ANALYSIS GUIDE D:
SELECT CONTENT REPRESENTATIONS and MODELS MATCHED TO THE LEARNING GOAL

Record the main learning goal in the space below.

Describe the content representation or model in the space below.

Is the content representation or model …	YES	NO
1. Scientifically accurate?		
2. Closely matched to the main learning goal?		
3. Presenting science ideas in ways that are comprehensible to students?		
4. Reinforcing or introducing student misconceptions?		
5. Addressing common student misconceptions?		
6. Distracting students from the main learning goal with too many details or new terms?		

How can the content representation or model be improved to better match the learning goal?

How will you help students understand how the content representation or model relates to phenomena or ideas being studied? How will students make sense of the strengths and limitations of the content representation or model?

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Teacher/Video	Schilling_mnstl_gr8_SEC_L3_C1-3
Content Area	Sun's Effect on Climate and Seasons
STeLLA Strategy	Strategy 6: Engage students in developing and using content representations and models
Context	Lesson 3 of 7. The clip has three segments in which students use their prior knowledge to manipulate a model to explain seasonal temperature patters. A small group gets confused as they are not able to use the model to explain these patterns. The last segment shows the whole group discussion after a small group shared their ideas about "flipping the tilt" during Earth's orbit.

Clip 1

00:00:01	T	So, show me where it would look like-
00:00:03	SN	Sum-
00:00:04	T	summer in the Northern Hemisphere.
00:00:07	SN/SN/T	What? / Summer? / Where would it look like if it's summer?
00:00:08	SN	Like that.
00:00:09	T	Just like that.
00:00:10	SN/SN/T	Yeah. / Mm-hm. / Okay. And so if it's summer there, what's- what does it look like for the Southern Hemisphere?
00:00:16	SN	It's colder or it's winter.
00:00:18	SN/T	Winter. / It's winter, so what can we say about the light? What's happening with the light? How- how do you know it's summer in the Northern Hemisphere and winter in the Southern Hemisphere?
00:00:27	SN	'Cause the light would be more-
00:00:28	SN/SN	Because- / There's more light in the Northern Hemisphere.
00:00:32	T	Okay, so there's more- you're saying more light. Caleb, what did you say?
00:00:35	SN	Like, the earth is tilted, so it can shine on there.
00:00:40	T	Okay, so the earth is tilted so it can shine on there? Riley, what were you going to say?

00:00:45	SN	Well, it's harder to reach the other side here.
00:00:47	T	Harder to reach- what do you mean by harder to reach the other side there?
00:00:49	S	It's probably can't, like, move across the world, so-
00:00:53	SN	Yeah. Light can't travel through it.
00:00:55	T	Well, it can travel through, but- but we're not showing the piece where this is also rotating, so is this side of the earth also going to get light?
00:01:03	SN	Yeah, and it's (inaudible).
00:01:06	T	Exactly. Exactly. So then-
00:01:08	SN	Like, this is-
00:01:09	T	show me where winter is.
00:01:10	SN	Right here.
00:01:11	T	Where- how does- how does our earth look?
00:01:12	SN	Over here.
00:01:14	T	Go ahead and move it. So where- where's winter?
00:01:19	SN	Like, um…I don't know.
00:01:22	SN	(Inaudible).
00:01:24	SN	Okay, yeah, winter.
00:01:25	T	Okay. So now where- what season do we have in the Northern Hemisphere?
00:01:32	SN	Winter.
00:01:33	SN	Well, winter, yeah, up here.
00:01:36	T	Just up here?
00:01:38	SN/T	I- / Oh. Let- let's- I'm going to let you guys talk about that, okay? I'm going to let you guys talk about it. Okay, so how-

Clip 2

00:01:47	T	You think you got it?
00:01:48	SN	Like, yeah. The earth's tilt switches.
00:01:51	T	Oh, the earth's tilt switches? What do you mean by the earth's tilt switches?

