The Sun's Effect on Climate and Seasons
Lesson 1: Temperature and Latitude

Grade: 5	Length of lesson: 85 minutes	Placement of lesson: 1 of 6 lessons
Anchoring Phenomenon: Earth's Northern and Southern Hemispheres experience repeating, predictable seasonal changes in average temperatures.		
Unit Learning Goal: Earth's curved surface and consistent tilt and its orbit around the Sun result in uneven heating across the planet. This difference in the sunlight's intensity causes different locations on Earth to experience different seasons at the same time of year as well as varying average yearly temperatures.		
Lesson Main Learning Goal: Temperatures on Earth's surface vary according to latitude (how far north or south a location is from the equator) and time of year. **Science and Engineering Practice:** Analyzing and Interpreting Data: Analyze and interpret data to provide evidence for phenomena. **Crosscutting Concept:** Patterns: Graphs and charts can be used to identify patterns in data.		
Unit Central Question: Why are some places on Earth hotter than others at different times of the year?		**Lesson Focus Question:** What patterns in temperature can you find on Earth at different times of the year?
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, average temperatures on Earth generally increase as the latitude decreases (from the poles toward the equator) and generally decrease as the latitude increases (from the equator toward the poles). Related to time of year, average temperatures are higher in the Northern Hemisphere from about June through September and higher in the Southern Hemisphere from about December through March. There are patterns of temperatures on Earth related to latitude and time of year. As you get closer to the equator, temperatures are typically higher and it feels warmer. As you get closer to the poles, temperatures are typically lower and it feels cooler. When temperatures are higher in the Northern Hemisphere, they are lower in the Southern Hemisphere and vice versa. The surface of Earth is heated unevenly; therefore, temperatures vary by latitude and time of year.		
Ideal student response to the Lesson Focus Question: There is a pattern of temperatures on Earth related to latitude (a location's distance north or south from the equator) and time of year. As you get closer to the equator, temperatures are typically higher and it feels warmer. As you get closer to the poles, temperatures are typically lower and it feels cooler. In July, temperatures are higher in the Northern Hemisphere and lower in the Southern Hemisphere. In January, the temperatures are opposite—higher in the Southern Hemisphere and lower in the Northern Hemisphere. Temperatures are not the same at all latitudes and vary significantly at different times of the year.		

Preparation

MATERIALS NEEDED	AHEAD OF TIME
Sun's Effect on Climate and Seasons PowerPoint (by lesson) **Student Handouts** • HO1.1 *Map of United States with Average Temperatures, Dec–Feb* (1 per student) • HO1.2 *Map of United States with Average Temperatures, Jun–Aug* (1 per student) • HO1.3 *Average Temperatures around the World January and July* (1 per pair of students) • HO1.4 *World Map Record Page* (2 per pair of students) • HO1.5 *Bar Graph of January Temperatures* (1 per student) • HO1.6 *Bar Graph of July Temperatures* (1 per student) **Other Materials** • Communicating in Scientific Ways chart • 3" × 3" sticky notes (a few per student) • fine-point Sharpie marker (1 per student) • inflatable globe (1 per pair and 1 for teacher) • **optional:** • Chart paper • Markers • Teacher copy of HO1.4, HO1.5, and HO1.6 for display and reference	• Review the information about the Sun's effect on climate pages 1-7 in the *Content Background* document. • Prepare all handouts. • Prior to beginning this unit, you will want to make sure that your students have a good mental image of the following ideas. 1. The Sun is at the center of our solar system. 2. Earth revolves (orbits) around the Sun every 365 days, which creates our year.

Lesson 1 General Outline

Time	Phase of lesson	How the science content storyline develops
7 min	**Introduction:** Teacher introduces the Unit Central Question: *Why are some places on Earth hotter than others at different times of the year?*	The Sun is important to life on Earth. It provides light and warms Earth.
10 min	**Lesson Focus Question:** Teacher introduces Lesson Focus Question: *What patterns in temperature can you find on Earth at different times of the year?*	
10 min	**Setup for Activity:** Students review the Lesson Focus Question and set up their *World Map Record Pages* using data from the Average Temperatures around the World January and July data table.	In general, temperatures on Earth vary according to latitude and time of year.
15 min	**Activity:** Students analyze data from new content representations—bar graphs of temperature data—to document patterns in temperature in different locations and at different times of the year.	Related to latitude, average temperatures on Earth generally increase as the latitude decreases (from the poles toward the equator) and generally decrease as the latitude increases (from the equator toward the poles). Related to time of year, average temperatures are higher in the Northern Hemisphere from about June through September and higher in the Southern Hemisphere from about December through March.
30 min	**Follow-up to Activity:** Students share the patterns in temperature they discovered by using the content representations. They relate those patterns to the key science ideas captured in the Lesson Focus Question.	There are patterns of temperatures on Earth related to latitude and time of year. As you get closer to the equator, temperatures are typically higher and it feels warmer. As you get closer to the poles, temperatures are typically lower and it feels cooler. When temperatures are higher in the Northern Hemisphere, they are lower in the Southern Hemisphere and vice versa.
12 min	**Summarize and Synthesize:** Students write two patterns they think are most important in describing temperatures on Earth. Then, the teacher summarizes the key science ideas from the lesson. Revisit students' wonderings to find out if any of their questions were answered.	Average temperatures vary by latitude and by time of year.
1 min	**Link to Next Lesson:** Teacher links science ideas to the next lesson.	

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
7 min	**Introduction: Unit Central Question** Synopsis: Teacher introduces the Unit Central Question: *Why are some places on Earth hotter than others at different times of the year?* Main Science Idea: The Sun is important to life on Earth. It provides light and warms Earth.	Ask questions to elicit student ideas and predictions.	Today, we begin a unit about the Sun's effect on Earth's climate and seasons. Why is the Sun important to life on Earth? ***NOTE TO TEACHER:*** *No need to probe students' understanding of how the Sun's light provides heat to Earth. This is beyond the scope of this unit.*	The Sun gives us light. The Sun makes us warm. We couldn't see without the Sun. The Sun has energy. **Can you say more about how you know the Sun has energy?** The Sun helps plants grow. We can heat things with solar energy.
		Highlight key science ideas.	*Highlight key ideas shared by students that are important to this unit and can be expected as prior knowledge.* ● **The Sun provides light (for us to see and for plants to grow).** (K-LS1, 2-LS2) ● **The Sun warms Earth.** (K-PS3) ● **Sunlight is one factor that influences weather.** (K-ESS2) ● **Light is evidence that energy is present.** (4-PS3) ● **The Sun is a star.** (5-ESS1) ***NOTE TO TEACHER:*** *As you probe students' thinking, make notes about students' misconceptions so you can probe and challenge those ideas throughout the lessons.*	

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
		Set the purpose with a focus question (in this case, the Unit Central Question).	In this unit, we will think about some important questions. One of those questions is our Unit Central Question: *Why are some places on Earth hotter than others at different times of the year?* ***NOTE TO TEACHER:*** *Record this question in a visible place (chalkboard or chart paper), allowing room below to record student thinking in the next step.* What do you think? Write your ideas in your notebook and be ready to share.  Give students time to think about the Unit Central Question and write their ideas in their science notebook before they respond aloud. Then listen to students' ideas. What's visible about student thinking? ***NOTE TO TEACHER:*** *Keep this discussion brief. Use it to make students' thinking visible about the Sun's effect on Earth and uneven heating. Record the students' ideas in a visible place under the Unit Central Question so you can refer to them as students' ideas change.* This is the question we will keep in front of us as we complete our lessons.	Some places get more sunlight than others. **Can you share an example of a place that gets more sunlight?** It's hotter in the desert. Some places only get summer. **Can you share an example of a place that only gets summer?** **What do others think?** It's hotter in the summer and colder in the winter. We are closer to the Sun in the summer. The Sun shines more in the summer than in the winter. **What do you mean "shines more"?**

