RESPeCT Summer Institute Professional Development Leader Guide (PDLG)

Grade Level	1	**Day**	3	**STeLLA Strategy**	STL Strategy 4: Analyze and Interpret Data and Observations STL Strategy 5: Construct Explanations and Arguments	**Subject Matter Focus**	Sound
Focus Questions	• How can analyzing data and constructing explanations help students *move forward* toward deeper understandings of science ideas? • What does a good soundmaker consist of? What is your evidence?						
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). • When something vibrates, it causes the air around it to vibrate. • A good soundmaker requires a vibrating component (oscillator) and a neighboring resonator with a large volume of air (resonance space) that amplifies one frequency more than other frequencies.						

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.	**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**	• Video Clip 3.1: Derose classroom (analyze and interpret, strategy 4); 3.1_mspcp_gr1_sound_derose_L3_c1 • Video Clip 3.2: Doody classroom (analyze and interpret, strategy 4; construct explanations and arguments, strategy 5); 3.2_mspcp_gr1_sound_doody_L5_c2

• Watch video clips and anticipate participant responses.
• Prepare charts for the day's agenda and focus questions.
• For content deepening:
  • Assemble one clucker for each pair of participants. (See supplies and assembly instructions in Sound lesson 2a.)
	• 3.1 Quick Reference Tools for Strategies 4 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 Who Will Receive More Sound?
	• 3.6 Math Challenge: Portions of Sound Energy
	• 3.7 Daily Reflections—Day 3
	
	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
	• Lesson materials kit
	• For content deepening (1 per pair):
	  • Tuning fork
	  • Small plastic container and a rubber band
	  • Small funnel
	  • Water bottle
	  • Graduated cylinder
	  • Large aluminum tray
	  • Vuvuzela (stadium horn)
	  • A clucker
	
	PD Resources
	• STeLLA strategies booklet
	• RESPeCT PD program binder
	• RESPeCT lesson plans binder
	
	Resources in Lesson Plans Binder
	Resources section:
	• Sound Content Background Document
	• Common Student Ideas about Sound	

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 to better understand strategies 4 and 5, how they're related, and how they can be used to challenge student thinking to move forward. • Deepen science-content knowledge of sound through lesson analysis.
12:00–12:45 45 min	**LUNCH**	
12:45–3:15 150 min (Includes 10-min break)	**Content Deepening: Sound**	• Deepen participants' science-content knowledge of sound and the intensity of sound. • Deepen participants' understandings of what makes a good soundmaker.
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

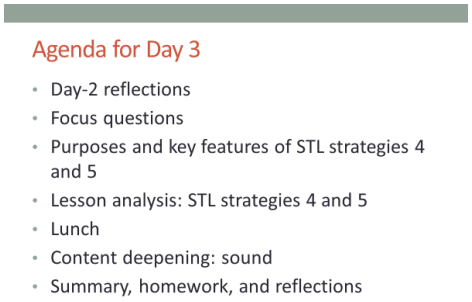
<table>
<tr><th>PD Model: Time/Phase</th><th>Purpose, Content, and What Participants Do</th><th>Slides</th><th>Process</th></tr>
<tr><td rowspan="3">8:00–8:35
35 min

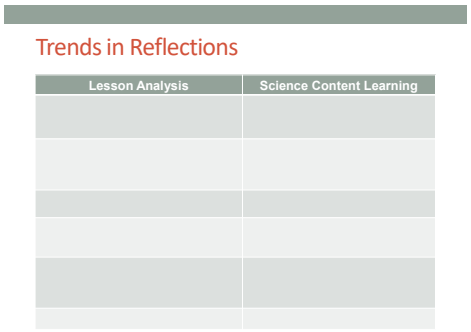
Getting Started

Slides 1–8</td><td rowspan="3">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 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</td><td>  </td><td>Display Slide 1. RESPeCT PD Program (5 min)

a. Take care of any housekeeping issues.</td></tr>
<tr><td>  </td><td>Display Slide 2. Agenda for Day 3 (2 min)