00:01:54	S	Like, then it, like, tilts that way.
00:01:56	SN	Yeah, that's, like (inaudible).
00:01:58	T	Ohh. Okay.
00:01:59	S	now it goes-
00:02:00	SN	Now it goes here.
00:02:02	T	It's an interesting idea. That's an interesting idea. We'll come back to that. I want you guys to share that with the rest of the class.
00:02:10	SN	And so the north gets more than the south. No, wait, no- never mind, I'm dumb. So, like-
00:02:17	ST	So- so, Gabe, what are you trying to explain that you're-
00:02:20	S	Well, I was trying to explain that- 'cause, like, it makes sense to have it like that or that. Like, this was the southern tip, so the south would get more during the summer.
00:02:30	T/S	Okay. / And, like, later on in the future, it's going to, like, turn, so, like, the North America gets more, like, winter.
00:02:36	T	So what- so-
00:02:38	SN	If it, like, stays the same way.
00:02:40	T	So it stays the same. What do you mean by it stays the same way?
00:02:43	SN/SN	Well, what we- / It might go like this, like (inaudible) that way.
00:02:47	T	Okay.
00:02:48	S	And then it (inaudible) this side it's on the other side.
00:02:51	T	That's an interesting idea. So why- so what are you noticing as you're moving it like that? What is it doing?
00:02:57	SN/SN	That it- / Then it kind of like changes which one gets more of the heat or whatever.
00:03:01	T	Which one what?

Clip 3

00:03:05	T	Okay. Did any group have something different that they- that they worked with or that they showed? Somebody have something different?
00:03:15	T	Everybody had where the axis flipped? Thank you, Lauren.
00:03:18	SN	Well, when- I don't know. It doesn't seem possible that the seasons could actually, like, change, 'cause it's not like- it's halfway around the orbit, now it's time to flip.

00:03:27	S	It doesn't just do that because-
00:03:29	T	So you disagree with- well, you disagree with Table 1 and Table 8.
00:03:32	S	Yes.
00:03:33	T	Okay. So it doesn't just flip, so what does it do? What do you think it does?
00:03:38	S	Well, if it just keeps spinning, it goes, like, night and day all the way around. It's going to be the same amount of light on each spot, so I don't know how the seasons would change.
00:03:47	T	Okay, so- so you're noticing as people are moving it or as your group moved it around. Can you show me how you moved it around again? So how did you move the earth?
00:03:59	T	Okay. So you moved it just like that, so- so you're wondering how do we get different seasons? Because you noticed that there's the same hemisphere point getting more direct light?
00:04:11	S/T	Mm-hm. / Okay.
00:04:12	S	‘Cause of the way it's tilted.
00:04:13	T	'Cause of the way it's tilted.
00:04:14	S	'Cause it stays in, like, a direct path or it doesn't go up and down or anything.
00:04:19	T	That's a great idea. That's a nice addition to our ideas. All right, so- so we do have a disagreement- we do have some of you agree. Is there anybody else that'd like to share? Go ahead.
00:04:31	SN	We were saying that, like, the base doesn't spin at all. Like, it's still turning, so then when it's on one side, like, this one in the South Hemisphere would probably be getting more light.
00:04:41	T	Okay.
00:04:42	S	But here it-
00:04:43	T	So you don't even turn the base at all.
00:04:46	S	Yeah.
00:04:48	T/S	Okay, so what- / It automatically changes.
00:04:50	T	Okay, so what are you seeing? When you move it right there, what are you seeing?
00:04:54	S	Um-
00:04:55	T	Can you show me some evidence of what- why you think that's the way that needs to move?

00:05:00	S	Because winter and everything, there's probably less sun, like, heat. And then it would change from, like, north to south.
00:05:08	T/S	Okay. / So it'd be turning and then it'd be the other side that gets more heat than the other.
00:05:13	T	So what- what do you mean by “different side”?
00:05:16	SS	The other side.
00:05:18	T	So what- what do you mean by side?
00:05:21	SN/T	The hemisphere. / The hemispheres. So-

Teacher/Video	Schilling_mnstl_gr8_SEC_L3_C4
Content Area	Sun's Effect on Climate and Seasons
STeLLA Strategy	Strategy 6: Engage students in developing and using content representations and models
Context	Lesson 3 of 7. Students share their models in whole group. The last group shares a relatively accurate model.

