RESPeCT Summer Institute Professional Development Leader Guide (PDLG)

Grade Level	4	**Day**	3	**STeLLA Strategy**	STL Strategy 4: Analyze and Interpret Data and Observations STL Strategy 5: Construct Explanations and Arguments	**Subject Matter Focus**	Earth's Changing Surface

Focus Questions	• How can analyzing data and constructing explanations help students *move forward* toward deeper understandings of science ideas? • Can mountains grow so tall they reach outer space? Why or why not? • What is an angle, and how do you measure it?
Main Learning Goals	Participants will understand the following: • In addition to challenge questions, the Student Thinking Lens (STL) strategies include activities that move student thinking forward toward more-scientific understandings. • STL strategies 4 and 5 are two activities that can be used to move student thinking forward: Engage students in analyzing and interpreting data and observations (strategy 4), and engage students in constructing explanations and arguments (strategy 5). • Analyzing and interpreting go beyond making observations to organizing data, identifying patterns and looking for meaning in the data, and searching for relationships between science ideas and data. • Constructing explanations involves making a claim, supporting the claim with evidence and reasoning, and coming up with alternatives that challenge the claim (argumentation). • Weathering is a process that changes Earth's surface by causing rock to fragment, crack, and crumble into smaller pieces.

Preparation	**Materials**	**Videos**

Daily Setup Tasks
• Check that video clips are correctly linked to PowerPoint (PPT) slides.
• Set up PowerPoint.
• Make sure video clips play correctly with good sound.
• Arrange furniture and food.
• Arrange participant materials.
• Put up posters and charts.
 	
Planning and Preparation Tasks:
• Study the PDLG, PowerPoint slides (PPTs), video clips, and handouts. Make changes to PPTs if needed.
• Review the reflections from day 2 and create a summary slide.
• Watch video clips and anticipate participant
	Posters and Charts
	• STeLLA Framework and Strategies poster
	• Day-3 Agenda (chart)
	• Day-3 Focus Questions (chart)
	• Norms for Working Together (chart)
	• Effective Science Teaching chart (from day 1)
	• Strategy charts from days 1 and 2 (STL strategies 1–3)
	• Parking Lot poster
	
	Handouts in RESPeCT PD Binder Front Pocket
	• Z-fold summary chart: Student Thinking Lens Strategies
	
	Handouts in RESPeCT PD Binder, Day 3
	• 3.1 Quick Reference Tools for Strategies 4
		• Video Clip 3.1: Potter classroom (analyze and interpret, strategy 4); 3.1_stella2-04-potter4-L4_C1-2
		• Video Clip 3.2: Potter classroom (construct explanations and arguments, strategy 5); 3.2_stella2-04-potter4-L4_C9
		
		• For content deepening:
		  • Boy Riding Bike (00:17:73 min)
		  • Girl Ice Skating (00:53:33 min)

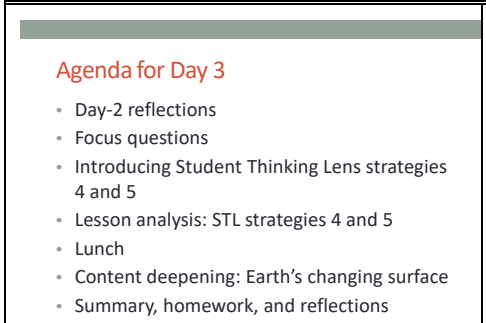
responses.
• Prepare charts for the day's agenda and focus questions.
• Review the activities for ECS lessons 5a/b in the lesson plans binder.
• Content deepening:
  • For the soda-can investigation from ECS lesson 5a, assemble enough cans of soda to give each pair of participants 2 cans, with a few extras in case some cans don't freeze properly. Place half of the cans (and a few extras) in the freezer overnight. You'll need to retrieve the cans from the freezer before lunch break ends on the day of the session. Each pair will be given 1 room-temperature can and 1 frozen can. The frozen can should show some expansion that causes it to bulge or changes its shape in some other way.
  • For the rock-shakers investigation from ECS lesson 5b, assemble the jugs and lava rocks, place 4–6 rocks inside each jug, and secure the lid.
  • For the math content deepening activities, review the game instructions on handout 3.7 (Angle Add-Up Game). Cut apart the protractors from handout 3.6 (360-Degree Protractors). Each participant will be given a protractor. Photocopy the number cards from handout 3.8. Cut apart and assemble one set of cards for each pair of participants. Then laminate the record sheet (page 2 of handout 3.7) so participants can use a dry-erase marker to sketch the angles on each circle (If you decide not to laminate the sheet, have participants sketch the angles with a pencil.)
	and 5
	• 3.2 Practice Identifying Strategies 4 and 5 in Student Work
	• 3.3 Transcript for Video Clip 3.1
	• 3.4 Transcript for Video Clip 3.2
	• 3.5 Misconception Related to Angles: A Larger Space Means a Larger Angle
	• 3.6 360-Degree Protractors (1 protractor per pair)
	• 3.7 Angle Add-Up Game (1 per participant)
	• 3.8 Number Cards (1 set per pair)
	• 3.9 Daily Reflections—Day 3
	
	Handouts in RESPeCT Lesson Plans Binder
	• 5.2 Pictures of a Tree in a Boulder (from ECS lesson 5a)
	• 5.3 Weathering Processes (from ECS lesson 5b)
	
	PD Leader Masters, Days 1–4
	• PD Leader Master: Practice Identifying Strategies 4 and 5 in Student Work
	
	Supplies
	• Science notebooks
	• Chart paper and markers
	• Science-lesson materials kit (Earth's changing surface)
	• For content deepening investigations from ECS lessons 5a/b:
	  • Cans of soda (2 cans per pair—1 at room temperature and 1 frozen)
	  • Small (16 oz) plastic jugs or tubs with lids and 4–6 lava rocks inside (1 jug of rocks per pair of participants)
	• For math content deepening:
	  • 360-degree protractors (1 per participant) (from handout 3.6)
	  • Paper plates, 5–9 inches in size (2 different colors, 1 of each color per participant)
	  • Scissors	

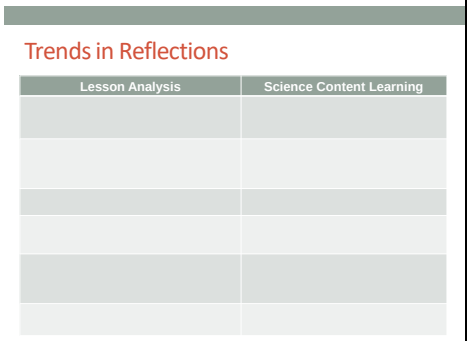
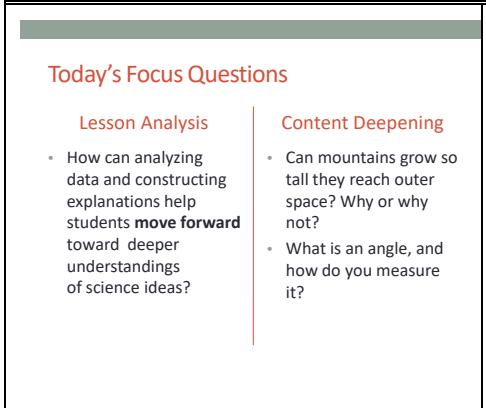
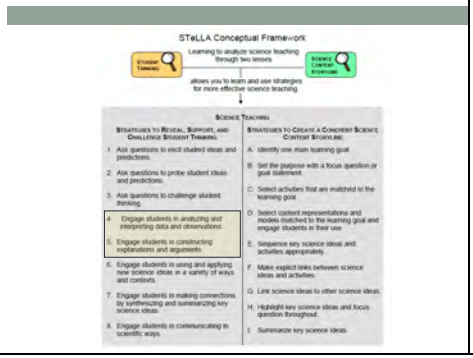
	• Straightedge ruler (1 per pair) • Dry-erase marker (or pencil) (1 per pair) • Number cards (1 set per pair) (from handout 3.8) **PD Resources** • STeLLA strategies booklet • RESPeCT PD program binder • RESPeCT lesson plans binder **Resources in Lesson Plans Binder** *Resources section:* • Earth's Changing Surface Content Background Document • Common Student Ideas about Earth's Changing Surface	

DAY 3 SESSION OUTLINE

Time	Activities	Purpose
8:00–8:35 35 min	**Getting Started: Housekeeping, Agenda, Day-2 Reflections, Focus Questions, STL Strategies**	• Build community by sharing participants' reflections from day 2. • Set the stage for a day of learning. • Emphasize the theme for the rest of the week: What do we do with the ideas we've elicited from students? How do we help them change and advance their understandings of science concepts?
8:35–9:35 60 min	**Introducing Student Thinking Lens (STL) Strategies 4 and 5**	• Develop an initial understanding of strategy 4: Engage students in analyzing and interpreting data and observations. • Develop an initial understanding of strategy 5: Engage students in constructing explanations and arguments. • Examine the relationships among the science practices of observing, analyzing and interpreting, and constructing explanations and arguments.
9:35–12:00 145 min (Includes 10-min break)	**Lesson Analysis: STL Strategies 4 and 5**	• Use lesson analysis of classroom videos to better understand strategies 4 and 5, how they're related, and how they can challenge student thinking to move forward. • Deepen science-content knowledge of Earth's changing surface through lesson analysis.
12:00–12:45 45 min	**LUNCH**	
12:45–3:15 150 min (Includes 10-min break)	**Content Deepening: Earth's Changing Surface**	• Deepen participants' science-content knowledge of Earth's changing surface by conducting investigations from ECS lessons 5a/b. • Deepen participants' understandings of Common Core State Standards (CCSS) for mathematics regarding angles and their measurement.
3:15–3:30 15 min	**Wrap-Up: Summary, Homework, and Reflections**	• Reflect on the day's learning and summarize key ideas about the science content and strategies 4 and 5, linking those ideas to participants' images of effective science teaching and changes they want to make in their individual teaching practices.