a. Talk through the agenda for the day.</td></tr>
<tr><td>  </td><td>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.</td></tr>
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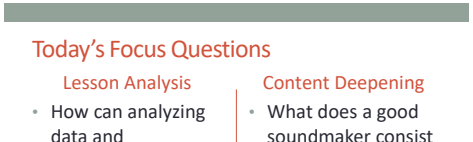
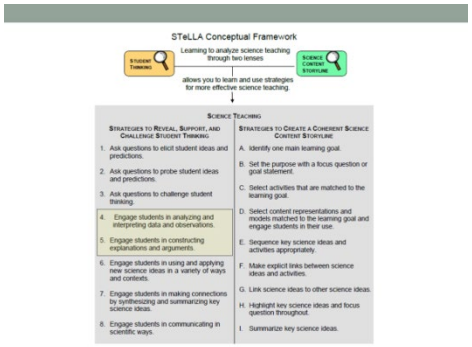
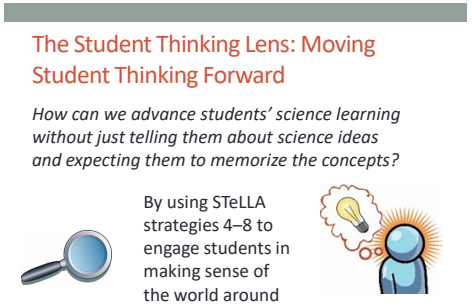
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	agenda, the focus questions, and the theme of the day and the rest of the week: *moving student thinking forward*. • Review Summary of STeLLA Student Thinking Lens Strategies in the STeLLA strategies booklet and recognize 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** • STeLLA strategies booklet		**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 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:

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			• 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." • "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!**"

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		The Student Thinking Lens: Moving Student Thinking Forward <table><tr><th>Strategies That Reveal Student Thinking</th><th>Strategies That Move Student Thinking Forward</th></tr><tr><td>1. Elicit questions</td><td></td></tr><tr><td>2. Probe questions</td><td></td></tr><tr><td>3. Challenge questions</td><td>3. Challenge questions</td></tr><tr><td>4. Analysis and interpretation of data</td><td>4. Analysis and interpretation of data</td></tr><tr><td>5. Construction of explanations</td><td>5. Construction of explanations</td></tr><tr><td>6. Use and application of new ideas</td><td>6. Use and application of new ideas</td></tr><tr><td>7. Synthesis and summarizing</td><td>7. Synthesis and summarizing</td></tr><tr><td>8. Scientific communication</td><td>8. Scientific communication</td></tr></table>	**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.
		The Student Thinking Lens: From Questions to Activities • Look at the Summary of STeLLA Student Thinking Lens Strategies in the strategies booklet. • What distinguishes strategies 1–3 from the rest of the Student Thinking Lens strategies?	**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 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.

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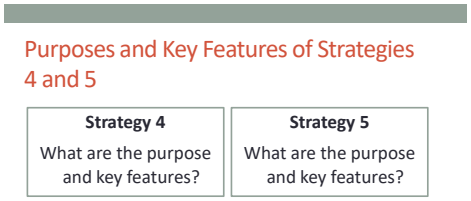
8:35–9:35 60 min **Introducing Student Thinking Lens (STL) Strategies 4 and 5** Slides 9–11	**Purpose** • Develop an initial understanding of strategy 4: Engage students in analyzing and interpreting data and observations. • Develop an initial understanding of strategy 5: Engage students in constructing 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 explanations of scientific data or observed phenomena, as well as critiquing proposed explanations using scientific argumentation.		**Display Slide 9.** Purposes and Key Features of Strategies 4 and 5 (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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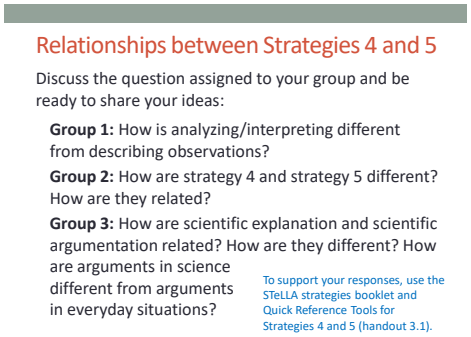
	What Participants Do • Create and discuss strategy charts summarizing the purposes and key features of strategies 4 and 5. • Discuss the differences and relationships among observing, analyzing and interpreting, and constructing explanations and arguments. • Use written scenarios to practice identifying 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 about 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