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
			Transition: To help us answer our Unit Central Question, let's begin by looking for **patterns** in temperatures. Let's see if we can identify what places are hotter and what places are cooler at different times of the year.	
10 min	**Lesson Focus Question** Synopsis: Teacher introduces Lesson Focus Question: *What patterns in temperature can you find on Earth at different times of the year?*	Set the purpose with a focus question. Engage students in communicating in scientific ways.	In today's lesson, we will concentrate on this focus question: *What patterns in temperature can you find on Earth at different times of the year?* ***NOTE TO TEACHER:*** *Write the Lesson Focus Question on the board or on chart paper so you and the students can refer to it often throughout the lesson. Leave space so all the lessons' questions can be added over the course of the unit.* To begin thinking about our focus question, let's look at our Communicating in Scientific Ways chart and use some sentence stems to help us. ***NOTE TO TEACHER:*** *Keep this discussion brief. Use it to make students' thinking visible about the Sun's effect on Earth and uneven heating. Record the students' ideas on the board or chart paper so you can refer to them as students' ideas change.* *Choose from the options below depending on whether students are familiar with the strategy.* Option 1: Today we'll use these four things that scientists do--#2 Observe, #3 Organize data and observations; look for patterns, #6 Listen to others' ideas and ask clarifying questions, and #7 Agree or disagree with others' ideas; add onto someone	Option 1 Agree or disagree and piggyback is easy for me.

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
			else's ideas. Take a moment and review the sentence starters for these four. Which ones are easy for you? Which are harder?	**What makes that easy for you?** "I see" is easy. "What is your evidence?" is one I don't use very much. **What might you need to do to use it more often?** **What makes this sentence starter important?** Evidence is important in science.
			<u>Option 2:</u> Which of the things that scientists do or the sentence starters do you think would be most helpful today? Choose one or two categories. ***NOTE TO TEACHER:*** *Gather a few ideas from the group. If appropriate, encourage students to try out a new or more-challenging sentence starter. Highlight the four categories on your classroom chart.*	<u>Option 2</u> Since we are looking for patterns, then the *organize data* category. Number 4. **What is number 4, and what would make it useful in answering our focus question today?**
		Select content representations and models matched to the learning goal.	*Display the* Map of United States with Average Temperatures, Dec–Feb in the PowerPoint. *Handout and refer to the similar student handout.* OK, now let's look at this map of the United States. What do you see? It should be something you can come up to the map and point to. This would be a good time to use the sentence starters "I see" or "I noticed".	I see that temperatures get warmer when you go from north to south in the United States. **How do you know the temperatures are warmer or cooler?** I noticed that temperatures get colder when you go up.

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
			NOTE TO TEACHER: *You may want to point out part of the title of the map (*Average Temperatures, Dec–Feb*) and the map legend.* *Display the* Map of United States with Average Temperatures, Jun–Aug in the Power Point. *Handout and refer to the similar student handout.* To continue thinking about our focus question, let's look at *this* map of the United States. What do you see? It should be something you can come up to the map and point to or point to on your handout. ***NOTE TO TEACHER:*** *You may want to point out part of the title of the map (*Average Temperatures, Jun–Aug*) and the map legend.* Do you notice any patterns? How would you describe the patterns that we see in temperature in the United States? Let's use the sentence starters in number 3, such as, "I see a pattern". ***NOTE TO TEACHER:*** *As students are verbally sharing patterns, record their ideas on the displayed map and link them by drawing an arrow from the statement to the location on the map or a circled area on the map.* *Encourage students to add their own ideas about patterns to their handouts. Remind them to draw a line or arrow from their idea and the location on the map.*	**What do you mean by "up"? Come show us on the map.** The pattern is that it gets warmer as you go south in the United States. **What do we mean by a "pattern"?** A pattern is like a check or a plaid. Or day and night is a pattern. **What do others think?** There's also a pattern when you go north—it gets cooler.

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
			Walk around the room and provide guidance as needed. Now look at both maps. Do you see any patterns that are on *both* maps? *Highlight a student(s) statement of the pattern in average temperatures in both summer and winter in the United States, for example,* In the United States, there is a pattern that the average temperatures usually are higher as we move from the northern states to the southern states. ***Transition:*** We've identified a pattern in temperatures in the United States, but our focus question is about patterns in temperatures on Earth. Next, we will look at temperatures all over the world and look for more patterns in temperature.	**What determines a pattern? What do these examples have in common?** A pattern is something that happens over and over. It is repeating. **Do you agree with [student]?** **What might this have to do with the Sun?** **Tell us more about differences in temperature.**

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
10 min	**Setup for Activity** Synopsis: Students review the Lesson Focus Question and set up their *World Map Record Pages* using data from the Average Temperatures around the World January and July data table. Main Science Idea: In general, temperatures on Earth vary according to latitude and time of year.	Highlight key science ideas and *focus question* throughout.	***NOTE TO TEACHER:*** *The goal of the setup for the activity is to prepare students to look for patterns using multiple forms of data.* If you lived in a different part of the world, would going south always mean that you would find higher average temperatures? Can you think of a place in the world where going south would not mean higher average temperatures ? All this relates to our Lesson Focus Question, *What patterns in temperature can you find on Earth at different times of the year?* Before we can answer this question, we need to get organized. Please write the focus question in your science notebook. Then, I would like you to circle the word "patterns". Notice that similar to our last question about average US temperatures, we are now looking for patterns in world temperature data. ***NOTE TO TEACHER:*** *Divide students into teams of two. Distribute the data table,* Average Temperatures around the World January and July *(1 copy per pair)* ***and*** *the* World Map Record Page *(2 copies per pair). On one copy of the map, they will record temperatures during January and on the other temperatures during July.*	If I went south to the South Pole, it would be really cold. **Tell us more about the South Pole and why you think it would be really cold.** Antarctica is south, and it's cold there, too. I'm not really sure why, but I know the poles are very cold.

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
		Make explicit links between science ideas and activities.	Let's look first at the data table of average temperatures around the world. What are the headings of the columns? What information does this data table contain? ***NOTE TO TEACHER:*** *If students don't clearly understand* latitude*, wait to discuss it until they look at the world map. Latitude and longitude (not part of this lesson) serve as a grid system for people to locate places on Earth. It is not necessary to explain to students how latitude is calculated—that is beyond the scope of this lesson.* ***Help students distinguish between degrees of latitude and degrees of temperature*** *as they add the temperature data to their maps. For example, you might ask,* "You see that the latitude at the equator is 0°. Is the temperature at the equator 0°?" *Students are likely to know that isn't the case; the same would be true at the poles. Keep reminding them that degrees of latitude and degrees in temperature are not measuring the same thing. Call out that the data table shows average temperatures, not the temperature of a single day.*	The headings are "City and country", "Latitude", and the temperatures in January and July. **What does *latitude* mean?** It will help us see temperatures in different places. Latitude numbers are either N or S. **What does "N or S" mean?** N means North of equator and S means South of equator. **Notice that the data table shows average temperatures. What is an *average*?** In math we add all the numbers up and divide by how many numbers there are to get the average. **For these data, what numbers would be added up and what would you divide by to get the average?** **Why might this be important?** Well, I guess one temperature only tells us about a day; but an average temperature tells us more about weather over more time. **Does anyone know what we call average weather over a long period of time?** Yes, climate.