DAY 3

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
8:00–8:35 35 min **Getting Started** Slides 1–8	**Purpose** • Build community by sharing participants' reflections from day 2. • Set the stage for a day of learning. • Emphasize the theme for the rest of the week: What do we do with the ideas we've elicited from students? How do we help them change and advance their understandings of science concepts? **Content** • Student Thinking Lens (STL) strategies reveal student thinking (elicit and probe strategies) and challenge student thinking (the rest of the strategies). • STL strategies are divided into questions (elicit, probe, and challenge) and activities. • A variety of strategies can be used to move student thinking		**Display Slide 1.** RESPeCT PD Program (5 min) a. Take care of any housekeeping issues.
			**Display Slide 2.** Agenda for Day 3 (2 min) a. Talk through the agenda for the day.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	forward. Today's focus is STL strategy 4 (Engage students in analyzing and interpreting data and observations) and strategy 5 (Engage students in constructing explanations and arguments). **What Participants Do** • Discuss the reflections from day 2. • Listen to an overview of the agenda, the focus questions, and the theme for the day and the rest of the week: moving student thinking forward. • Review Summary of STeLLA Student Thinking Lens Strategies in the STeLLA strategies booklet and recognize two patterns: 1. Some strategies are designed only to reveal student thinking (strategies 1 and 2), while most are also designed to challenge student thinking. 2. The Student Thinking Lens includes three questioning strategies and five activity strategies. **Posters and Charts** • STeLLA Framework and Strategies poster • Day-3 Agenda (chart) • Day-3 Focus Questions (chart) • Strategy charts from day 1 (STL strategies 1–3) **PD Resources**		**Display Slide 3.** Trends in Reflections (5 min) a. Invite participants to look at your feedback on their reflections from day 2 and offer reactions, comments, or follow-up questions. b. **Optional:** Give participants an opportunity to refine the norms for working together.
			**Display Slide 4.** Today's Focus Questions (2 min) a. Introduce the focus questions that will guide today's session. b. "The words moving forward are in bold on the slide because that's our theme for today and the rest of the week. Yesterday we practiced asking elicit and probe questions, which are great for revealing student ideas. But what do we do with those ideas once we've elicited them? How do we support students in moving forward toward deeper understandings of science ideas?"
			**Display Slide 5.** STeLLA Conceptual Framework (1 min) a. Point out the strategies highlighted on the slide. b. "We'll continue working on understanding and using the Student Thinking Lens questioning strategies, but today we'll focus on two closely related activity strategies. Strategy 4 engages students in analyzing and interpreting data and observations, and strategy 5

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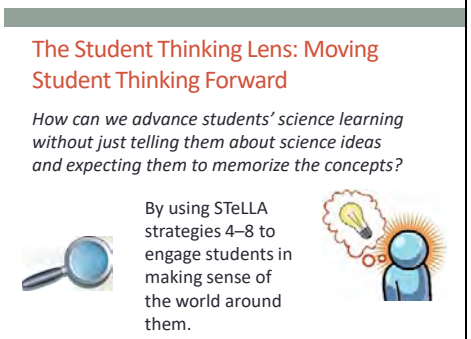
	• STeLLA strategies booklet		engages students in constructing explanations and arguments."
			**Display Slide 6.** The Student Thinking Lens: Moving Student Thinking Forward (10 min) a. Initially, reveal *only* the question on the slide. b. Have participants think about the question for a minute; then open up a brief conversation about it. c. Ask the following questions to stimulate discussion if participants are struggling: • What was your experience as a science student in school or college? • How were you expected to learn science ideas? What learning methods were used? • Did you ever have the opportunity in science classes to make sense of the experiments you performed (instead of just recording the correct answers in a lab report)? • Did science teachers ever support your learning in ways that went beyond merely having you take lecture notes, read from a textbook, or record the correct answers in lab reports? d. After discussing the questions, reveal the second part of the slide and emphasize the following points: • "Strategies 4 and 5 (as well as 6, 7, and 8) are designed to move student thinking forward by engaging students in sensemaking as they observe data. Rather than just spoon-feeding students science content to read or memorize, these activities lead them toward deeper understandings of science ideas as they construct meaning from evidence."

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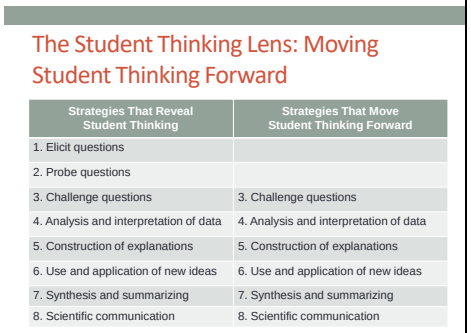
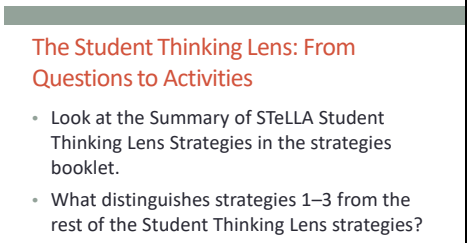
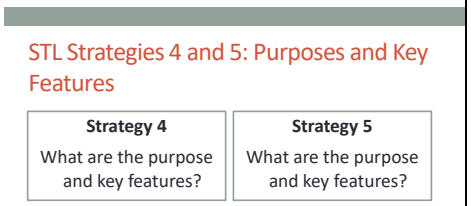
			• "Telling students about science ideas is important, but teachers tend to tell students too much. Instead of doing the hard cognitive work for them, we need to create more opportunities for students to do the thinking and sensemaking *themselves* so they can truly understand the science concepts. So don't be in such a hurry to tell students the right answers. **Slow down and give them a chance to think!**"
			**Display Slide 7.** The Student Thinking Lens: Moving Student Thinking Forward (5 min) a. Have participants look at the slide representation of the Student Thinking Lens strategies. b. Ask: "What do you notice?" **Key ideas:** • Elicit and probe questions are designed *only* to reveal student thinking, not to challenge it. • The rest of the strategies reveal *and* challenge student thinking.
			**Display Slide 8.** The Student Thinking Lens: From Questions to Activities (5 min) a. **Individuals:** Have participants briefly examine the summary chart of STL strategies in the STeLLA strategies booklet (Summary of STeLLA Student Thinking Lens Strategies). **Note:** Direct participants to the correct page in the strategies booklet or have them consult the table of contents. b. **Whole group:** "How are the first three strategies

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			different from the rest?" **Key ideas:** • Strategies 1–3 are questions; the rest are activities. • Probe and challenge questions can and should be asked during all types of activities.
8:35–9:35 60 min **Introducing Student Thinking Lens (STL) Strategies 4 and 5** Slides 9–11	**Purpose** • Develop an initial understanding of strategy 4: Engage students in analyzing and interpreting data and observations. • Develop an initial understanding of strategy 5: Engage students in constructing explanations and arguments. • Examine the relationships among the science practices of observing, analyzing and interpreting, and constructing explanations and arguments. **Content** • STL strategy 4 engages students in analyzing and interpreting data and observations. Activities involve organizing data and/or observations, identifying patterns, and looking for meaning in the data. • STL strategy 5 engages students in constructing explanations and arguments. Activities involve using logical thinking, evidence, and science ideas to construct		**Display Slide 9.** STL Strategies 4 and 5: Purposes and Key Features (30 min) a. **Small groups (12 min):** Divide participants into two groups and assign one strategy to each group. Have one group create a chart listing the purpose and key features of strategy 4, and have the other group chart the purpose and key features of strategy 5. Each group should be prepared to answer the discussion question for the assigned strategy. b. **Whole-group share-out (18 min):** Have groups report on the purpose and key features of each strategy. **Key ideas:** • Strategy 4 involves activities that engage students in organizing their data and/or observations and looking for patterns and meaning in them. They aren't just "doing" activities or describing their observations. • Strategy 5 engages students in learning how to use logical thinking, evidence, and science ideas to construct explanations of scientific data or phenomena they have observed. It also engages them in critiquing various proposed explanations through scientific argumentation. • Remind participants that these strategies are closely related and will overlap in some activities. However, each has a specific purpose and unique attributes.

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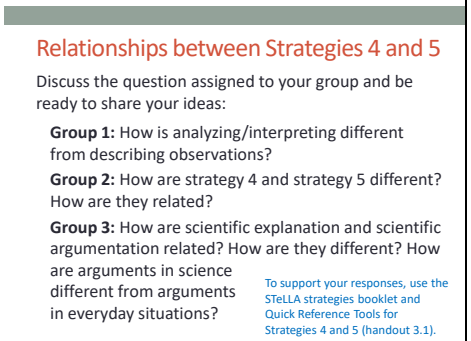
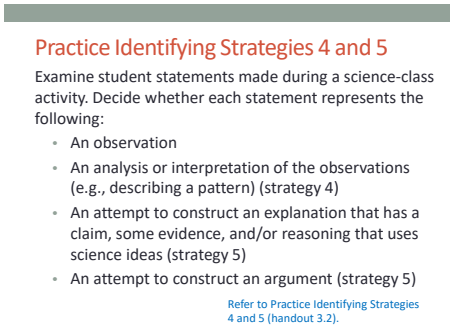
	explanations of scientific data or observed phenomena, as well as critiquing proposed explanations using scientific argumentation. **What Participants Do** • Create and discuss strategy charts summarizing the purposes and key features of strategies 4 and 5. • Discuss the differences and relationships among observing, analyzing and interpreting, and constructing explanations and arguments. • Use written scenarios to practice identifying instances of observing, analyzing and interpreting, and constructing explanations and arguments. **Handouts in PD Binder** • 3.1 Quick Reference Tools for Strategies 4 and 5 • 3.2 Practice Identifying Strategies 4 and 5 **PD Leader Masters** • PD Leader Master: Practice Identifying Strategies 4 and 5 **Supplies** • Chart paper and markers **PD Resources** • STeLLA strategies booklet		**Display Slide 10.** Relationships between Strategies 4 and 5 (15 min) a. **Small groups (5 min):** Divide participants into three small groups or pairs. Assign each group one question to discuss and tell participants to be ready to share their ideas with the entire group. b. **Emphasize:** Participants should use the STeLLA strategies booklet and Quick Reference Tools for Strategies 4 and 5 (PD handout 3.1) to support their responses. c. **Whole-group share-out (10 min):** • "What did you come up with for the first question?" **Key ideas for question 1:** Analysis and interpretation involve moving beyond simply describing observations to *doing* something with the data, including (but not limited to) making comparisons, identifying relationships, and organizing data in ways that will reveal patterns (such as using charts, diagrams, and graphs). • "What did you come up with for the second question?" **Key ideas for question 2:** Strategy 4 lays the groundwork for strategy 5. Before we can build a scientific explanation for a specific phenomenon, we need to make some observations, analyze the data to reveal patterns, and organize the data to gather the necessary evidence to support construction of a scientific explanation. A scientific explanation includes a claim that answers the question being studied, evidence that supports the claim, and reasoning that links the claim to the evidence and to science ideas.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			• "What did you come up with for the third question?" **Key ideas for question 3:** A scientific explanation includes a claim that answers the question being studied, evidence that supports the claim, and reasoning that links the claim to the evidence and to science ideas. Scientific arguments involve assessing the strength and quality of the evidence and reasoning in different scientific explanations for the same observations and determining which proposed explanation has the best supporting evidence, science ideas, and reasoning.
			**Display Slide 11.** Practice Identifying Strategies 4 and 5 (15 min) a. "Before we view classroom video clips to identify and analyze strategies 4 and 5, we're going to practice identifying observations, analyses, interpretations, explanations, and arguments from a handout of student statements. Learning to distinguish which strategy students are using in these examples will help us when we review the classroom videos, where the strategies aren't always as clear cut." b. Refer participants to handout 3.2 in their PD program binders (Practice Identifying Strategies 4 and 5). c. **Pairs:** Have participants work in pairs to analyze student statements in the handout. d. **Whole group:** As participants discuss and clarify their analyses of the student statements, encourage them to refer frequently to the STeLLA strategies booklet and the Quick Reference Tools handout (PD handout 3.1). **Note:** For examples of ideal participant responses, see PD Leader Master: Practice Identifying Strategies 4 and 5.