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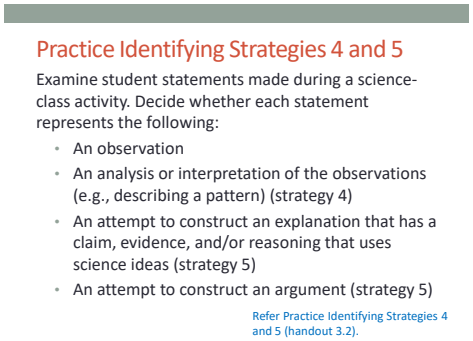
			evidence and to science ideas. • "What did you come up with for the third question?" **Key ideas for question 3:** A scientific explanation includes a claim that answers the question being studied, evidence that supports the claim, and reasoning that links the claim to the evidence and to science ideas. 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

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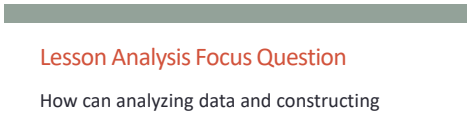
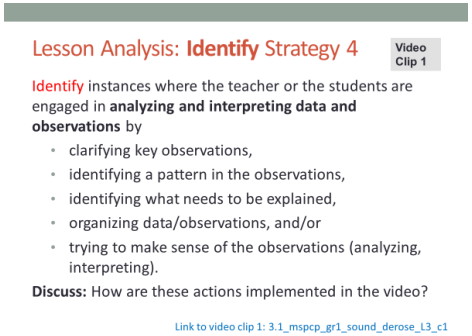
			(PD handout 3.1). **Note:** For examples of ideal participant responses, see PD Leader Master: Practice Identifying Strategies 4 and 5.
9:35–12:00 145 min (Includes 10-min break) **Lesson Analysis: STL Strategies 4 and 5** Slides 12–22	**Purpose** • Use lesson analysis to better understand strategies 4 and 5, how they're related, and how they can be used to challenge student thinking to move forward. • Deepen science-content knowledge of sound 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		**Display Slide 12.** Lesson Analysis Focus Question (Less than 1 min) a. Review the focus question that will guide today's lesson analysis work.
			**Display Slide 13.** Lesson Analysis: Review Lesson Context, Video Clip 1 (2 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

	critiquing proposed explanations using scientific argumentation.
	
	What Participants Do
	• Watch one 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 practice identifying strategies 4 and 5.
	• Watch a second classroom video clip to identify strategies 4 and/or 5 and analyze student thinking that these strategies reveal and challenge.
	• Summarize key ideas about the relationships between strategies 4 and 5.
	
	Videos
	• Video Clip 3.1, Derose classroom
	• Video Clip 3.2, Doody 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."
			
			Observations:
			• **Identifying what needs to be explained:**
			  • At video segment 00:58, the teacher identifies what needs to be explained by asking students, "Where did the vibration [sound] start?" The question clarifies that sounds require a source.
			  • At segments, 01:22 and 01:30, students identify the source of the sound/vibration as the tuning fork (the teacher).
			  • At segment 01:31, the teacher asks students to identify where the vibration went.
			  • At segment 01:40, students indicate that the vibration traveled to the ear (Piper).
			• **Trying to make sense of the observations (analyzing and interpreting):**
			  • At video segment 02:09, the teacher helps students make sense of their observations by asking, "Did that Slinky look like anything to you?" You could argue that the teacher is prompting (leading) students to look for a pattern of repeating vibrations in the Slinky.