00:00:01	T	So right there in that position, which hemisphere is getting more heat? Or more light?
00:00:08	SN	The north.
00:00:09	T	The north, Northern Hemisphere. Okay. But you said heat, right?
00:00:14	SN/T	Yeah. / Are we getting heat from the sun?
00:00:17	SN/SN	Yeah. / Mm-hm.
00:00:18	T	Are we getting heat from the sun?
00:00:20	SN	Yeah.
00:00:21	T	Are you sure? 'Cause what- 'cause remember that diagram that we worked with yesterday?
00:00:28	T	What did you count on that diagram?
00:00:30	SN	Light rays.
00:00:31	SN	Rays.
00:00:32	T	Light rays. So do we get any heat?
00:00:37	SN/T	No. / We don't actually get heat from the sun. It's in the form of energy with- which is light. Okay?

STeLLA Lesson Analysis Protocol: Belcastro SEC Lesson 4 Clip 1 Example

1. Identify the Lens & Strategy

- What instances of asking questions that probe and challenge student thinking do you observe?
- What instances of developing and using models do you observe?

2. Analyze the Video Using the Analysis Question(s)

- What do students seem to understand (or not) about the sun's effect on climate and seasons?
- How did the use of the identified strategies make student thinking more visible?

Lesson Analysis Step	To Do	Your Analysis
Claim	Turn an observation, question or judgment into a specific claim that responds to the focus question.	*MY CLAIM: This group of students uses the model of the Earth-Sun system to reason about the patterns of temperatures on Earth at different times of the year. They reason with the model (physical representation) to help negotiate their understanding that the amount of light hitting the northern hemisphere, southern hemisphere, and equator at different positions in Earth's orbit influences the seasons in the hemispheres. They seem to have at least the beginnings of scientifically accurate understanding of a causal explanation of patterns in temperature at different times of the year.*
Evidence and Reasoning	Point to a specific place in the video transcript, lesson plan, or student work that supports your claim. Connect your claim and evidence with reasoning based on STeLLA Strategies, research on learning, your teaching experience, or scientific principles. Also look for evidence that challenges your claim.	*MY EVIDENCE: For example, after the teacher's challenge question for students to use their vocabulary words at 50.2, two different students talk about the equator and northern hemisphere getting more light than the southern hemisphere when the Earth is at position 1. Christina says "more on the equator" and "it's also more bright on the northern hemisphere" at 1:10.2-1:06.2. Another boy says, "it's [sunlight's] not as much [in the southern hemisphere] at 1:18.0.* *From 1:25.8 through 3:13.0 two students have different ideas about what is happening to Earth at position 3 and then seem to negotiate an accurate understanding using words like "more bright" and "not as much" to describe the amount of sunlight or directness of sunlight at different places.* *MY REASONING: According to the NGSS, when students are developing and using models they are engaging with models that can be content representations or physical representations, think about the strengths and limitations of the model in comparison to the real world, and reason with the model. In this clip, Students reason with models. Students use the word "because" to link their observations (of light and maybe patterns identified earlier) that places near the equator are warmer because they get more sunlight and that because of the amount of sunlight, the northern hemisphere is in summer when the North Pole is pointing toward the Sun and the southern hemisphere is in winter when the North Pole is pointing toward the Sun with each having opposite seasons when the North Pole is pointed away from Sun.*
Alternatives	Consider an alternative interpretation or explanation. Consider new questions this might raise. Consider alternative question(s), activity(s), or strategies.	*I wonder how she'll help students use this model (and others) to get at the influence of day length on avg. temperatures at different times of year. I wish that the kids could have left the model on the floor so the sun didn't move so much! I wonder how she sets up her classroom so that students work together!*

3. Reflect and Apply

Teachers reflect on the experience.

Lesson Analysis Protocol [Schilling_mnstl_gr8_SEC_L3_C1-3 and Schilling_mnstl_gr8_SEC_L3_C4]

1. Identify Lens and Strategy

- What instances of Strategy 6, engage students in using content representation and models, can you identify?

2. Analyze the Video

- What do students understand (or not) about why some places on Earth are hotter than others at different times of the year?
- How did students' and/or teacher's use a content representation or model reveal, support or challenge their thinking?

Lesson Analysis Step	To Do	Your Analysis
Claim	Turn an observation, question or judgment into a specific claim that responds to the focus question.	
Evidence	Point to a specific place in the video transcript, lesson plan, or student work that supports your claim. Be sure to use timestamps if your evidence comes from a transcript.	
Reasoning	Connect your claim and evidence with reasoning based on STeLLA Strategies, research on teaching and learning, your teaching experience, or scientific principles.	
Consider Alternatives	Alternatives may include an alternative interpretation of evidence, new questions this clip or analysis might raise, and/or alternative question(s), activity(s) or strategies that might have better supported student learning.	