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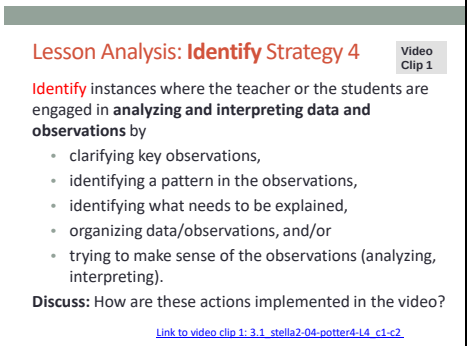
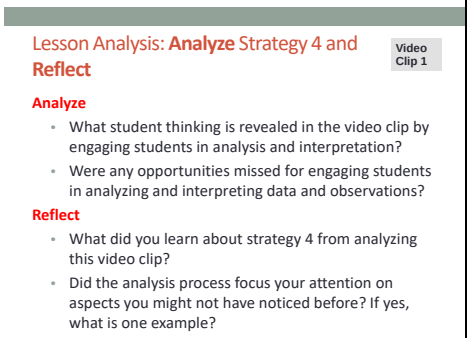
9:35–12:00 145 min (Includes 10-min break) **Lesson Analysis: STL Strategies 4 and 5** Slides 12–22	**Purpose** • Use lesson analysis of classroom videos to better understand strategies 4 and 5, how they're related, and how they can challenge student thinking to move forward. • Deepen science-content knowledge of Earth's changing surface through lesson analysis. **Content** • STL strategy 4 engages students in analyzing and interpreting data and observations. Activities involve organizing data and/or observations, identifying patterns, and looking for meaning in the data. • STL strategy 5 engages students in constructing explanations and arguments. Activities involve using logical thinking, evidence, and science ideas to construct explanations of scientific data or observed phenomena, as well as critiquing proposed explanations using scientific argumentation. **What Participants Do** • Watch a classroom video clip to identify strategy 4 and analyze student thinking that this strategy reveals and challenges. • Examine transcript excerpts in the STeLLA strategies booklet for	Lesson Analysis Focus Question How can analyzing data and constructing explanations help students *move forward* toward deeper understandings of science ideas?	**Display Slide 12.** Lesson Analysis Focus Question (Less than 1 min) a. Review the focus question that will guide today's lesson analysis work.
		Lesson Analysis: **Review** Lesson Context Video Clip 1 Review the lesson context at the top of the video transcript (handout 3.3 in your program binder).	**Display Slide 13.** Lesson Analysis: Review Lesson Context, Video Clip 1 (3 min) a. "Now let's see if we can recognize students analyzing and interpreting data in a classroom video clip." b. Review the lesson context at the top of the transcript for video clip 1 (handout 3.3 in PD binder), making sure participants understand both the content and activity in focus.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	practice identifying strategies 4 and 5. • Watch a second classroom video clip to identify strategy 5 and analyze student thinking this strategy reveals and challenges. • Summarize key ideas about the relationships between strategies 4 and 5. **Videos** • Video Clip 3.1, Potter classroom • Video Clip 3.2, Potter classroom **Handouts in PD Binder** • 3.1 Quick Reference Tools for Strategies 4 and 5 • 3.3 Transcript for Video Clip 3.1 • 3.4 Transcript for Video Clip 3.2 **PD Resources** • STeLLA strategies booklet		**Display Slide 14.** Lesson Analysis: Identify Strategy 4, Video Clip 1 (25 min) a. "As we watch the video clip, we'll identify actions that illustrate strategy 4. Be on the lookout for instances where the teacher or the students do something listed on the slide. That's what we'll discuss first." b. Show the video clip. c. **Individuals:** "Think about the strategy 4 actions listed on the slide." d. **Whole group:** "Discuss the question on the slide. Make sure to support your claims with evidence from the video transcript."
			**Display Slide 15.** Lesson Analysis: Analyze Strategy 4 and Reflect, Video Clip 1 (25 min) a. **Individuals:** "For the first analysis question on the slide, study the transcript for video clip 1 and come up with a claim, evidence, and reasoning to support your claim. For the second analysis question, consider alternative moves the teacher could have made as you identify missed opportunities." b. **Whole group:** After participants have shared their analyses, ask, "Were there any missed opportunities for engaging students in analyzing and interpreting data?" c. **Reflect:** Discuss the reflection questions on the slide, making sure participants share specifically what they learned about strategy 4.

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		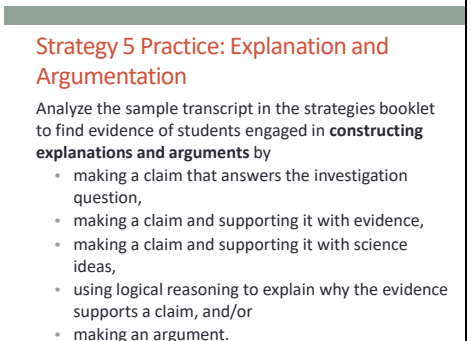	**Display Slide 16.** Strategy 5 Practice: Explanation and Argumentation (10 min) a. "Strategy 5 is the focus of the next video clip, although you may also see evidence of strategy 4 being used." b. Have participants analyze the transcript example (under "About Earth's Changing Surface" in the strategy 5 chapter) in the STeLLA strategies booklet and look for evidence of students engaging in constructing explanations and arguments. **Note:** This is an important activity, but it can be cut if time is short. c. "Before we view another classroom video, let's practice analyzing an example of strategy 5 in the STeLLA strategies booklet. Read the brief sample transcript in the section titled 'About Earth's Changing Surface' and see if you can find any evidence of students engaging in constructing explanations and arguments. Refer to the action list on the slide for guidance." d. **Individual work time (5 min).** e. **Whole-group share-out:** Have participants share evidence from the transcript of students engaging in strategy 5, noting the specific action illustrated from the list on the slide. Ask what makes the first student's explanation different from the second student's argument.
	10-MINUTE BREAK		

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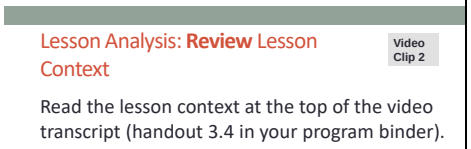
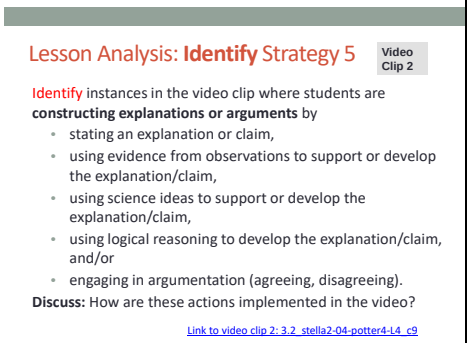
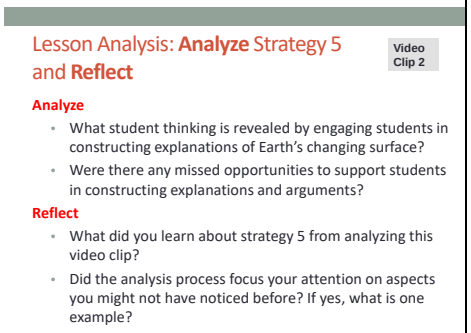
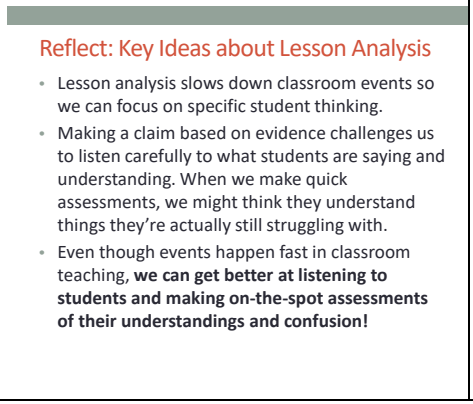
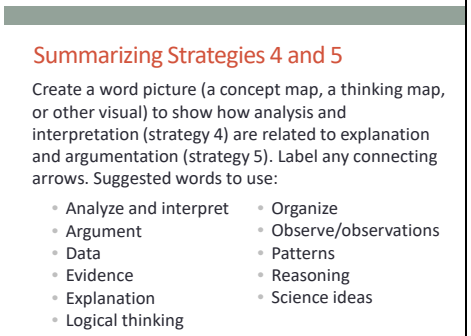
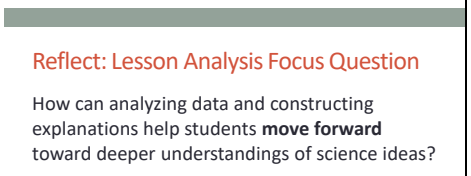
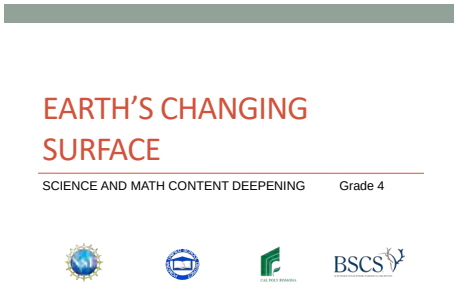
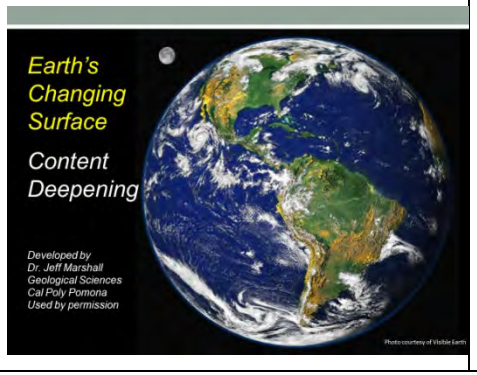
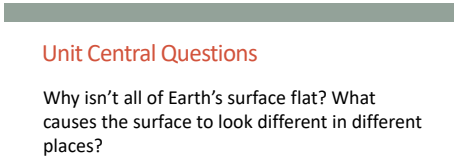
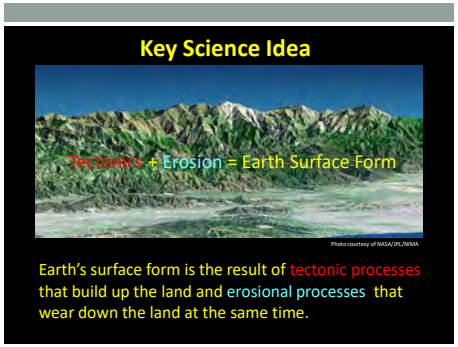
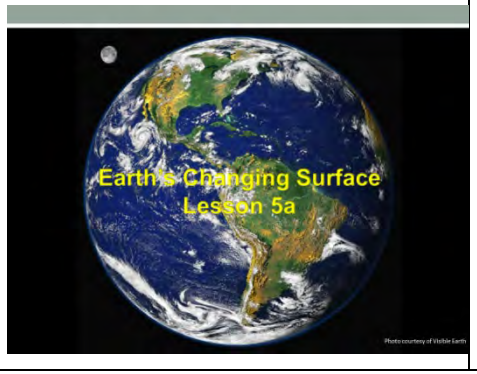
			**Display Slide 17.** Lesson Analysis: Review Lesson Context, Video Clip 2 (2 min) a. "Now we're going to look at another video clip and focus on identifying strategy 5: Engage students in constructing explanations and arguments." b. Read the context of the lesson at the top of the transcript for video clip 2 (handout 3.4 in the PD program binder). c. "In this synthesis activity, students are using science ideas from a lesson investigation to answer the focus question, 'Can mountains grow so tall they reach outer space? Why or Why not?'"
			**Display Slide 18.** Lesson Analysis: Identify Strategy 5, Video Clip 2 (25 min) a. "As you watch the video clip, identify instances where students are engaged in constructing explanations and arguments (strategy 5). You might notice examples of strategy 4 (analyzing and interpreting data), but focus on identifying strategy 5. Also notice the kinds of questions the teacher asks (elicit, probe, or challenge)." b. Before showing the video clip, read the list of actions on the slide. c. **Individuals:** "Think about the strategy 5 actions listed on the slide." d. **Whole group:** "Discuss the question on the slide. Make sure to support your claims with evidence from the video transcript." e. **Emphasize:** "Strategy 5 is designed to help move student thinking forward toward deeper understandings of science ideas, so we should see challenge questions

