightly near the equator, but farther away from the equator, temperatures vary significantly.
1 min	Link to next lesson: The teacher previews the next lesson.	

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4 min	<p>Unit Central Question</p> <p>Synopsis: The teacher introduces the unit central question, <i>Why are some places on Earth hotter than others at different times of the year?</i></p> <p>Main science idea(s):</p> <ul style="list-style-type: none"> The Sun's light energy—solar radiation—heats the surface of Earth. 	Ask questions to elicit student ideas and predictions.	<p>Show slides 1 and 2.</p> <p>Today we're beginning a unit about the Sun's effect on Earth's climate and seasons.</p> <p>Why do you think the Sun is important for life on Earth?</p> <p>NOTE TO TEACHER: <i>If students don't mention it, you might want to tell them you'll be using the term solar radiation when you talk about the Sun's energy. There's no need to probe students' understandings of how the Sun's light heats Earth, since this is beyond the scope of the climate lessons.</i></p> <p>Show slide 3.</p> <p>In this unit, we'll think about some important questions, like our unit central question, <i>Why are some places on Earth hotter than others at different times of the year?</i></p> <p>What do you think? Write your ideas in your science notebooks and be ready to share them with the class.</p> <p>Individual work time.</p> <p>Whole-class share-out. So why do you think some places on Earth are hotter than others at different times of the year?</p>	<p>The Sun gives us light.</p> <p>The Sun makes us warm.</p> <p>We couldn't see without the Sun.</p> <p>The Sun has energy.</p> <p>The Sun helps plants grow.</p> <p>We can heat things with solar energy.</p>	

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			<p> During this discussion, listen to students' ideas. What's visible about student thinking?</p> <p>NOTE TO TEACHER: <i>Keep this discussion brief, using it to make student thinking visible about the Sun's effect on Earth's climate and why there is uneven heating. Record students' ideas on chart paper so you can refer back to them as they change. Don't probe student thinking at this time. Simply listen to their ideas and note any misconceptions so you can probe and challenge those ideas throughout the lessons.</i></p> <p>Throughout this lesson series, we'll gather information that will help us answer our unit central question.</p>	<p>Some places get more sunlight than others. That's why it's hotter in the desert.</p> <p>We're closer to the Sun in the summer, so it's hotter.</p> <p>It's hotter in the summer and colder in the winter because the Sun shines more in the summer than in the winter.</p>	
5 min	<p>Lesson Focus Question</p> <p>Synopsis: The teacher introduces the focus question, <i>What temperature patterns can you find on Earth at different latitudes?</i> Students relate the focus question to US temperature data during the winter months.</p> <p>Main science idea(s):</p> <ul style="list-style-type: none"> In general, temperatures in the 	Set the purpose with a <u>focus question</u> or goal statement.	<p>Show slide 4.</p> <p>Today we'll investigate this focus question: <i>What temperature patterns can you find on Earth at different latitudes?</i></p> <p>Take a moment to write this question in your science notebooks and draw a box around it.</p> <p>NOTE TO TEACHER: <i>Post the focus question at the front of the classroom so students can refer to it throughout the lesson.</i></p> <p>Show slide 5.</p>		

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	<p>United States are warmer in the southern latitudes and cooler in the northern latitudes.</p>	<p>Select content representations and models matched to the learning goal and engage students in their use.</p>	<p>Keep this focus question in mind as we look at a map of winter temperatures for the United States.</p> <p>NOTE TO TEACHER: <i>This map is also a teacher master—handout 1.1, Map of Average Temperatures in the United States, December–February. If desired, you may want to display it on a projector or document reader.</i></p> <p>What do you notice about the average temperatures on this map?</p> <p>How would you describe the temperature patterns you observe?</p>	<p>Temperatures get warmer when you go from north to south in the US.</p> <p>Temperatures get colder when you go up.</p> <p>It gets warmer as you go south in the United States.</p> <p>There’s also a pattern when you go north; it gets cooler.</p>	<p>How do you know the temperatures are warmer or cooler?</p> <p>What do you mean by “up”?</p> <p>What do you mean by a “pattern”?</p> <p>Do you agree or disagree with this observation?</p> <p>Does this pattern have anything to do with</p>