3. Reflect and Apply

What ideas about engaging students in using content representation and models do you want to keep in mind for your own teaching?

Lesson Analysis Protocol [Schilling_mnstl_gr8_SEC_L3_C1-3 and Schilling_mnstl_gr8_SEC_L3_C4]

1. Identify Lens and Strategy

- What instances of Strategy 6, engage students in using content representation and models, can you identify?

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3. Reflect and Apply

What ideas about engaging students in using content representation and models do you want to keep in mind for your own teaching?

Reflection - Day 4 Name:_____

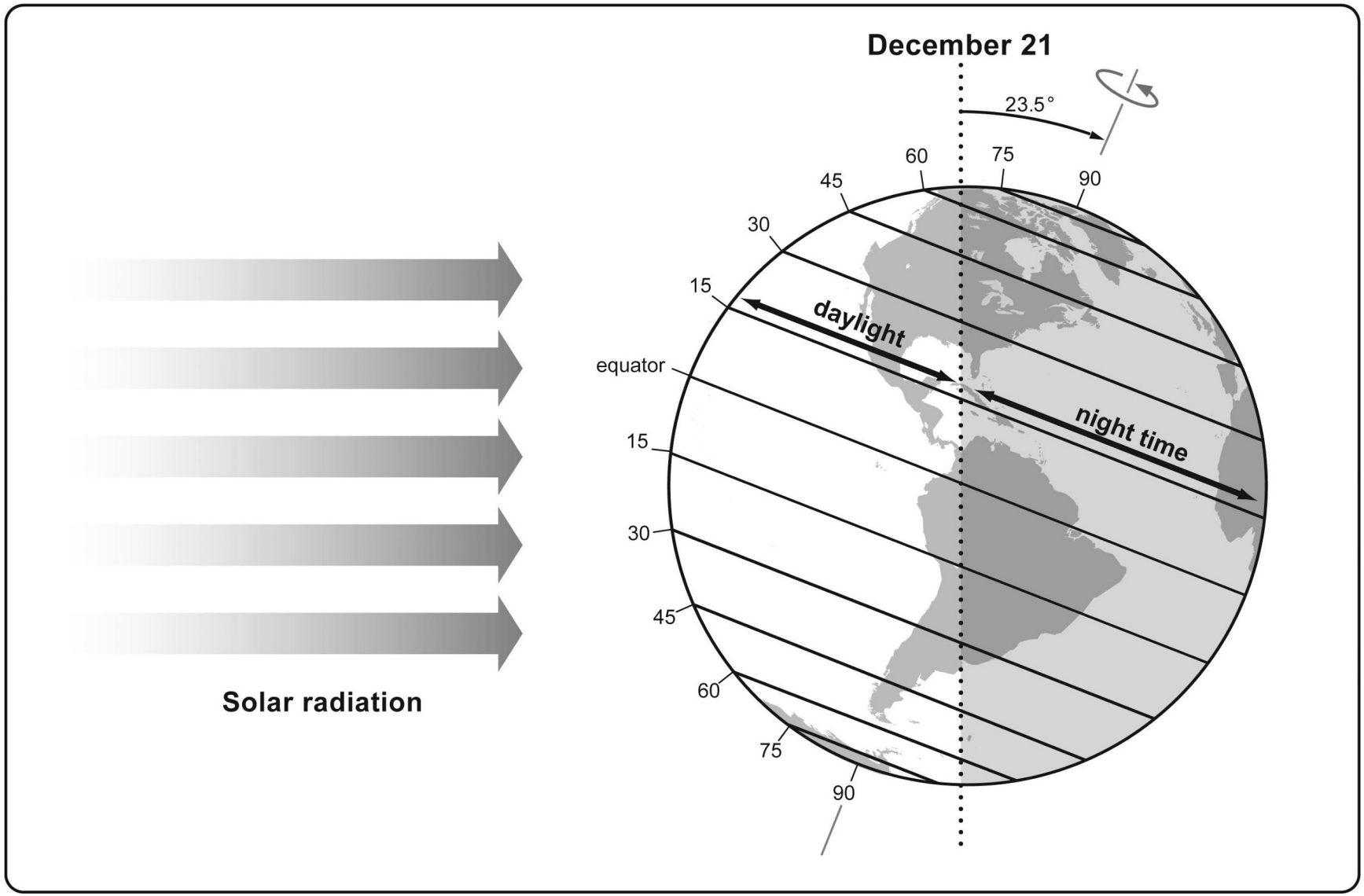
1. We have been discussing and using content representations and models. How has their use impacted your own learning about the Sun's effect on climate and seasons?