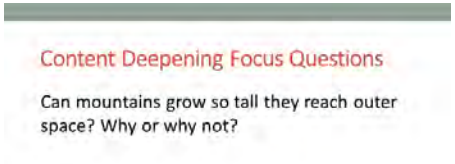
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			as well as probe questions in the video clip."
			**Display Slide 19.** Lesson Analysis: Analyze Strategy 5 and Reflect, Video Clip 2 (25 min) a. **Individuals:** "For the first analysis question on the slide, study the video transcript and come up with a claim, evidence, and reasoning to support your claim. For the second analysis question, consider alternative moves the teacher could have made as you identify any missed opportunities." b. **Whole group:** After participants have shared their analyses, ask, "Were there any missed opportunities for engaging students in constructing explanations and arguments?" c. **Reflect:** Discuss the reflection questions on the slide, making sure participants share specifically what they learned about strategy 5.
			**Display Slide 20.** Reflect: Key Ideas about Lesson Analysis (3 min) a. "Let's reflect on some key ideas you can take away from your lesson analysis experiences. These ideas may not reflect your personal experiences with lesson analysis so far, but hopefully you'll see their value in the lesson analysis process over time." b. Read the key ideas on the slide. c. Ask participants for their reactions to these ideas.

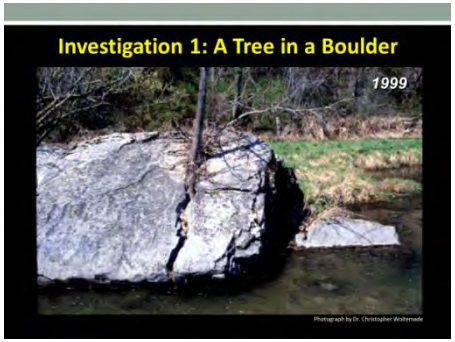
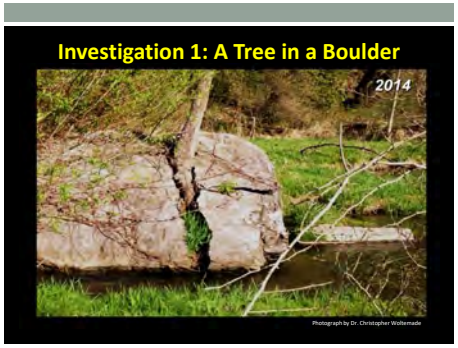
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 21.** Summarizing Strategies 4 and 5 (12 min) **Note:** Skip this activity if time is short. a. **Individuals:** To summarize strategies 4 and 5, have participants work independently to create visuals that show how analysis and interpretation (strategy 4) are related to explanation and argumentation (strategy 5). b. **Pairs:** "Share and compare your visuals with a partner." c. **Whole group:** "What questions did this activity raise for you?"
			**Display Slide 22.** Reflect: Lesson Analysis Focus Question (5 min) a. Review today's lesson analysis focus question. b. **Think-Pair-Share:** "Think for a moment about this focus question and how you might convince parents or colleagues that analyzing data and constructing explanations moves student thinking forward toward deeper understandings of science ideas. Then share your ideas with an elbow partner."

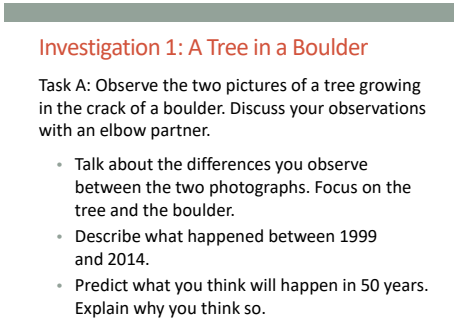
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
12:00–12:45 45 min	**LUNCH**		
12:45–3:15 150 min (Includes 10-min break) **Content Deepening: Earth's Changing Surface** Slides 23–77	**Purpose** • Deepen participants' science-content knowledge of Earth's changing surface by conducting investigations from ECS lessons 5a/b. • Consider Common Core State Standards (CCSS) for mathematics regarding angles and their measurement. **Content** • Earth's surface form is the result of tectonic processes that build up the land and erosional processes that wear down the land at the same time. • Rock weathering refers to all natural processes that break down and reduce the strength of intact rock. • Physical weathering involves the mechanical disintegration of intact rock and minerals into smaller		**Display Slide 23.** Content Deepening: Earth's Changing Surface (Less than 1 min) a. **Transition:** This slide marks the transition to the content deepening work. **Note:** Throughout this content deepening phase, refer as needed to the content background document and Common Student Ideas about Earth's Changing Surface.
			**Display Slide 24.** Today's Content Deepening (Less than 1 min) a. "Today's content deepening will focus on science ideas about Earth's changing surface from ECS lessons 5a/b. We'll also explore Common Core math standards regarding angles and their measurement."

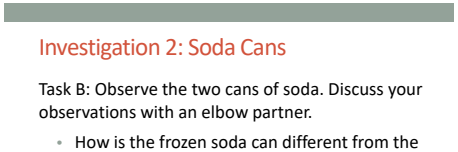
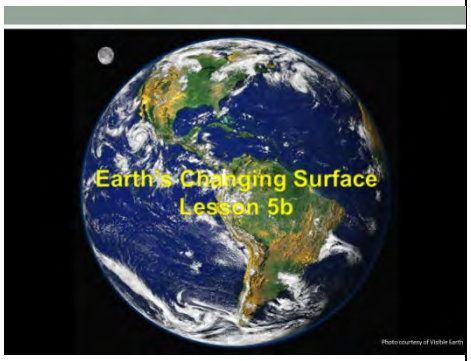
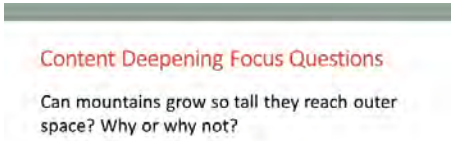
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	pieces. This process includes pressure release, thermal expansion and contraction, and the growth of foreign crystals. • Chemical weathering involves the chemical alteration of minerals that reduces rock strength. This process includes oxidation-reduction, hydrolysis, and biochemical weathering. • Physical weathering and chemical weathering occur at the same time and are often interdependent processes that break down rock and minerals to prepare them for erosion. • An angle is formed by two rays with a common endpoint. The vertex is where the rays intersect. Each ray makes up a side of the angle. • Angles are measured in degrees. • Angles are classified by their measure. The seven angle classifications are acute, obtuse, straight, right, reflex, zero, and complete. **What Participants Do** • Explore and discuss key science ideas behind ECS lessons. • Apply content learning to answer the focus questions for lessons 5a/b. • Explore how angles are classified and measured. • Review Common Core State Standards and student		**Display Slide 25.** Unit Central Questions (Less than 1 min) a. Review the unit central questions on the slide. b. Remind participants that these questions will guide student learning throughout the entire series of ECS lessons. c. "We'll gather more information during today's content deepening investigations to help us answer these questions."
			**Display Slide 26.** Key Science Idea (Less than 1 min) a. Remind participants that Earth's surface form is the result of tectonic processes that build up the land and erosional processes that wear down the land at the same time. This key science idea is the fundamental theme of the ECS unit.
			**Display Slide 27.** Earth's Changing Surface: Lesson 5a (Less than 1 min) a. "Next, we'll explore ideas about Earth's changing surface from ECS lesson 5a."