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			<p>In the United States, we know that temperatures usually get warmer as we move from the northern states to the southern states. Next, we'll look at temperatures all over the world and look for more patterns.</p>		<p>the Sun?</p> <p>Tell me more about temperature differences from north to south.</p>
5 min	<p>Setup for Activity</p> <p>Synopsis: Students review the focus question, paying special attention to the word <i>patterns</i> as they think about how temperatures might vary around the world based on latitude.</p> <p>Main science idea(s):</p> <ul style="list-style-type: none"> • Temperatures on Earth vary according to latitude, or how far a location is from the equator, both north and south. 	<p>Make explicit links between science ideas and activities before the activity.</p> <p>Highlight key science ideas and focus question throughout.</p>	<p>If you lived in a different part of the world, would you always find warmer temperatures going south? Can you think of a place in the world where going south would <i>not</i> mean warmer temperatures?</p> <p>ELL support: This discussion could also be supported with photos and/or brief read-aloud texts for richer language and imagery.</p> <p>ELL support: Explicitly connect the South Pole and Antarctica, and elicit the names in students' home languages.</p> <p>Show slide 6.</p> <p>This relates to our focus question, <i>What temperature patterns can you find on Earth at different latitudes?</i></p> <p>To answer this question, we'll need to gather temperature data and look for patterns. So go back to the focus question in your notebooks and circle the word</p>	<p>If I went south to the South Pole, it would be really cold.</p> <p>Antarctica is south, and it's cold there, too.</p>	<p>Tell me more about the South Pole.</p> <p>Antarctica is south from where?</p>

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			<p><i>patterns</i> as a reminder.</p> <p>NOTE TO TEACHER: <i>Make sure all students know what the term pattern means as it relates to temperatures and location, so they understand exactly what they're expected to look for and identify.</i></p> <p><i>Then have students pair up. Distribute handout 1.2—Average Temperatures around the World: January and July—and handout 1.3—World Map Record Page—to each pair of students. Make sure to give pairs two copies of the world map. On one copy, they'll record January temperatures from the data table (handout 1.2), and on the other, they'll record July temperatures. Emphasize that during the activity, they'll be looking for temperature patterns using different ways of representing the same data.</i></p> <p>ELL support: You may want to consider introducing ELL students to the notion of latitude in advance, asking them to color different latitudes on copies of the maps that will be used during today's activity.</p>		
10 min	<p>Activity</p> <p>Synopsis: Students set up world map record pages using information from the temperature data table. Then they consider the relationship between latitude and temperature</p>	<p>Make explicit links between science ideas and activities during the activity.</p> <p>Select content</p>	<p>Show slide 7.</p> <p>To help us answer our focus question, we're going to investigate temperature patterns at different locations, or latitudes, on Earth.</p> <p>First, let's look at the data table on handout 1.2 that shows average temperatures</p>		

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	<p>in various locations around the world.</p> <p>Main science idea(s):</p> <ul style="list-style-type: none"> • 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). 	<p>representations and models matched to the learning goal and engage students in their use.</p>	<p>around the world in January and July.</p> <p>What are the column headings?</p> <p>What information does this data table contain?</p> <p>NOTE TO TEACHER: <i>If students don't have a clear understanding of latitude as a grid system for locating places on Earth, wait until they look at the world map before discussing it. It isn't necessary to explain how latitude is calculated, since this is beyond the scope of the lesson. Simply help students distinguish degrees of latitude and temperature as they record the temperature data for January and July on the corresponding maps. For example, you might say, "Notice that the latitude at the equator is 0°. Is the temperature at the equator 0° as well?" Students are likely to realize that isn't the case. Comparing latitudes and temperatures at the poles would yield the same result. Keep reminding students that degrees of latitude and degrees of temperature are different measurements.</i></p> <p>Show slide 8.</p> <p>Now let's look at the World Map Record Page I passed out earlier. You and your partner should have two copies of this</p>	<p>The headings are "City and Country," "Latitude," "January Temperatures," and "July Temperatures."</p> <p>The table shows temperatures in different places around the world for January and July.</p> <p>There are latitude numbers for each location with an N or an S.</p> <p>N stands for "North," and S stands for "South." They mean north or south of the equator.</p> <p>Some of the numbers are high in January. I don't understand that.</p>	<p>Are degrees of latitude and degrees of temperature the same?</p> <p>What do N and S mean?</p> <p>Tell me more about the high numbers in January.</p>

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			<p>map. Add “January” at the top of the first map after the words “Temperatures during.” And on the second map, add “July” after the words “Temperatures during.”</p> <p>Why do you think we need two different maps?</p> <p>Where will you find the temperature data you need to complete each map?</p> <p>Show slide 9.</p> <p>Pairs: Work with your partner to find the January and July temperature data for each location on the data table and record it on each world map.</p> <p>Write the temperature of each location either above or below the name on the map so you can see it clearly. Make sure you write the temperatures on the correct maps for January and July.</p> <p>As you add the temperature data to your maps, pay attention to the <i>latitude</i> of each location and look for <i>patterns</i> in the data. After the activity, we’ll talk about the patterns you observed.</p> <p>NOTE TO TEACHER: <i>As you circulate around the classroom, help students relate the data table to the world maps. These</i></p>	<p>Because some temperatures are for January, and some are for July. They aren’t the same.</p> <p>The temperatures are on the data table.</p>	