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
			Now, let's look at the *World Map Record Pages*. Label one map "Temperatures during *January*" and the other map "Temperatures during *July*." Where will you find the temperature data you need to complete the map? As you add these temperature data to your maps, I want you to pay attention to how the latitude of each city's location is related to the temperature. ***NOTE TO TEACHER:*** *Circulate around the classroom and help students relate the data table and world maps. The two content representations contain the same data about locations of the cities, but they present the data in different ways. The maps add an important dimension—the location of each city related to the equator—to help students visualize the data as they relate to patterns of temperature around the world. The map of average world temperatures can also help them think about these patterns. Additionally, display or make available the inflatable student globes which will be used later in the lesson.*	The temperatures are in the data table. Some are for January, and some are for July. They are not the same.
15 min	**Activity** Synopsis: Students analyze data from new content representations—bar graphs of temperature data—to document patterns in temperature in different	Highlight key science ideas and *focus question* throughout.	Once again, let's look at our Lesson Focus Question: *What patterns in temperature can you find on Earth at different times of the year?* What patterns have we been looking for so far?	We have been looking for patterns about latitude and temperature. **Say more about patterns related to temperature and latitude.**

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
	locations and at different times of the year. <u>Main Science Ideas</u> Related to latitude, average temperatures on Earth generally increase as the latitude decreases (from the poles toward the equator) and generally decrease as the latitude increases (from the equator toward the poles). Related to time of year, average temperatures are higher in the Northern Hemisphere from about June through September and higher in the Southern Hemisphere from about December through March.	Select content representations matched to the learning goal.	Now you will work with your partner as we look at the same data in a slightly different way—by using *bar graphs* of the temperature data related to latitude. First, look at your data table and world maps. Let's locate and highlight the equator on our maps. Where is the equator—at what degree of latitude? Yes, 0° latitude. ***NOTE TO TEACHER:*** *By marking the equator, students might see the patterns in temperature variations north and south more easily. After you distribute the bar graphs (*Bar Graph of January Temperatures *and* Bar Graph of July Temperatures*) help students orient themselves to the new content representation. Help them to see that all three representations—the maps, the data table, and the bar graphs—use the same data but organize and display them in different ways. You might post the Teacher Copies of representations on the board so you can point out which one you refer to at different points in the activity.*	There might be patterns about temperature at different locations in the world or different latitudes. **Who can add to [student's] idea?** **What do you mean by patterns at different times of the year?**

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
		Make explicit links between science ideas and activities.	Let's look first at the bar graph of January temperatures. a. What do the bars represent?	The bars show how hot or cold it is.
			b. What labels are on the *x*- and *y*-axes?	The *x*-axis has the degrees of latitude. The *y*-axis shows the temperature.
			c. How do the bars on the graph relate to the temperatures you wrote on the world maps?	They are the same. **Can you point to a temperature that's the same between the graph and the map?**
		Engage students in analyzing and interpreting data and observations.	Now consider everything in your collection of data sources. Take a few minutes to talk with your partner about the data you have to help you answer our focus question for today. What are some things you notice?	Alaska and Antarctica never really get warm – they are always pretty cold even though one is up north and the other way down south.
		Engage students in communicating in scientific ways.	***NOTE TO TEACHER:*** *Circulate around the room and listen to students' conversations. Once you feel students are comfortable with the content representations and understand how they relate to one another, invite them to find patterns in the data. Remind them to write down the patterns and draw a line or arrow to the graph where they see the pattern. Encourage them to use sentence starters such as these:*	**Where is it hotter in January? How do you know that?** Most of the southern areas, but it's the same temperature in Jakarta, Indonesia, in January and July. I don't understand that. **What do the bars have to do with latitude?**

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
			One pattern I noticed is …. *Another pattern I noticed is ….* *I see ….* Using these bar graphs, look for patterns in the data and then record them on your handouts. Find patterns in your comparison of the temperatures in January and July in various locations on Earth. For example, can you find patterns related to the Northern and Southern Hemispheres?	Each bar shows the average temperature of a certain latitude. **Can anyone add to that idea?** **Tell us what you are wondering about.** **How does that relate to latitude?** **Say more about why you are confused.**
30 min	**Follow-up to Activity** Synopsis: Students share the patterns in temperature they discovered by using the content representations. They relate those patterns to the key science ideas captured in the Lesson Focus Question. Main Science Ideas: There are patterns of temperatures on Earth related to latitude and time of year. As you get closer to the equator, temperatures are typically higher and it feels warmer. As you get closer to the poles, temperatures are typically lower and it feels cooler. When temperatures are	Engage students in communicating in scientific ways.	***NOTE TO TEACHER:*** *Refer to the* Bar Graph of January Temperatures *and* Bar Graph of July Temperatures *that you posted earlier or show the slide so all students can see them.* Let's share our ideas together in a whole-class discussion. What patterns do you see related to latitude and temperature at various places on Earth? Refer to your handouts where you wrote down the patterns you and your partner identified. ***NOTE TO TEACHER:*** *Call on a specific group or ask for a volunteer group.* Tell us about a pattern you noticed. Use a sentence starter from our CSW chart #3.	A pattern we noticed is it's hotter in July in the Northern Hemisphere and it's colder in July in the Southern Hemisphere. **What is your evidence that it is a pattern? What are your reasons for that statement?**

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
	higher in the Northern Hemisphere, they are lower in the Southern Hemisphere and vice versa.		Did any other team find the same pattern? Do you agree with the pattern that your classmates described? If not, why not? ***NOTE TO TEACHER:*** *If teams do not agree, engage students in a classroom dialogue by asking students to share the reasons for their explanations. Encourage them to use the data in their explanations. Then, using think-pair-share, ask teams of students to address the following questions, especially if students do not see these*	We used the July column on the World Map. It showed cities close to the same distance from equator in the North and South Hemisphere. We saw they were pretty much one high and one low. Another pattern is that it's hot by the equator and it's cold at the poles. **Tell us more about "by the equator" and "at the poles." Can you include the word *latitude* in your statement?** We noticed the pattern that the closer the latitude is to the equator, the warmer it is no matter what hemisphere. The same pattern for latitudes close to the poles, except they are colder. **Can you add to [student's] ideas?**

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
			patterns. If students need help developing their explanation, remind them of how to communicate in scientific ways. For example: I agree/disagree with [student name] because _____. Add your maps into you science notebook, and then, write all the patterns we have identified. Add any other patterns you noticed. Remember, you can use this sentence starter: *The patterns I noticed in the data were …* *1) ...* *2) ...* *3) ...* ***NOTE TO TEACHER:** Typical patterns identified by students include the following:* • *Cities closest to the equator in both the Northern and Southern hemispheres had higher average temperatures all year round.* • *As you move up or down from the equator, the average temperatures get lower and lower.* • *The highest temperatures in the US are in the south in both winter and summer.* • *Both the North and South pole areas stayed cold all year round.* *Consider increasing the clarity of statements to refer to the months of the year rather than "summer" or "winter" and average temperatures rather than "warmer" or "cooler".*	

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
		Highlight key science ideas and focus question throughout. Link science ideas to other science ideas.	***NOTE TO TEACHER:*** *As students talk about the patterns in data, hand student pairs the inflatable globes to visually describe the patterns on the globe and ask more-specific questions that relate to our Lesson Focus Question, such as the following:* a. What happens to the temperature if a city's location is closer to the equator?	Cities closer to the equator have higher temperatures. **How do you know? What is your evidence? What specific data support this pattern? Can you include the word *latitude* in your evidence? Is there a map, graph, or data table you can point to?**
			b. What happens to the temperature if a city's location is farther away from the equator?	Cities farther from the equator have lower temperatures.
			c. How do temperatures differ in January and July?	The temperatures seem backwards in different places in January and July. **What do you mean by "backwards"? What is your evidence? What data can you point to?** They are opposite. Some of the cities have summer while others are having winter. **When it's summer for us, what is the season in South America? Provide evidence to support your answer.**