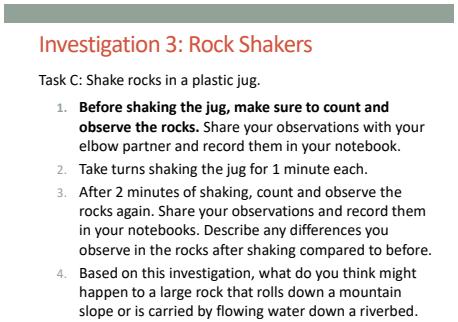
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process

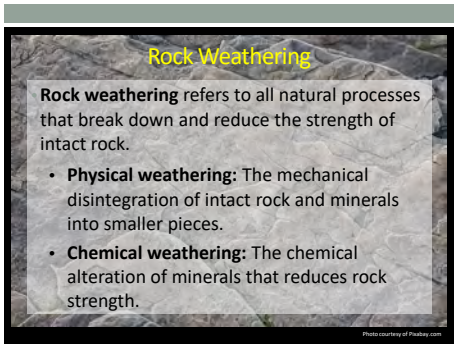
	misconceptions regarding angles and their measurement.
	
	Handouts in PD Binder
	• 3.5 Misconception Related to Angles: A Larger Space Means a Larger Angle
	• 3.7 Angle Add-Up Game
	
	Handouts in Lesson Plans Binder
	• 5.2 Pictures of a Tree in a Boulder (from ECS lesson 5a)
	• 5.3 Weathering Processes (from ECS lesson 5b)
	
	Supplies
	• Science notebooks
	• Chart paper and markers
	• Science-lesson materials kit (Earth's changing surface)
	• For content deepening from ECS lessons 5a/b:
	  • Cans of soda—frozen and room temperature (2 per pair)
	  • Plastic jugs with lids and lava rocks inside (1 per pair)
	• For math content deepening:
	  • 360-degree protractors (1 per participant) (from handout 3.6)
	  • Paper plates (2 different colors, 1 of each color per participant)
	  • Scissors
	  • Straightedge ruler (1 per pair)
	  • Dry-erase marker (or pencil) (1 per pair)
			**Display Slide 28.** Content Deepening Focus Questions (Less than 1 min)
			
			a. Read the focus questions on the slide.
			b. Emphasize that these questions will guide student learning throughout ECS lesson 5a.
			c. Have participants write these questions in their science notebooks and draw a box around them.

			**Display Slide 29.** Investigation 1: A Tree in a Boulder (1 min) a. Have participants locate handout 5.2 (Pictures of a Tree in a Boulder) in their lesson plans binder. b. "The first photograph on the handout was taken in 1999. Examine this photograph closely, focusing on the tree and the crack in the rock."
			**Display Slide 30.** Investigation 1: A Tree in a Boulder (2 min) a. "Now look at the second photograph on your handout. This photo of the same rock and tree was taken 15 years later in 2014." b. **Think-Pair-Share:** "Examine this photo closely, focusing again on the tree and the crack in the rock. Think about the similarities and differences between the two photographs. Then turn to an elbow partner and share your observations."

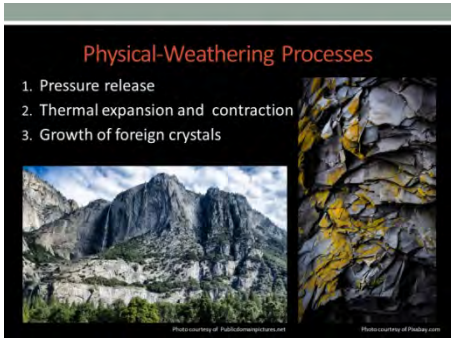
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	• Number cards (1 set per pair) (from handout 3.8) **PD Resources** • RESPeCT lesson plans binder **Resources in Lesson Plans Binder** *Resources section:* • Content background document • Common Student Ideas		**Display Slide 31.** Investigation 1: A Tree in a Boulder (5 min) a. Read the instructions on the slide. b. **Pairs:** Direct participants to work through Task A with their elbow partners. c. **Whole group:** Invite pairs to share their observations and predictions with the group. Probe participants' responses and elicit differing points of view. d. During this discussion, record participants' observations and predictions on chart paper.
			**Display Slide 32.** Investigation 2: Soda Cans (Less than 1 min) a. Distribute two cans of soda—one frozen and the other at room temperature—to each pair of participants. **Note:** Make sure the frozen cans are bulging or show some other kind of expansion deformities. b. "One of these soda cans was frozen overnight, and the other remained at room temperature."

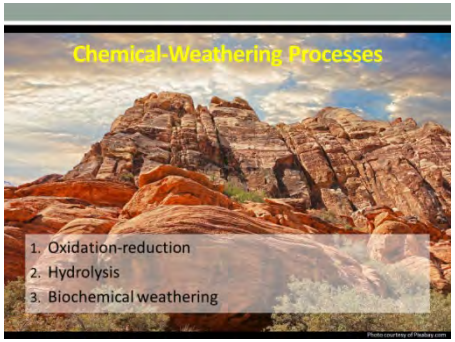
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 33.** Investigation 2: Soda Cans (5 min) a. Read the instructions for Task B on the slide. b. **Pairs:** Direct participants to work through this task with their elbow partners. c. **Whole group:** Invite pairs to share their observations and predictions with the group. Probe participants' responses and elicit differing points of view. d. During the discussion, record participants' observations and predictions on chart paper.
			**Display Slide 34.** Earth's Changing Surface: Lesson 5b (Less than 1 min) a. "Now we'll explore ideas about Earth's changing surface from lesson 5b."
			**Display Slide 35.** Review: Content Deepening Focus Questions (Less than 1 min) a. Review the focus questions on the slide. b. "These questions from ECS lesson 5a will guide student learning throughout lesson 5b as well."

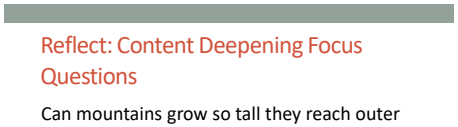
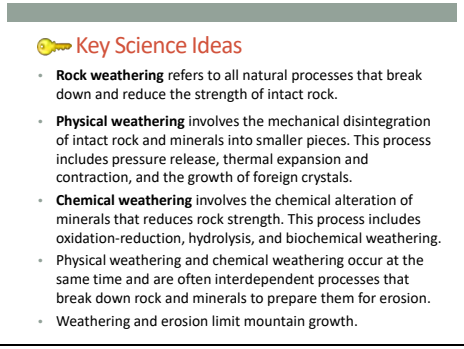
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 36.** Investigation 3: Rock Shakers (Less than 1 min) a. For this investigation, have participants pair up again. b. Distribute one plastic jug with lava rocks to each pair. Make sure all the jugs have lids. **Note:** Alternatively, you may use water bottles or tubs with lids for this activity.
			**Display Slide 37.** Investigation 3: Rock Shakers (15 min) a. Read through the instructions on the slide. b. **Pairs (10 min):** "You and your elbow partner will have 4 minutes to complete your preshaking rock count, sharing your observations, and recording them in your notebooks. Then you'll have a total of 2 minutes to take turns shaking your jug. I'll cue you when it's time to trade off. After 2 minutes of shaking, you'll have 4 minutes to count your rocks again and share your postshaking observations. Make sure to record your observations in your notebooks." c. Answer any questions participants may have. Then direct pairs to count their rocks and make their preshaking observations. d. At the end of 4 minutes, make sure everyone has finished recording their observations before directing pairs to start shaking their jugs. Use a timer to keep track of the time, or keep an eye on the clock. After 1 minute of shaking, tell partners to trade off. e. After 2 minutes, ask pairs to stop shaking their jugs.

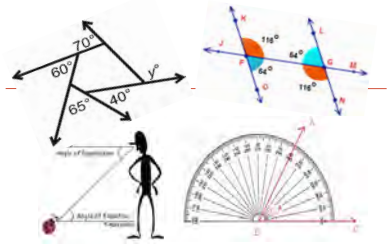
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			Give them 4 minutes to count their rocks again and discuss their observations before recording them in their notebooks. f. **Whole-group discussion (4 min):** Make sure everyone has finished the task before inviting pairs to share their observations with the group. After the share-out, ask participants to explain how this investigation relates to the previous investigations with the soda cans and the tree and boulder. Probe participants' responses and elicit differing points of view. g. During this discussion, record key observations and ideas on chart paper.
			**Display Slide 38.** Rock Weathering (10 min) a. "Next, we'll explore some key science ideas about rock weathering." b. "The term *rock weathering* refers to all natural processes that break down and reduce the strength of intact rock. Weathering processes take place in situ at rock outcroppings. These processes break down rocks and prepare them for erosion. *Erosion* is the removal and transport of weathered material by means of flowing water, ice, wind, or gravity. In this case, weathered rock is removed and transported to a new location as sediment." c. "As the slide indicates, there are two main categories of rock weathering: physical weathering and chemical weathering." d. Read the definitions on the slide. e. **Think-Pair-Share:** "Think for a moment about the three investigations we just completed: the tree-and-boulder investigation, the soda-can investigation, and the rock-

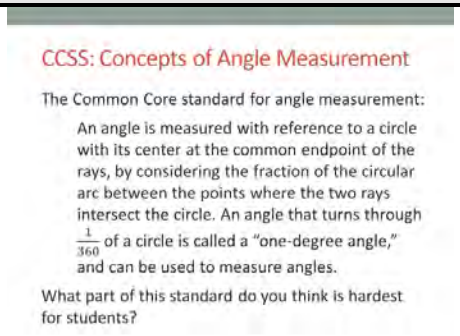
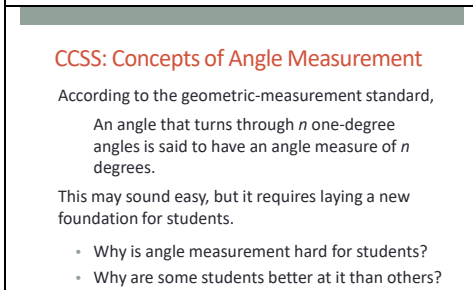
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			shakers investigation. Which of the weathering categories on the slide do you think best describes each investigation? Share your ideas with an elbow partner and then write them in your notebooks." f. **Whole-group share-out:** "So which weathering category do you think best describes each of our investigations? Let's hear your ideas." g. As participants share, probe their ideas and elicit differing points of view. Guide the discussion toward the conclusion that all three investigations describe physical weathering. In each investigation, rock was mechanically broken down through physical force. In the tree-and-boulder investigation, tree roots widened a preexisting crack in rock. The frozen soda can demonstrated that expanding ice can widen a preexisting crack in rock, and the rock-shakers investigation demonstrated that larger rocks can be broken into smaller pieces as they collide with one another. h. "Rust is an example of chemical weathering. A rock turning rust red is an example of rainwater chemically oxidizing iron-bearing minerals in much the same way a metal wagon or bicycle rusts when left outside in the rain for a long time." i. Emphasize that both physical and chemical weathering reduce the strength of hard rocks and make them more susceptible to erosion.