2. How has your understanding of elicit, probe, and challenge questions been refined through our work today?

3. How does the teacher's use of elicit, probe, and challenge questions influence students' ability to productively develop and use models/content representations to make sense of the phenomenon?

Science Content Handouts

Daylight Hours on December 21st



Discussion Questions

- How does length of day change with latitude? (Share evidence from the data table.)

- Are parts of Earth always dark? If yes, use latitude to describe where.
  .

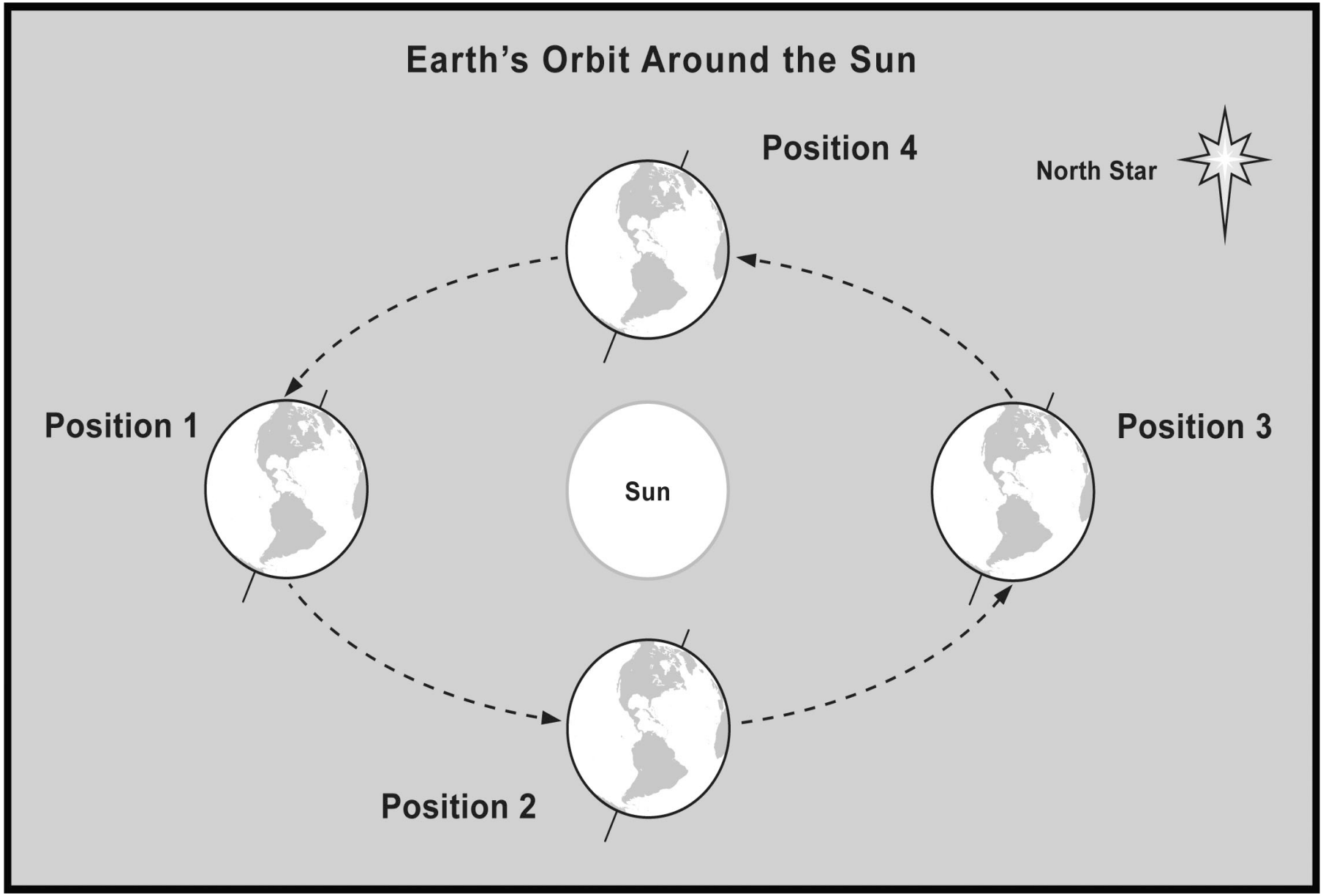
- Are parts of Earth always in light? If yes, use latitude to describe where.