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
				If I look at Charleston in July, the average temperature is 80, but in Rio de Janeiro, the average is just 33. So summer for us is winter for them.
			d. Are those patterns the same in all of the Northern Hemisphere and the Southern Hemisphere?	July is summer for the Northern Hemisphere, but it is winter for the Southern Hemisphere.
			Bring students back together for a brief whole-group discussion and ask the following questions: ● Which data representation was most helpful as you worked to identify the patterns in temperature? ● Which was least helpful? *Highlight the idea that how we represent data helps us identify patterns and make sense of the data.*	The map helped me. **What made it helpful?** I thought the data table was hard, but we needed it to add to our map. **Tell us more about that.**
			NOTE TO TEACHER: *Introduce the Driving Question Board (DQB). Review the* Anchor Lesson *reading in your STeLLA PD binder for additional guidance.* We are going to take some time to write down and share some questions you now have related to the data we studied and the patterns we identified. ***NOTE TO TEACHER:*** *Have students write their questions on sticky notes—one question per sticky note. They should write their questions big and bold—so everyone can see the questions clearly.*	

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
			Give students several minutes to populate their sticky notes with questions. *Fine-point Sharpie markers work well to make the questions bold enough to be viewed easily on the Driving Question Board.* *Next, begin the process of developing a shared Driving Question Board.* I bet we have a lot of really good questions. It is important that we hear everybody's questions, and we might find that we have questions similar to some of our classmates' questions. In order to help us organize our questions, we are going to create a Driving Question Board. We are going to use our DQB to guide our investigations into what is going on with these patterns in global average temperatures. ***NOTE TO TEACHER:*** *Explain to students how you will create the DQB. Instruct students to share their questions, one by one, with the whole group. Select a student who may not have as many sticky notes as others to read one of their questions aloud to the class then post it on the DQB. Students should raise their hand if they have a question that relates to the question that was just read aloud. The first student selects the next student whose hand is raised. The second student reads his or her question, says why or how it relates, and posts it near the question it most relates to on the DQB. That student selects the next student.*	

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
			Once there are no more related questions, ask if anyone has a question on a different topic. Select a student who should read their question out loud and then place it in a new location on the DQB to start a new group of related questions. Continue this until all science questions are on the board. If anyone thinks of a related question as you're putting together the board, they can capture that question on a sticky note and add it to the appropriate cluster.  Listen to students' ideas. What's visible about student thinking? ***NOTE TO TEACHER:*** *Be sure that students understand that "seasons" is a hemisphere-dependent concept and that not all places experience seasons similar to the United States (such as "cold winters" and "hot summers"). Some places are characterized by "rainy seasons" and "dry seasons". For the purposes of this lesson series, "winter" and "summer" will refer to cold and warm times of the year, respectively.*	
12 min	**Summarize and Synthesize** Synopsis: Students write two patterns they think are most important in describing temperatures on Earth. Then,	Engage students in synthesizing and summarizing	We have looked at temperature patterns in January and July for cities around the world located closer to and farther from the equator. Refer to your list of patterns in your science notebook and answer this question in your	

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
	the teacher summarizes the key science ideas from the lesson. Revisit students' wonderings to find out if any of their questions were answered. <u>Main Science Idea</u> Average temperatures vary by latitude and by time of year.	key science ideas.	notebook: What pattern do you think is *most* important in describing the temperatures on Earth 1) in different locations (circle these ideas) or 2) at different times of the year (underline these ideas)? ***NOTE TO TEACHER:*** *If time allows, invite students to share their summaries. Then, close the lesson with a summary of the key science ideas from the lesson. Use one of the inflatable globes as you describe the temperature patterns and science ideas. Be sure not to tilt the globe in any particular way to clue students into the idea of Earth's tilt. This will be covered in a later lesson, and introducing the idea by the way you hold the globe in this early lesson may distract students from the main science ideas in this lesson.*	
		Summarize key science ideas.	*While projecting the Power Point slide,* Map of Average World Temperatures*, summarize and record the important patterns and science ideas from today's lesson:* ● *Temperatures on Earth are generally warmer in locations closer to the equator.* ● *Temperatures decrease as the latitude increases—as we move away from the equator either north or south.* ● *Temperatures are not the same at all latitudes, especially at different times of the year. For example, temperatures are higher in the*	

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
		Engage students in communicating in scientific ways.	*Northern Hemisphere during July and higher in the Southern Hemisphere in January.* ***NOTE TO TEACHER:*** *It is important to record and keep the Lesson 1 Summary of Science Ideas chart as it will be referred to in Lesson 2.* *Ask the following questions to emphasize other important ways that scientists think:* ● How did looking for patterns help you today? ● How did using the sentence starters help you?	
1 min	**Link to Next Lesson** Synopsis: Teacher links science ideas to the next lesson.	Link science ideas to other science ideas (next lesson).	***NOTE TO TEACHER:*** *The focus question for the next lesson is "What causes the average temperatures on Earth near the equator to be higher than the average temperatures on Earth far from the equator?" It's likely that this question will appear in some form on the DQB. Refer to it or a related question or cluster of questions.* I notice that questions about why average temperatures are higher closer to the equator are part of our Driving Question Board *(pull off an example sticky note)*. Next time, we will explore that idea: Why are temperatures higher as we get closer to the equator and lower as we move away from the equator? *If the next lesson's focus question does not appear on the DQB, say something like the following:* As we have talked about the patterns in temperature that exist on Earth, have you	

Time	Phase of lesson and how the science content storyline develops	STeLLA strategy	Teacher talk and questions	Possible student and teacher dialogue
			wondered *why* temperatures are higher closer to the equator? Next time, we will explore that idea: Why are temperatures higher as we get closer to the equator and lower as we move away from the equator?	

BSCS SCIENCE LEARNING
Transforming Science Education Through Research-Driven Innovation

Lesson 1
The Sun's Effect on Climate and Seasons

1

The Sun's Effect on Climate and Seasons

Today, we will begin a unit about the Sun's effect on Earth's climate and seasons.

Why is the Sun important to life on Earth?

2

Unit Central Question

Why are some places on Earth hotter than others at different times of the year?

3

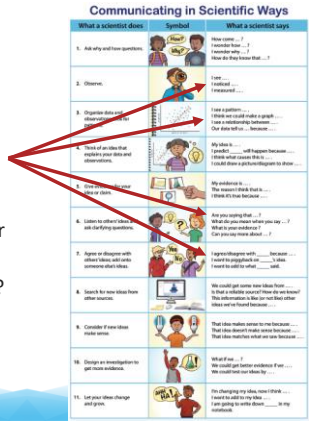
Lesson 1 Focus Question

What patterns in temperature can you find on Earth at different times of the year?

4

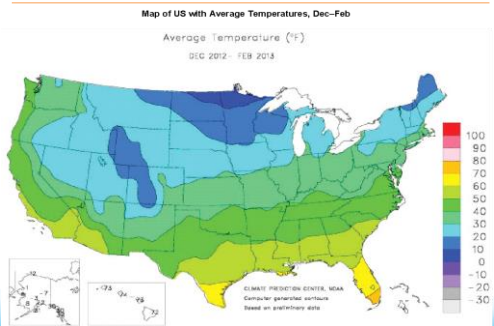
We will use these sentence starters today.

- Which are easy for you to use?
- Which are harder?



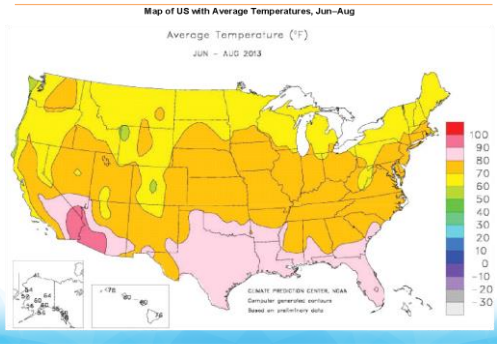
5

What patterns in temperature can you find on Earth at different times of the year?