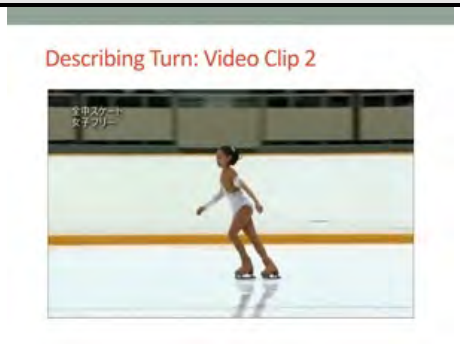
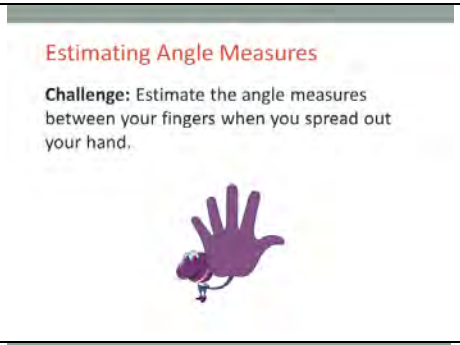
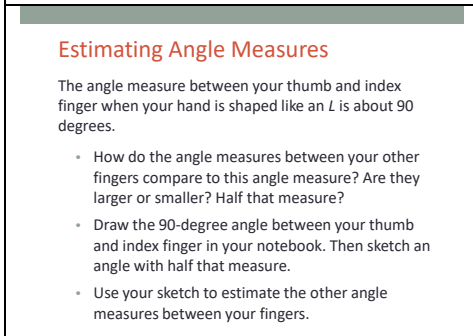
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 39.** Physical Weathering Processes (3 min) a. "This slide shows the three primary physical-weathering processes." b. "Pressure release causes rocks and minerals to crack by expansion in response to reduced confining pressure. Hard rock formed deep underground—like the granite in this photo—is under very high pressure from the weight of overlying rock. As erosion removes rock from Earth's surface over millions of years, the deeper rock moves closer to the surface and is under much less pressure. That rock will expand and crack outward like an onion skin in a process called *exfoliation*. The famous granite domes in Yosemite National Park are one example of this process." c. "Thermal expansion and contraction is another process that cracks rocks and minerals. Over long per iods of time, rocks on Earth's surface are exposed to cyclic heating and cooling, from day to night, summer to winter, warm period to ice age. Rocks can also be exposed to sudden heating from forest fires or lava flows. Heating results in expansion, and cooling results in contraction. Repeated heating and cooling cause rocks to crack and break down." d. "The growth of foreign crystals is the third important process that causes rocks to crack. This primarily happens on a microscopic scale as minerals undergo chemical changes that produce lower-density, higher-volume by-products that take up more space and push outward on surrounding minerals. This mineral expansion causes rocks to crack." e. Point out an important potential misconception: Students may think that the tree-and-boulder and soda-can investigations illustrate how tree roots and ice can

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			cause rocks to crack. But it's important to emphasize that these illustrations focus on *preexisting* cracks in rock formed by one of the three rock-weathering processes. Although growing tree roots and expanding ice are capable of increasing the size of preexisting cracks in rock, neither can exert enough pressure to cause new cracks to form. f. Highlight another potential misconception: Students may relate the rock-shakers investigation to weathering, since it illustrates how rocks break down when they collide with each other during erosion and transport. However, this is more of an erosional process than strictly a weathering process. Weathering is generally limited to things that happen to rock *before* erosion and transport.
			**Display Slide 40.** Chemical Weathering Processes (3 min) a. "This slide shows the three primary chemical-weathering processes." b. "Oxidation-reduction is a common process that occurs when oxygenated rainwater comes in contact with iron-bearing minerals on Earth's surface (such as pyroxene and magnetite) and converts these minerals into iron oxide or rust. This chemical-weathering process weakens rock and gives it a reddish color like the rocks on the slide." c. "Hydrolysis is the most common chemical-weathering process. Carbon dioxide dissolved in rainwater leads to the formation of carbonic acid that breaks down silicate minerals like feldspar and biotite, converting them to clay and releasing common nutrient ions like calcium, sodium, and potassium into the soil. The various types of soil that cover Earth's surface and allow humans to

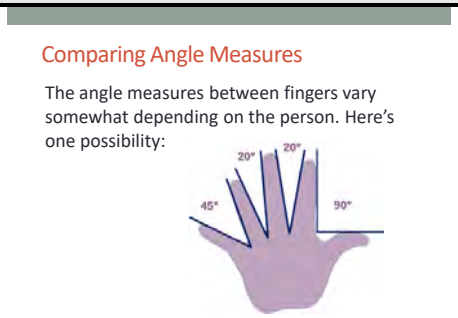
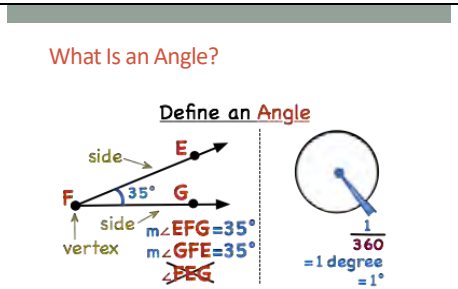
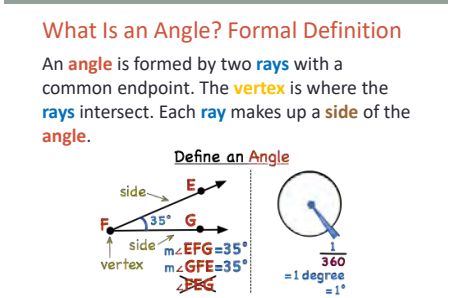
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			grow crops are the product of hydrolysis." d. "In biochemical weathering, living organisms, such as tiny microbes in water or soil, cause a wide range of chemical reactions that break down rock minerals. Plant roots also cause chemical reactions in rocks and soil. This allows a plant to take in needed nutrient ions originating from rock minerals." e. "Physical weathering and chemical weathering take place at the same time and are often interdependent processes that break down rocks and minerals to prepare them for erosion."
			**Display Slide 41.** Reflect: Content Deepening Focus Questions (5 min) a. Review the focus questions on the slide. b. Invite participants to share their ideas for answering the questions, using observations and evidence from today's investigations. c. Encourage participants to agree, disagree, ask questions, or add to the ideas others share. d. During this discussion, record key ideas on chart paper.
			**Display Slide 42.** Key Science Ideas (3 min) a. Review the key science ideas on the slide that answer the focus question. Emphasize that participants' observations and evidence from the tree-and-boulder, soda-can, and rock-shakers investigations helped shape these responses. b. **Whole-group discussion:** "Does everyone agree with these ideas? Would you like to add or revise anything?"

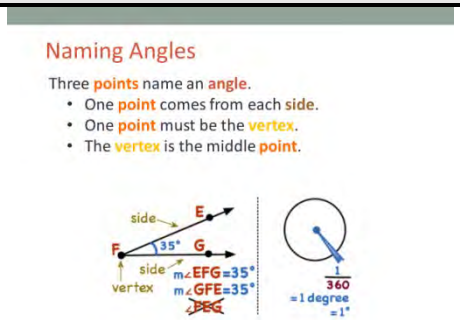
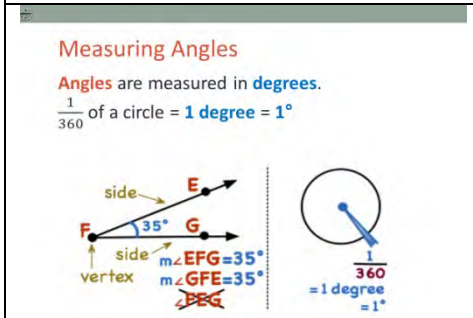
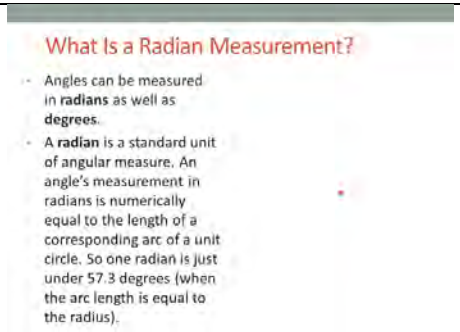
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			c. Ask participants to copy these ideas into their science notebooks under the focus question.
	10-MINUTE BREAK		
	What Participants Do • Review Common Core State Standards (CCSS) for mathematics regarding angles and their measurement. • Explore how angles are classified and measured. • Experience a concrete model with estimation. **Videos** • Boy Riding Bike • Girl Ice Skating **Handouts in PD Binder** • 3.5 Misconception Related to Angles • 3.7 Angle Add-Up Game **Supplies** • 360-degree protractors (1 per participant) (from handout 3.6) • Paper plates (2 different colors, 1 of each per participant) • Scissors • Straightedge ruler (1 per pair) • Dry-erase marker (or pencil) (1 per pair) • Number cards (1 set per pair) (from handout 3.8)	Math Content Deepening Focus Question What is an angle, and how do you measure it?	**Display Slide 43.** Math Content Deepening Focus Question (Less than 1 min) a. Read the focus question on the slide. b. Have participants write this question in their science notebooks and draw a box around it.
		What Do You Know about Angles?  	**Display Slide 44.** What Do You Know about Angles? (Less than 1 min) a. Ask participants what they know about angles. (Keep this discussion brief.)
		Common Core State Standards (CCSS) According to the California Common Core standards for mathematics, 4th-grade students must be able to do the following: • Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement.	**Display Slide 45.** Common Core State Standards (CCSS) (Less than 1 min) a. Review the CCSS standard for geometric measurement on the slide. b. Note that this is a new domain for 4th grade.

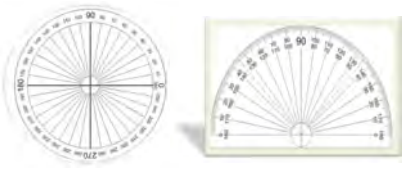
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 46.** CCSS: Concepts of Angle Measurement (3 min) a. Read the California Common Core standard for angle measurement on the slide. b. **Ask:** "What part of this standard do you think is hardest for students?" c. Invite participants to share some of the challenges students have in understanding angle measurement.
			**Display Slide 47.** CCSS: Concepts of Angle Measurement (3 min) a. Read the standard on the slide and note the use of the word *turns*. This supports the concept of how angles are measured, but it requires laying a new foundation for students. b. **Ask:** "Why is angle measurement hard for students? Why are some students better at it than others?"
	What Participants Do • Watch a video clip of a boy riding a bike. • Discuss what a complete turn means and how it's measured.		**Display Slide 48.** Describing Turn: Video Clip 1 (4 min) a. Show the video clip of a boy riding a bike. b. Ask participants, "How would you describe this turn?" c. Discuss what a complete turn means and how it's measured. Consider the idea that 360 degrees is a full turn or rotation.