- At which latitude is there equal lengths of day and night?

Whole Class:

How do you think more or less daylight in different parts of the world might affect how warm (with higher average temperatures) or how cold (with lower average temperatures) it is?

Here is a question to consider: If the length of daylight makes it warmer, will the summer temperatures at the poles when they have 24 hours of daylight be higher than at the equator?



Approximate Number of Daylight Hours
December 21

Latitude	Length of daylight line	Length of day +night line	Percent daytime	Hours of daylight
75º N	0mm	27mm	0%	0 hours
60°N	5mm	47mm	10%	2 hours
45°N	20mm	63mm	29%	7 hours
30°N	32mm	83mm	38%	9 hours
15°N	42mm	93mm	45%	11 hours
0°	49mm	98mm	50%	12 hours
15°S	52mm	94mm	56%	13 hours
30°S	52mm	85mm	63%	15 hours
45°S	49mm	70mm	78%	17 hours
60°S	42mm	50mm	89%	22 hours
75º S	27 mm	27 mm	100%	24 hours

Team Challenges:

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

Challenge #1

Barrow, Alaska, is located at latitude 71°N. In July, during the summer, people who live in Barrow get 24 hours of sunlight every day. That means that the Sun shines all of the time and it never gets dark.

In July, the average high temperature in Barrow, Alaska, is 45°F.

Lagos, Nigeria, is located at latitude 6°N. In July, during the summer, people who live in Lagos experience 12 hours of daylight and 12 hours of darkness each day in July.

In July, the average high temperature in Lagos, Nigeria, is 82°F.

Explain why the summer temperature in Barrow, Alaska, never gets above 45°F even though there is 24 hours of sunlight while Lagos, Nigeria, with only 12 hours of sunlight, reaches a temperature of 82°F.

Challenge #2

The city of Belem, Brazil, is located at latitude 1°S, which is almost at the equator.

Below are the average temperatures in Belem, Brazil, during one year.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
78°F	78°F	78°F	78°F	79°F	79°F	78°F	79°F	79°F	79°F	79°F	79°F

What do you notice about the temperatures in Belem, Brazil?

Why do you think Belem, Brazil, does not have summer and winter like we do in the United States?

Challenge #3

The city of Santa Rosa, Argentina, is located at latitude 37°S.

The city of Richmond, Virginia, USA, is located at latitude 37°N.

Below are the average temperatures in those two cities during one year.

	January	March	May	July	September	November
Santa Rosa 37°S latitude	74°F	67°F	52°F	45°F	54°F	67°F
Richmond 37°N latitude	38°F	48°F	66°F	78°F	70°F	49°F

Why is it warm in Santa Rosa, Argentina, when it is cold in Richmond, Virginia?

Why is it cold in Santa Rosa, Argentina, when it is warm in Richmond, Virginia?

Think about Positions 1, 2, 3, and 4 as the Earth orbits the Sun

Challenge #4

Four friends were sharing their ideas about why it is warmer in the summer than in the winter. This is what they said:

Ava: "It's because the Sun gives off more heat in the summer than in the winter."

Raul: "It's because Earth's tilt changes the angle of sunlight hitting Earth."

John: "It's because Earth orbits closer to the Sun in the summer than in the winter."

Shakira: "It's because one side of Earth faces the Sun and the other side faces away."

Which friend do you most agree with? _____

Describe your thinking about why it is warmer in the summer than in the winter. *

**Challenge #4 is adapted from: Keeley, P., Eberle, F., Dorsey, C. (2008). Summer Talk in Uncovering Student Ideas in Science: Another 25 Formative Assessment Probes. Arlington, VA: NSTA Press.*