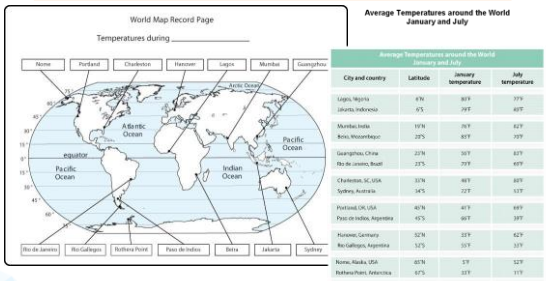
6

What patterns in temperature can you find on Earth at different times of the year?



7

What patterns in temperature can you find on Earth at different times of the year?



8

What patterns in temperature can you find on Earth at different times of the year?

With your partner, record on the *World Map Record Pages* the temperature for each city.

- Make sure you write temperatures for January on the map labeled "January" and temperatures for July on the map labeled "July".

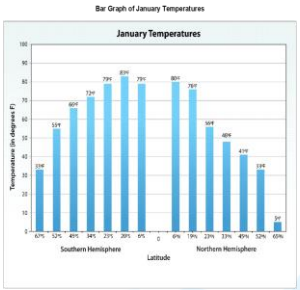
Notice the latitude of each city as you add the temperature.

9

What patterns in temperature can you find on Earth at different times of the year?

Mark the equator on your maps.

- The equator is at what degree of latitude?
- Where do you see the latitude of the equator on this bar graph?

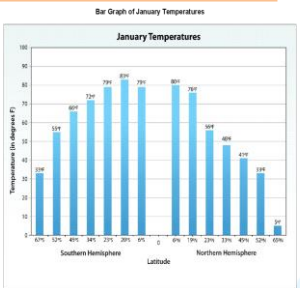


10

What patterns in temperature can you find on Earth at different times of the year?

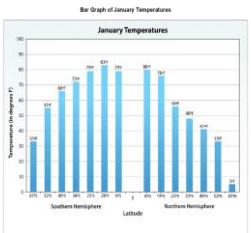
Let's make sense of our bar graphs.

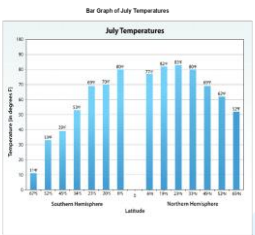
- What do the bars represent?
- What labels are on the *x*- and *y*-axes?
- How do the bars relate to the temperatures you wrote on the *World Map Record Pages*?



11

What patterns in temperature can you find on Earth at different times of the year?





12

What patterns in temperature can you find on Earth at different times of the year?

What patterns do you observe on the bar graphs of January and July temperatures?

- Write the patterns in your science notebook.
- Can you find patterns related to the month of the year—January versus July?
- Can you identify patterns related to the Northern and Southern Hemispheres?

Use all your data sources to look for patterns.

13

What patterns in temperature can you find on Earth at different times of the year?

Let's share our ideas.

Tell us one pattern you noticed related to latitude and temperature at various places on Earth.

Did any other team find the same pattern?
Do you agree with the pattern your classmates described?
If not, why not?

14

Summary: What patterns in temperature can you find on Earth at different times of the year?

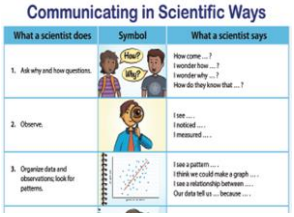
In your science notebook, write all the patterns we identify. Remember, you can use this sentence starter:

The patterns I noticed in the data were …

1) …

2) …

3) …



15

Summary: What patterns in temperature can you find on Earth at different times of the year?

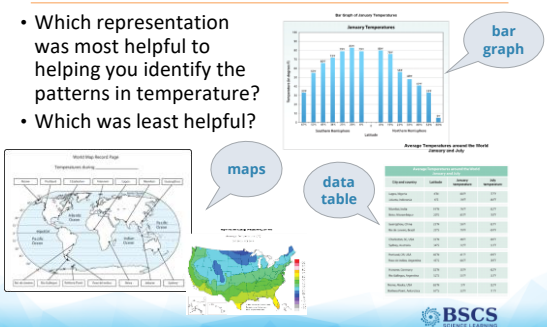
Did you notice these patterns?

- What happens to the temperature if a city's location is closer to the equator?
- What happens to the temperature if a city's location is farther away from the equator?
- How do temperatures differ in January and July?
- Are those patterns the same in the Northern Hemisphere and the Southern Hemisphere?

16

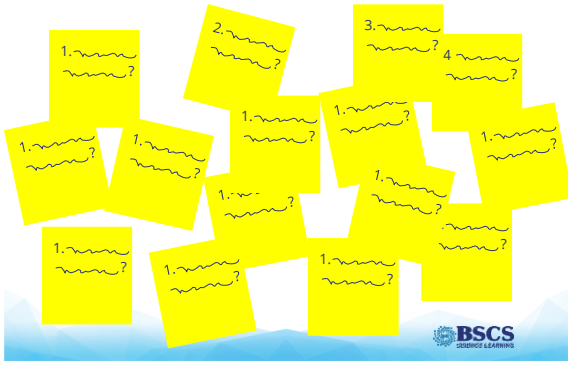
Summary: What patterns in temperature can you find on Earth at different times of the year?

- Which representation was most helpful to helping you identify the patterns in temperature?
- Which was least helpful?



17

Introducing the Driving Question Board (DQB)



18

Summarizing Key Science Ideas

Refer to your list of patterns in your science notebook and answer this question:

What pattern do you think is *most* important in describing the temperature on Earth …

1) in different locations (circle these ideas) or
2) at different times of the year (underline these ideas)?

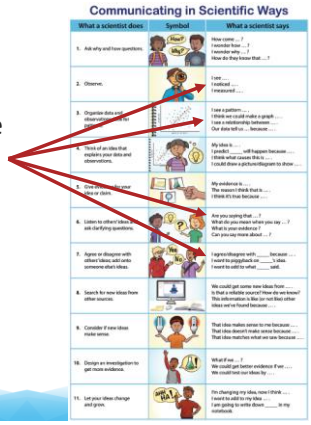
19

Lesson Summary: Key Science Ideas

- Temperatures on Earth are generally warmer in locations closer to the equator.
- Temperatures decrease as the latitude increases—as we move away from the equator either north or south.
- Temperatures are not the same at all latitudes, especially at different times of the year. For example, temperatures are higher in the Northern Hemisphere during July and higher in the Southern Hemisphere in January.

20

How did using the sentence starters help you?