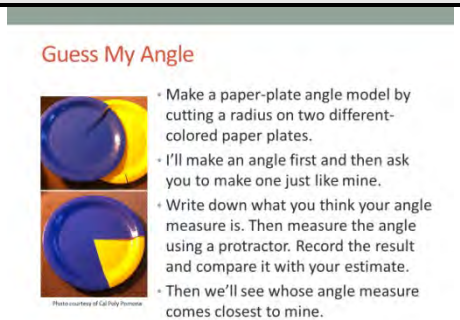
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	What Participants Do • Watch a video clip of a girl ice skating. • Estimate the number of degrees the girl turns and apply the concept of full rotation and 360 degrees.		**Display Slide 49.** Describing Turn: Video Clip 2 (4 min) a. "The next video clip of an ice skater engages us in the idea of a 360-degree turn that allows for some computation. Watch the skater's feet to get an accurate count and result. b. Show the video clip. c. Highlight the result of the computation: (360 x 3) + (360 x 3).
	What Participants Do • Explore angle estimation by measuring the angle between their fingers.		**Display Slide 50.** Estimating Angle Measures (Less than 1 min) a. "Your next challenge will be to estimate the angle measures between your fingers when you spread out your hand."
			**Display Slide 51.** Estimating Angle Measures (7 min) a. Read the directions on the slide. b. **Individuals (4 min):** Have participants work independently on their estimates. Be available to answer questions as they arise. c. **Whole group (2 min):** After participants have completed their estimates, discuss the results as a group.

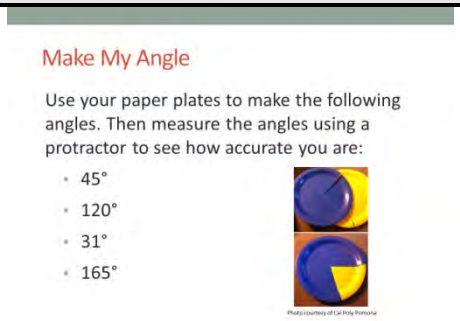
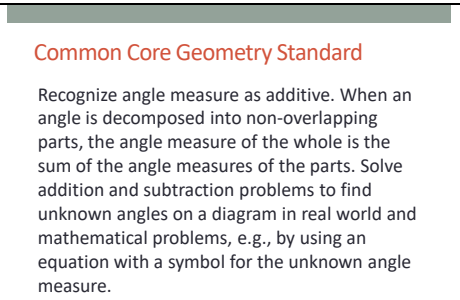
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Do Longer Fingers Mean Larger Angles? Do people with long fingers have larger angles between their fingers?	**Display Slide 52.** Do Longer Fingers Mean Larger Angles? (7 min) a. Read the question on the slide. b. "This question highlights an important misconception about angle measurement: Students may think that when two sides of an angle are longer than the sides of another angle, the angle with the longer sides is bigger." c. Have participants think about the question on the slide for a moment; then elicit participants' ideas and reasoning. d. **Individuals:** Distribute handout 3.5 (Misconception Related to Angles) and give participants a couple of minutes to read through the information silently. e. **Whole group:** Discuss the misconception and the suggested remedies. Invite participants to share other possible remedies.
		Do Longer Fingers Mean Larger Angles? **Answer:** Finger length does **NOT** affect angle measures. • The largest angle between the thumb and index finger measures about 90. (A 90-degree angle is a right angle.) • The other angle measures between fingers vary somewhat depending on the person. But turn doesn't change even though longer fingers extend the lines of an angle.	**Display Slide 53.** Do Longer Fingers Mean Larger Angles? (2 min) a. Read the answer on the slide. b. Ask participants whether they agree or disagree with this answer or have anything to add.

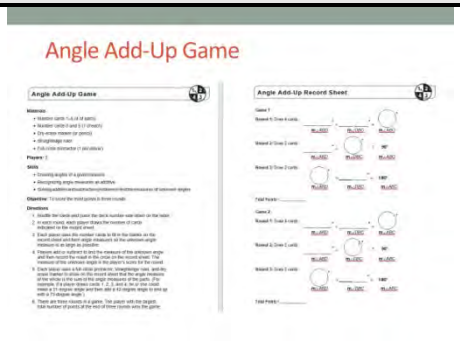
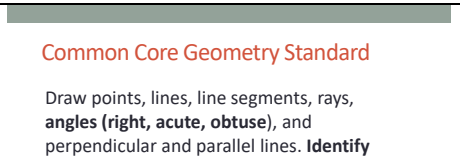
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 54.** Comparing Angle Measures (1 min) a. Have participants compare angle measures between the fingers on their hands to see whether they're the same or vary. b. Highlight the sample variations on the slide.
	What Participants Do • Formalize the definitions and notations associated with angles.		**Display Slide 55.** What Is an Angle? (2 min) a. Discuss the denotations on the slide. b. "Based on these denotations, how would you define an angle?" c. Elicit ideas from the group and record them on chart paper. d. After the discussion, have participants copy these ideas and the slide denotations into their science notebooks.
			**Display Slide 56.** What Is an Angle? Formal Definition (1 min) a. Read the formal definition of an angle on the slide. b. Have participants copy this definition into their science notebooks.

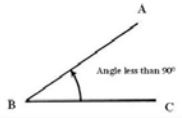
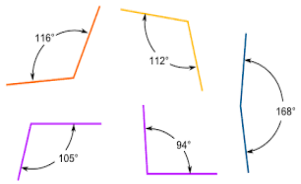
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 57.** Naming Angles (2 min) a. Walk participants through the information on the slide. b. **Ask:** "What do students struggle with when they name angles? Does order matter?" c. Elicit responses and reasoning from the group. d. Emphasize that order does matter. The vertex has to be in the middle of the three points (e.g. EFG or GFE, not FGE).
			**Display Slide 58.** Measuring Angles (Less than 1 min) a. Walk participants through the information on the slide.
	What Participants Do • Watch an animation and consider how it helps them make sense of radian measurement.		**Display Slide 59.** What Is a Radian Measurement? (3 min) a. Reveal only the first bullet point on the slide and read the information. b. Ask participants how they would define a radian measurement. c. Reveal the definition on the slide. Then show the slide animation at least once. **Note:** The animation is about 45 seconds. d. "What helped you better understand what a radian

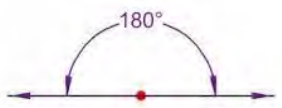
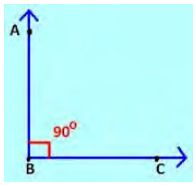
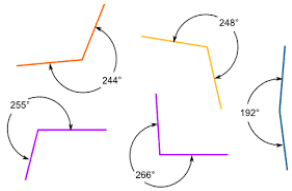
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			measurement is: the definition on the slide or the animation?" e. "If one radian is just under 57.3 degrees, how many radians are in a 90-degree angle?" **Note:** The answer is pi/2.
		Tools for Measuring Angles 	**Display Slide 60.** Tools for Measuring Angles (5 min) a. Discuss the tools used to measure angles. b. Tell participants that in the next activity, they'll measure angles using a 360-degree protractor like the one on the left side of the slide. c. Emphasize the importance of identifying the vertex and initial side of an angle when using a protractor to measure angles. d. "Students often struggle with identifying the initial side of an angle when using a protractor. What are some ways to support students in using this tool?" e. After this discussion, have participants pair up; then give each participant a protractor.
	What Participants Do • Consider an application problem related to angle measurement.	Angle-Measurement Challenge What is the angle measure between the hands on a clock if the long hand is on the number 12 and the other hand is on the number 1?	**Display Slide 61.** Angle-Measurement Challenge (3 min) a. Read the angle-measurement challenge on the slide. b. **Individuals:** Give pairs 2 minutes to work out the solution. c. **Whole group:** Call on one or two pairs to share their answers and reasoning. Invite other participants to agree, disagree, ask questions, or add on.

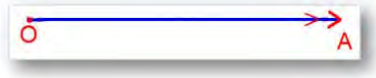
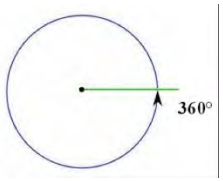
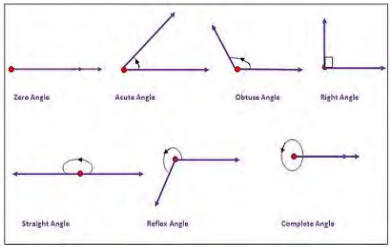
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	What Participants Do • Use paper plates to estimate and measure angles.		**Display Slide 62.** Guess My Angle (7 min) a. "Next, we'll use paper plates to estimate and measure angles." b. Distribute two different-colored paper plates to each participant and a pair of scissors. The read the directions on the slide. c. Demonstrate how to make an angle model by cutting a radius on two paper plates. Make sure to record the angle measurement. d. Direct participants to make an angle like yours with their paper plates. e. First, have participants estimate their angle measures and record them in their science notebooks. Then direct them to use their protractors to measure their angles and record the results. f. Have participants compare their results with their estimates to see how close they are. g. Next, tell participants your angle measure and ask them whether their results are close or an exact match. h. Throughout this activity, encourage participants to share their ideas and consider how this activity gives students an opportunity to reflect on their own estimates.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 63.** Make My Angle (8 min) a. Direct participants to use their paper plates to make the angles on the slide and then perform angle measures with their protractors to see how accurate they are. Remind participants to record their results in their science notebooks. b. When participants have completed these measurements, measure the angles yourself and record the results on chart paper. c. Have participants compare their results with yours and make any necessary corrections. d. Discuss why it's valuable for students to make and measure the angles themselves first. e. Note some of the challenges students might encounter when they attempt to measure angles. For example, students often don't align the initial side correctly (which means they don't start at 0), or they use the 180-degree mark as their initial side.
	What Participants Do • Engage in a game that directly addresses the CCSS geometry standard.		**Display Slide 64.** Common Core Geometry Standard (Less than 1 min) a. Read the Common Core standard on the slide. b. Ask participants whether they have any questions or comments.