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			<p><i>two content representations contain the same data but present it in different ways. The maps add an important dimension—the location of each city related to the equator—that will help students visualize the data as it relates to temperature patterns around the world. The map of average world temperatures and using an inflatable globe can also help them visualize these patterns.</i></p> <p><i>The focus of this lesson is temperature patterns at different latitudes around the world. In the next lesson, students will look for temperature patterns at different times of the year. Concepts and content representations have been layered in these lessons to expand student understandings of temperature patterns.</i></p>		
5 min	<p>Follow-Up to Activity</p> <p>Synopsis: Students share the temperature patterns they observed at different latitudes.</p> <p>Main science idea(s):</p> <ul style="list-style-type: none"> • There is a relationship between latitude and temperature patterns on Earth. 	<p>Highlight key science ideas and focus question throughout.</p> <p>Engage students in analyzing and</p>	<p>Show slide 10.</p> <p>Let’s return to our focus question, <i>What temperature patterns can you find on Earth at different latitudes?</i></p> <p>What types of patterns were you and your partner looking for in the data?</p> <p>NOTE TO TEACHER: <i>Keep the focus of this discussion on the relationship between temperature and latitude rather than time of year (which is the focus of lesson 1b).</i></p> <p>So what temperature patterns did you notice in the data you recorded on your world maps? Give examples of specific</p>	<p>We were looking for temperature patterns at different latitudes.</p>	<p>Tell me more about the relationship between temperature patterns and latitude.</p> <p>Who can add to this idea?</p>

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		interpreting data and observations.	<p>locations.</p> <p>What do you think latitude has to do with the temperature patterns you observed?</p>	<p>We noticed different temperature patterns at different times of the year.</p> <p>The temperatures in Alaska are really cold.</p> <p>Temperatures are higher closer to the equator.</p>	<p>What do you mean by “patterns at different times of the year”? Can you give an example?</p> <p>What do you mean by “higher”? <i>[Encourage students to use words like warmer or cooler rather than higher or lower.]</i></p> <p>Can anyone add to that idea?</p>
10 min	<p>Synthesize/Summarize Today’s Lesson</p> <p>Synopsis: Students complete two sentences that summarize their ideas about temperature patterns related to latitude and distance from the equator.</p> <p>Main science idea(s):</p> <ul style="list-style-type: none"> • Temperatures vary 	Engage students in making connections by synthesizing and summarizing key science ideas.	<p>Show slide 11.</p> <p>To summarize what we’ve learned so far about temperature patterns and latitude, let’s compare data from four different locations around the world.</p> <p>NOTE TO TEACHER: <i>In addition to reviewing ideas about temperature and latitude, this phase previews science concepts regarding temperature and time of year that will be explored in lesson 1b.</i></p>		

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	<p>slightly near the equator, but farther away from the equator, temperatures vary significantly.</p>		<p>Take out your world maps for January and July and look at the temperature data for Lagos, Nigeria, and Jakarta, Indonesia, on your maps. Pay close attention to the latitude, or where each place is located.</p> <p>What do you notice about the temperatures in these locations in January and July?</p> <p>Now look at the temperature data and latitudes for Nome, Alaska, and Rothera Point, Antarctica, on both maps.</p> <p>What do you notice about the temperatures in these locations in January and July?</p> <p>Show slide 12.</p> <p>Using the temperature data for these four locations, think about this question: <i>What patterns do you observe in the January and July temperature data when a location is close to the equator or farther away from the equator?</i></p> <p>Work independently to complete these sentences in your science notebooks:</p> <ul style="list-style-type: none"> • The pattern I observe in January is _____. • The pattern I observe in July is _____. <p>We'll share our observations at the beginning of the next lesson.</p>	<p>The temperatures are almost the same.</p> <p>The temperatures aren't the same.</p>	<p>Does anyone agree or disagree?</p> <p>Say more about why you disagree.</p>

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1 min	<p>Link to Next Lesson</p> <p>Synopsis: The teacher previews the next lesson.</p>	Link science ideas to other science ideas.	<p>Show slide 13.</p> <p>Today we explored how latitude influences temperature patterns around the world. To help us see these patterns, we used a data table and world maps.</p> <p>Next time, we'll use bar graphs to help us see patterns in our temperature data more clearly. We'll also investigate how the time of year influences temperature patterns.</p>		