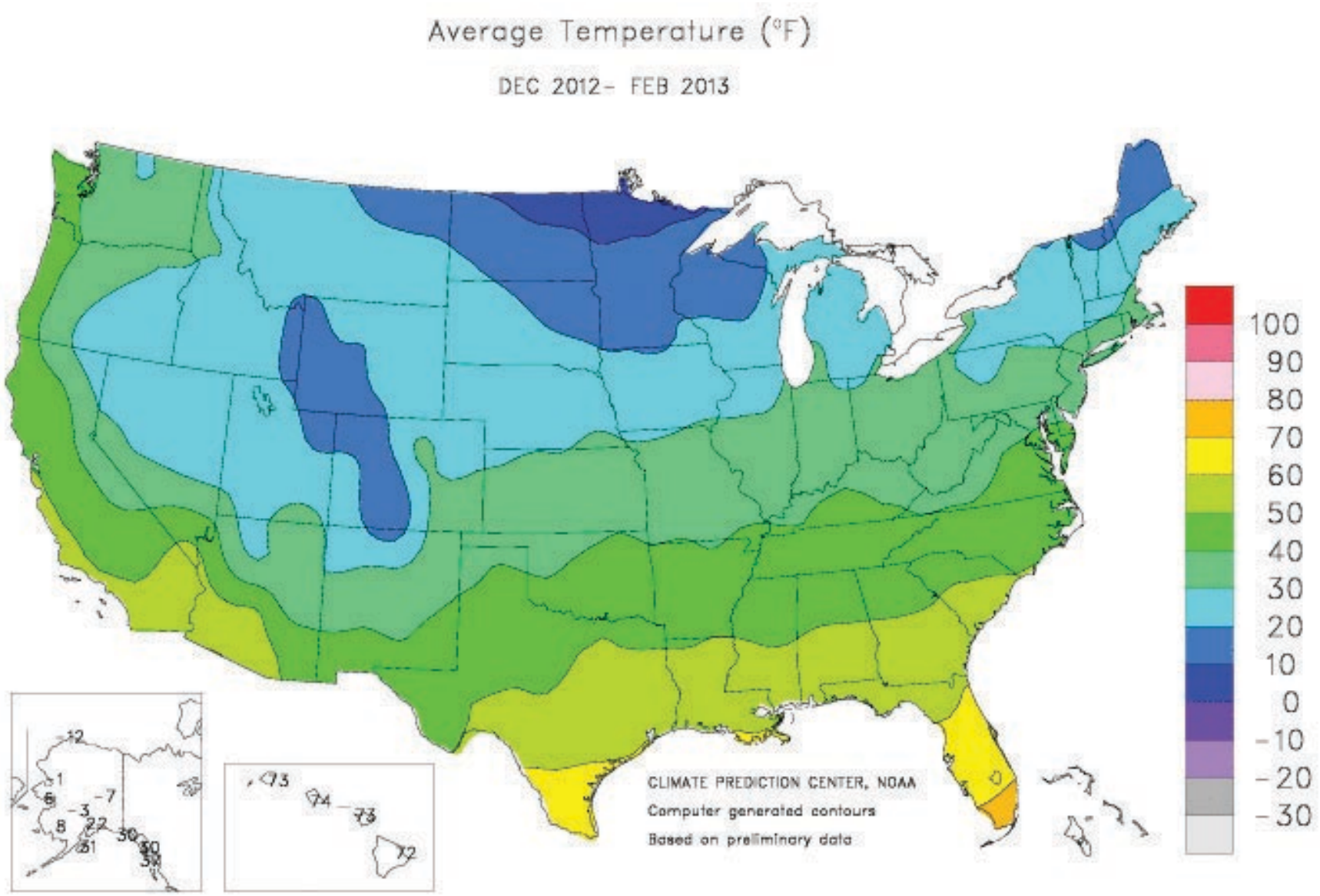
21

In the next lesson, you will think about …

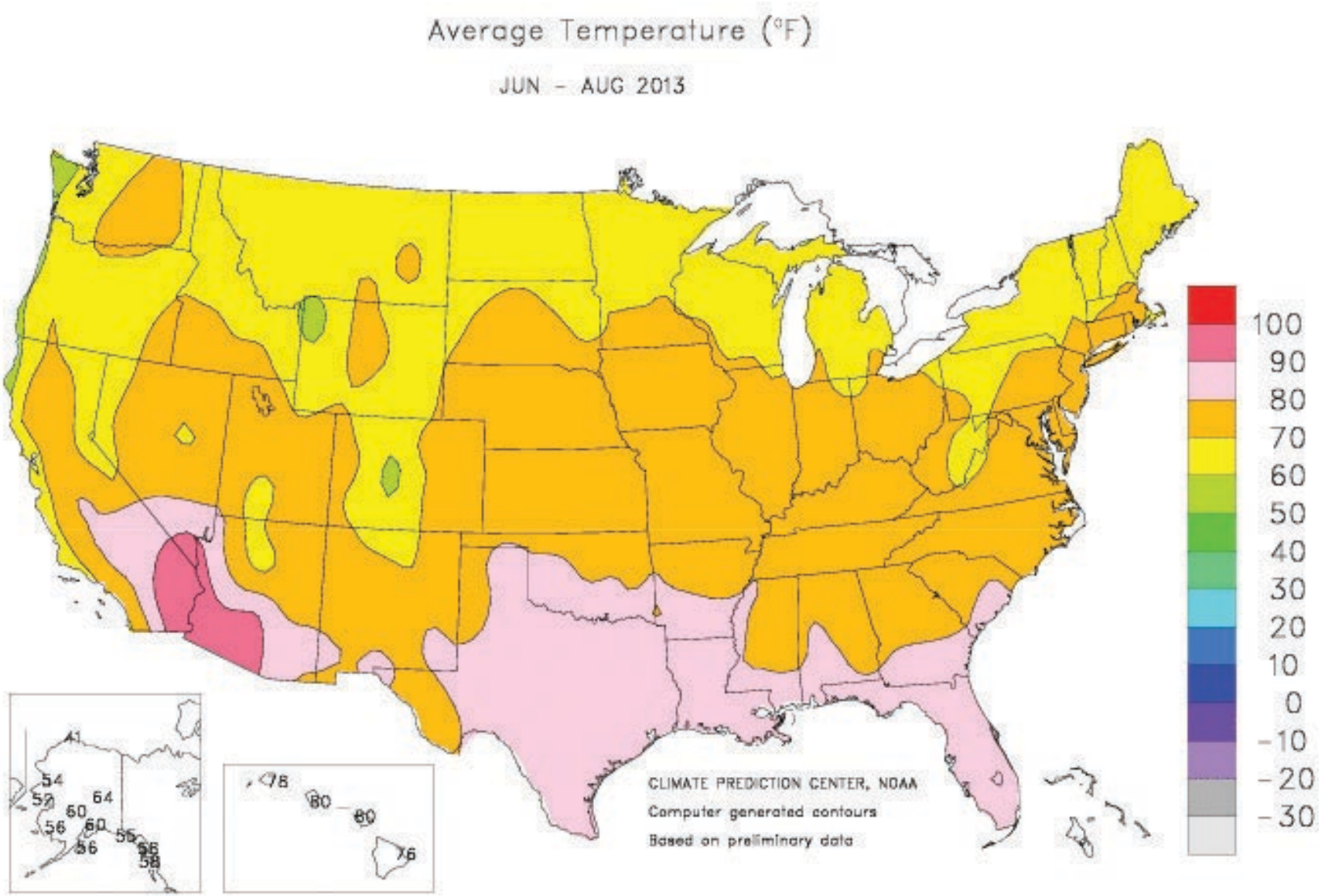
What causes the average temperatures on Earth near the equator to be higher than the average temperatures on Earth far from the equator?