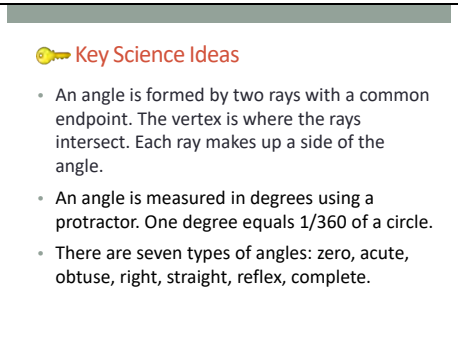
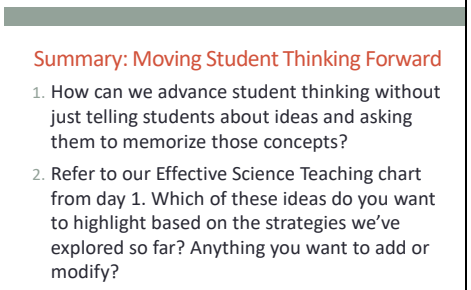
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 65.** Angle Add-Up Game (15 min) a. Have participants pair up for this activity. Then give handout 3.7 (Angle Add-Up Game) to each participant and a set of number cards, a straightedge ruler, and a dry-erase marker to each pair. Participants will also need their protractors. **Note:** If you decide not to laminate the record sheet, a pencil can be used to sketch the angles in lieu of a dry-erase marker. b. Emphasize that this game directly addresses the Common Core standard they just reviewed. c. Walk participants through the supply list and directions on the handout. d. Ask participants whether they have any questions and then begin the game. Circulate around the room during the activity to answer questions or address any difficulties participants may encounter. e. After the game, debrief participants on their experience. Ask, "How do you think this game will help students understand the concept of angle measurement?"
	What Participants Do • Address another CCSS standard by reviewing vocabulary associated with angles. • Identify and classify angles based on their measurements.		**Display Slide 66.** Common Core Geometry Standard (Less than 1 min) a. "Another Common Core standard we need to address relates specifically to the vocabulary associated with angles."

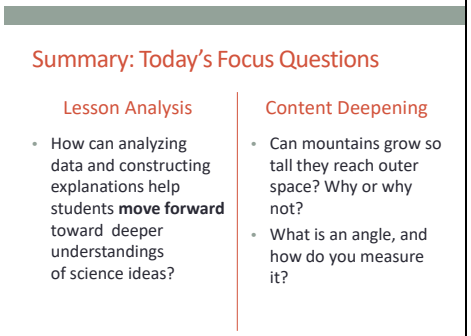
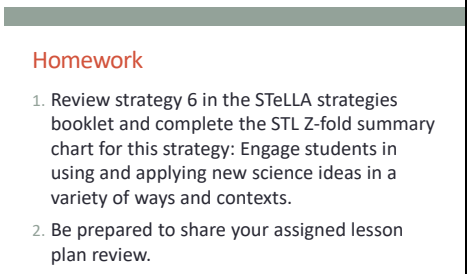
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Classifying Angles List all the angles you know about in your science notebook. Try to use their formal names. (**Hint:** There are seven types of angles.)	**Display Slide 67.** Classifying Angles (1 min) a. "Next, we'll classify, or name, the types of angles according to their measure." b. **Individuals:** Ask participants to list in their notebooks all the angles they know about. Encourage them to use the formal names, though it's unlikely they'll know all seven. c. **Whole group:** Call on participants to name the seven types of angles.
		Classifying Angles: Acute Angle This is an acute angle (so cute). 	**Display Slide 68.** Classifying Angles: Acute Angle (Less than 1 min) a. "The angle on this slide is an acute angle." b. Note that the measure of an acute angle is less than 90 degrees.
		Classifying Angles: Obtuse Angle These are obtuse angles. 	**Display Slide 69.** Classifying Angles: Obtuse Angle (Less than 1 min) a. "These are obtuse angles." b. Note that the measure of an obtuse angle is between 90 and 180 degrees.

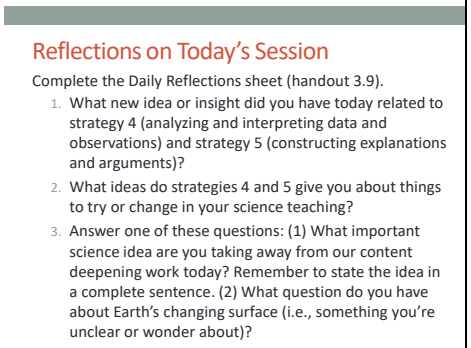
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Classifying Angles: Straight Angle This is a straight angle.  	**Display Slide 70.** Classifying Angles: Straight Angle (Less than 1 min) a. "This is a straight angle." b. Note that the measure of a straight angle is 180 degrees.
		Classifying Angles: Right Angle This is a right angle. Students should be able to use this notation.  	**Display Slide 71.** Classifying Angles: Right Angle (Less than 1 min) a. "This is a right angle." b. Note that the measure of a right angle is 90 degrees. c. "Fourth-grade students should be able to use the notation on the slide."
		Classifying Angles: Reflex Angle These are reflex angles.  	**Display Slide 72.** Classifying Angles: Reflex Angle (Less than 1 min) a. "These are reflex angles." b. Note that the measure of a reflex angle is greater than 180 degrees and less than 360 degrees.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Classifying Angles: Zero Angle This is a zero angle.  	**Display Slide 73.** Classifying Angles: Zero Angle (Less than 1 min) a. "This is a zero angle." b. "What does the name of this angle tell you about its measure?" c. **Emphasize:** "If you think of angles as turns, a zero angle has a zero turn."
		Classifying Angles: Complete Angle This is a complete angle, also called a **full angle**.  	**Display Slide 74.** Classifying Angles: Complete Angle (Less than 1 min) a. "This is a complete angle. Complete angles are also called *full angles*." b. Note that the measure of a complete angle is 360 degrees. This is equivalent to 1 turn or 2 pi radians.
		Review: The Seven Types of Angles  	**Display Slide 75.** Review: The Seven Types of Angles (Less than 1 min) a. Review the seven angles on the slide. b. **Emphasize:** "Even though you'll be teaching only acute, obtuse, and right angles, you should know the other types of angles in case a student asks about an angle that doesn't fall into these classifications. For example, a student may ask about an angle that measures 250 degrees. This is a reflex angle, not an obtuse angle." **Note:** These angle classifications are mutually exclusive (i.e., an angle can't be both a right angle and an acute angle). However, a triangle can have both

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			acute and right angles.
	What Participants Do • Apply ideas about angles to geometrical shapes and use reasoning to support their explanations.	Use and Apply: Angles and Geometric Shapes Think about these questions. Then discuss them with an elbow partner: 1. Can a triangle have more than one type of angle? Explain your reasoning. 2. Can a triangle have only one type of angle? Explain your reasoning. 3. What are the different angle combinations in a triangle? 4. Can a triangle have a reflex angle? 5. Can a polygon have a reflex angle?	**Display Slide 76.** Use and Apply: Angles and Geometric Shapes (3 min) a. Introduce the questions on the slide. b. **Think-Pair-Share:** Ask participants to think about these questions and then share their ideas and reasoning with an elbow partner. c. **Whole group:** Invite participants to share their ideas and reasoning with the group. As they explain their reasoning, consider the Common Core standards of practice. Ask probe and challenge questions to clarify participants' thinking as needed.
		Answers: Angles and Geometric Shapes 1. Can a triangle have more than one type of angle? Explain your reasoning. **Yes. A right angle has two acute angles and a right angle.** 2. Can a triangle have only one type of angle? Explain your reasoning. **Yes. An equilateral triangle has three acute angles (60, 60, 60).** 3. What are the different angle combinations in a triangle? **(1) acute, acute, acute, (2) acute, obtuse, acute, (3) acute, acute, right.** 4. Can a triangle have a reflex angle? **No.** 5. Can a polygon have a reflex angle? **Yes. A concave polygon can have a reflex angle.** 	**Display Slide 77.** Answers: Angles and Geometric Shapes (Less than 1 min) a. Review the answers to the use-and-apply questions on the slide.
		Reflect: Math Content Deepening Focus Question What is an angle, and how do you measure it?	**Display Slide 78.** Reflect: Math Content Deepening Focus Question (2 min) a. Review the focus question on the slide. b. Invite participants to share their ideas for answering the question, using observations and evidence from today's investigations. c. Encourage participants to agree, disagree, ask

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			questions, or add to the ideas others share. d. During this discussion, record key ideas on chart paper.
			**Display Slide 79.** Key Science Ideas (1 min) a. Review the key science ideas on the slide that answer the focus question. b. **Whole-group discussion:** "Does everyone agree with these ideas? Would you like to add or revise anything?" c. Ask participants to copy these ideas into their science notebooks under the focus question.
3:15–3:30 15 min **Wrap-Up: Summary, Homework, and Reflections**	**Purpose** • Reflect on the day's learning and summarize key ideas about the science content and strategies 4 and 5, linking those ideas to participants' images of effective science teaching and changes they want to make in their individual teaching practices. **What Participants Do** • Discuss ways of moving student		**Display Slide 78.** Summary: Moving Student Thinking Forward (5 min) a. Have participants share ideas about the first question on the slide. Then ask, "What are some things we've discussed today that address this question?" b. Refer participants to the Effective Science Teaching chart from day 1 and discuss the remaining questions on the slide. Modify the chart as participants share their ideas.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
Slides 78–81	thinking forward. • Add to/modify the Effective Science Teaching chart. • Review and discuss (as needed) today's focus questions. • Learn about the homework assignment and the focus of tomorrow's work. • Write reflections on today's learning. **Posters and Charts** • Effective Science Teaching chart • Strategy charts created today for STL strategies 4 and 5 **Handouts in PD Binder** • 3.9 Daily Reflections—Day 3 **Supplies** • Science notebooks **PD Resources** • STeLLA strategies booklet • STL Z-fold summary chart (front pocket of PD binder)	 	**Display Slide 79.** Summary: Today's Focus Questions. (5 min) a. Review today's focus questions. b. **Discuss:** "The STeLLA strategies booklet claims that strategies 4 and 5 are ways of moving student thinking forward. How would you support or challenge that claim? In other words, are you convinced that letting students analyze data and construct explanations will help them move forward toward deeper understandings of science ideas?" c. **Ask:** "What key ideas do you now have about how to address our science content deepening focus question?" **Display Slide 80.** Homework (2 min) a. "Tomorrow we'll focus on another strategy to help move student thinking forward toward deeper understandings of science ideas." b. Review the homework assignment and have participants copy it into their science notebooks.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 81.** Reflections on Today's Session (3 min) a. Have participants reflect on today's session and answer the questions on the Daily Reflections sheet (handout 3.9 in PD program binder). **Note:** To support this task, encourage participants to refer to the STeLLA strategies booklet, the charts they created for STL strategies 4 and 5, the Effective Science Teaching chart, and their STL Z-fold summary charts.