22

Map of United States with Average Temperatures, Dec–Feb

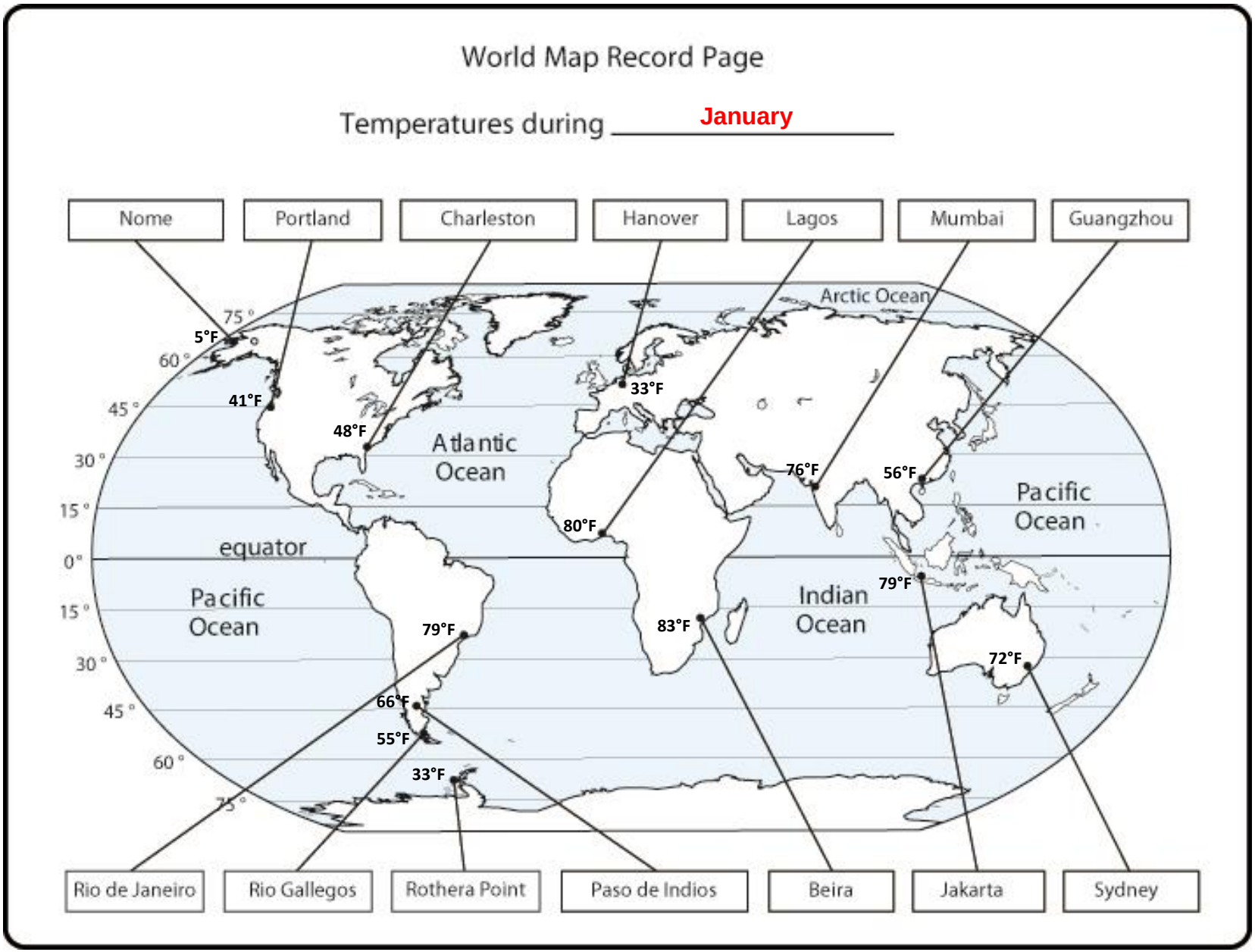


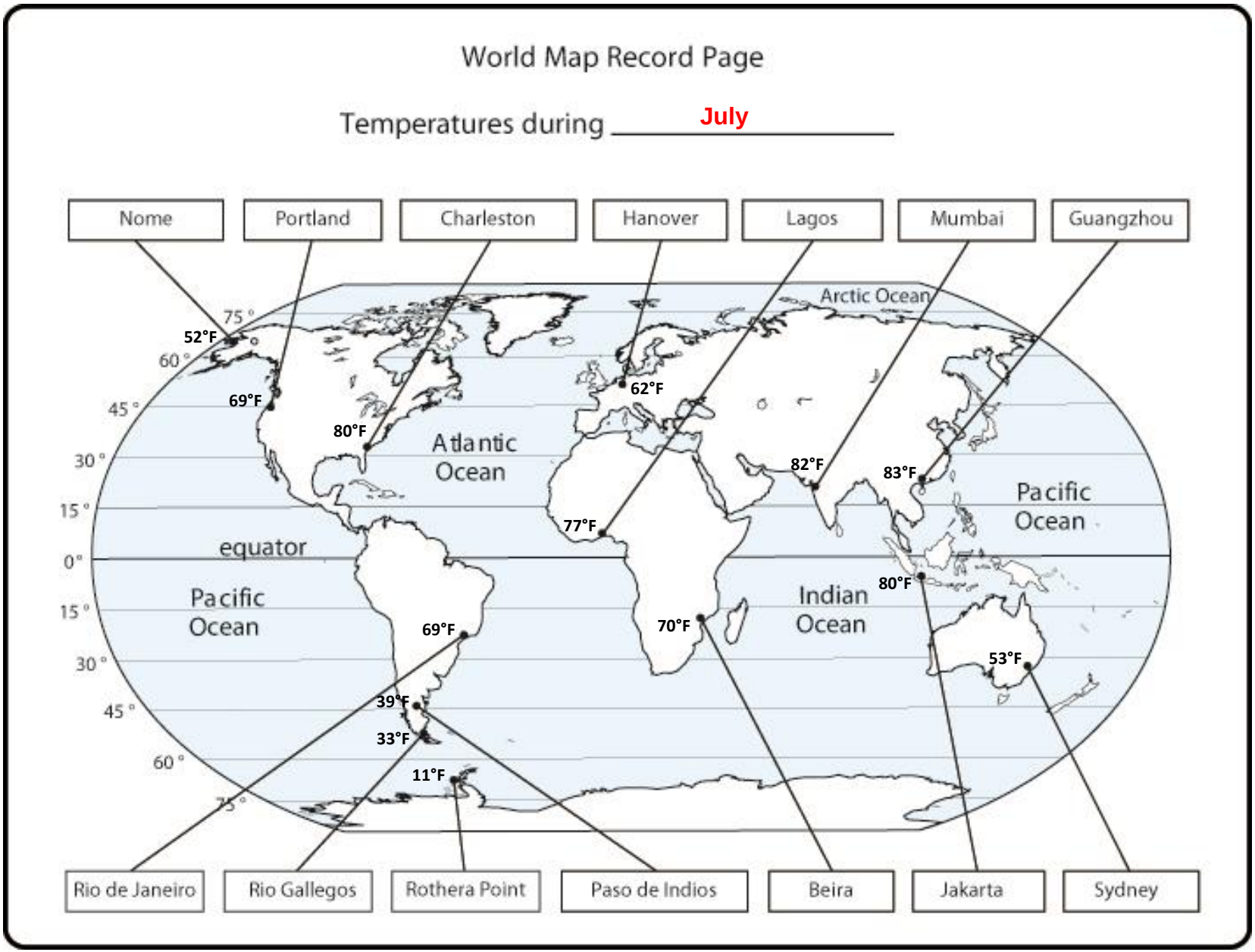
Map of United States with Average Temperatures, Jun–Aug



Average Temperatures around the World
January and July

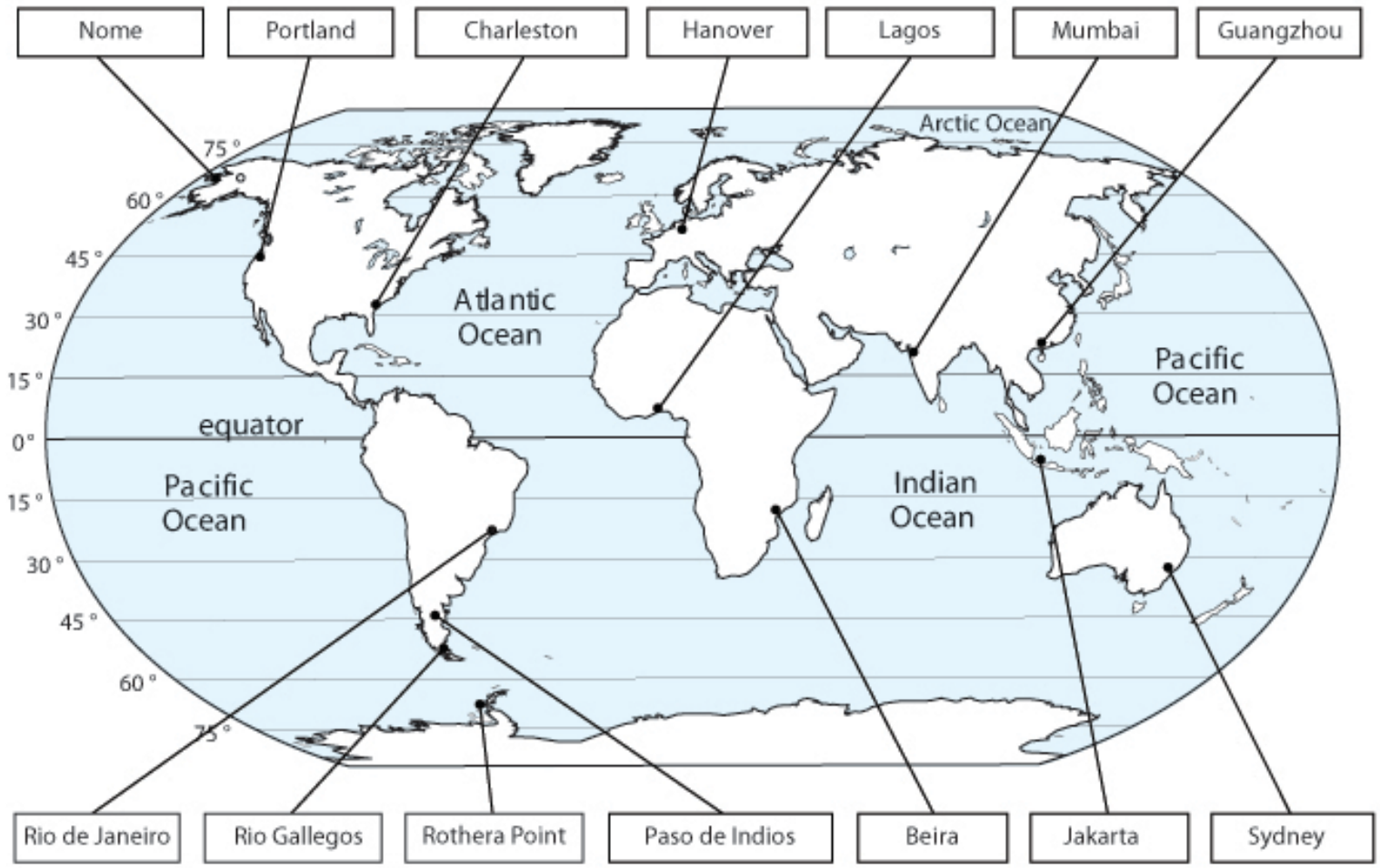
Average Temperatures around the World January and July			
City and country	**Latitude**	**January temperature**	**July temperature**
Lagos, Nigeria	6˚N	80˚F	77˚F
Jakarta, Indonesia	6˚S	79˚F	80˚F
Mumbai, India	19˚N	76˚F	82˚F
Beira, Mozambique	20˚S	83˚F	70˚F
Guangzhou, China	23˚N	56˚F	83˚F
Rio de Janeiro, Brazil	23˚S	79˚F	69˚F
Charleston, SC, USA	33˚N	48˚F	80˚F
Sydney, Australia	34˚S	72˚F	53˚F
Portland, OR, USA	45˚N	41˚F	69˚F
Paso de Indios, Argentina	45˚S	66˚F	39˚F
Hanover, Germany	52˚N	33˚F	62˚F
Rio Gallegos, Argentina	52˚S	55˚F	33˚F
Nome, Alaska, USA	65˚N	5˚F	52˚F
Rothera Point, Antarctica	67˚S	33˚F	11˚F



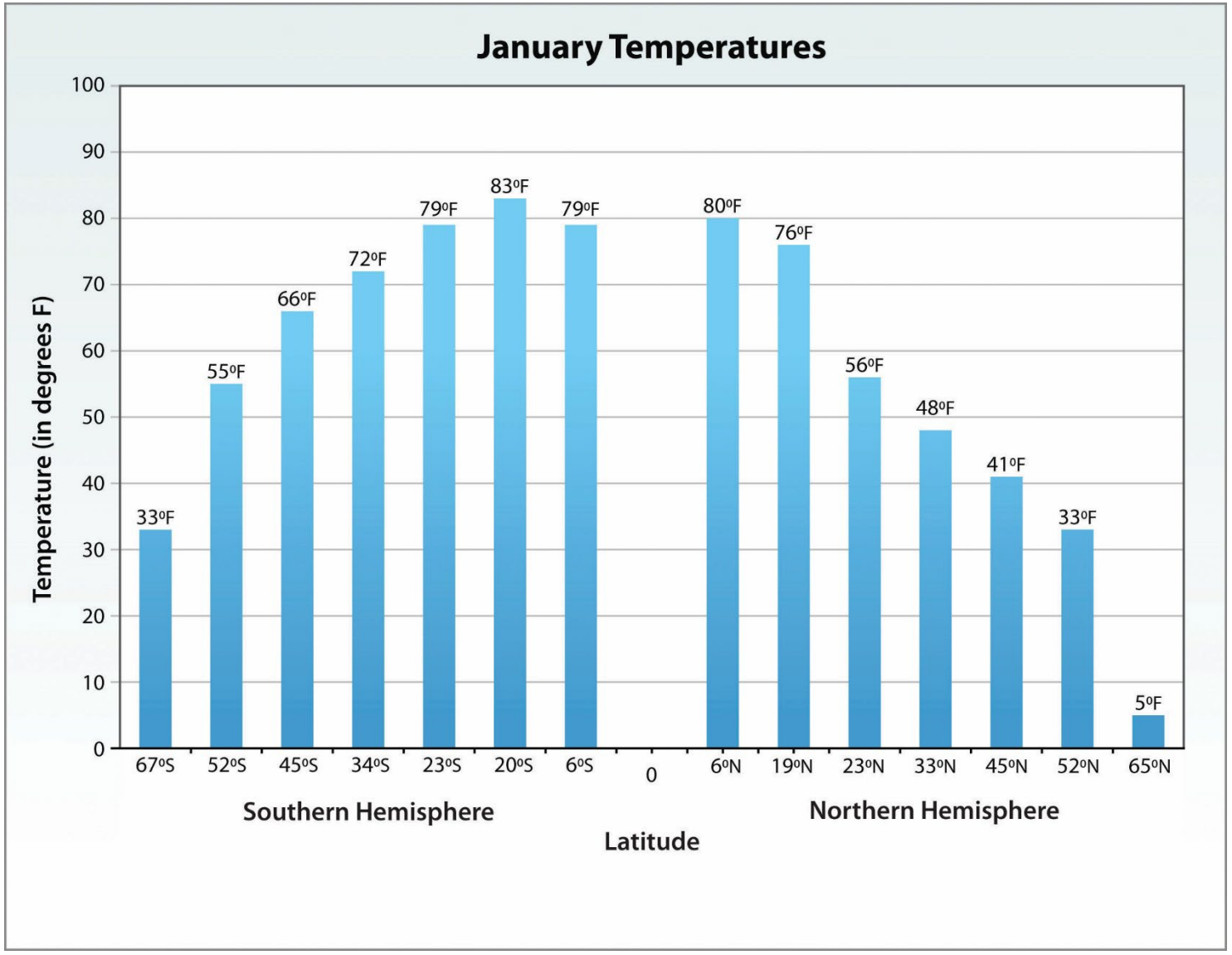


World Map Record Page

Temperatures during _____



Bar Graph of January Temperatures



Bar Graph of July Temperatures