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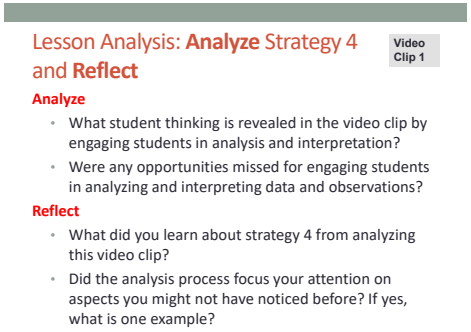
			• At segments 02:18-02:31, a student observes, "It bounced off of the tuning fork and went to the ear … and the Slinky was bouncing, so it was the vibration bouncing off of it … to get to the ear." • At this point, the teacher could have asked these challenge questions: "What does that look like? Tell us more about how you're thinking about that."
			**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. **Possible claim:** Students aren't successful in identifying the repeating pattern of vibrations in the Slinky model. **Evidence:** 02:18–02:27 **Reasoning:** The student knows that sound moves as a vibration from the source to the ear but doesn't identify this as a repeating pattern. **Missed opportunity:** At video segment 01:52, after summarizing what students said, the teacher could

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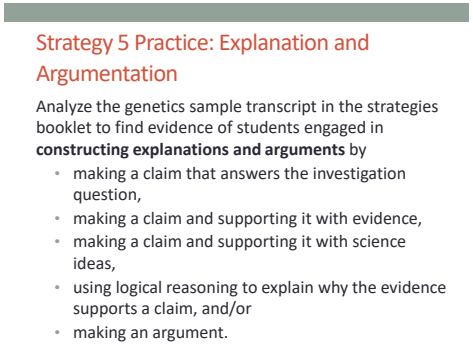
			have clarified student thinking by asking whether the Slinky itself moved to the other end. The teacher doesn't clarify that the vibrations (started with her hand pushing the Slinky) travel in a repeating pattern through the Slinky. This pattern provides students with evidence that the vibrations move from one end of the Slinky to the other.
			**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 for strategy 5 ("About Weather") 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 sample transcript in the 'About Weather' section and see if you can find any evidence of the teacher engaging students 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. **Observations:**

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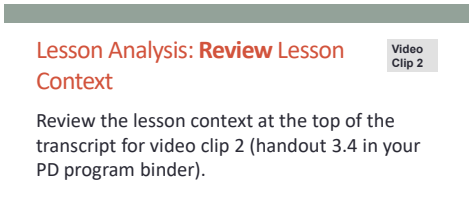
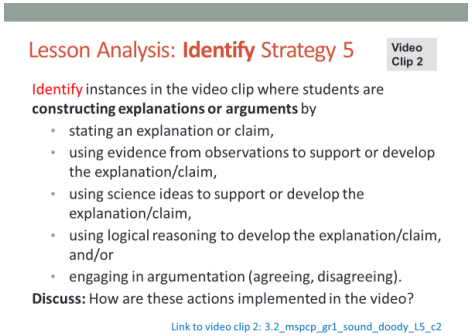
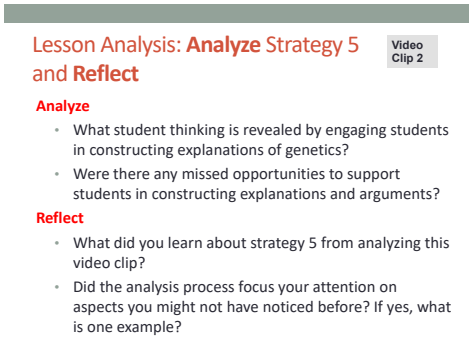
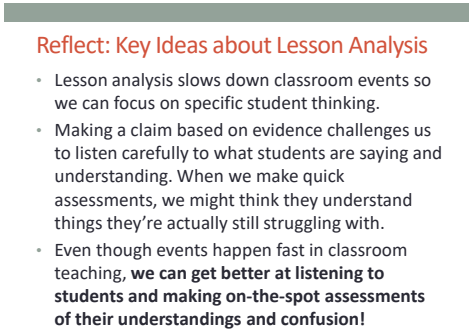
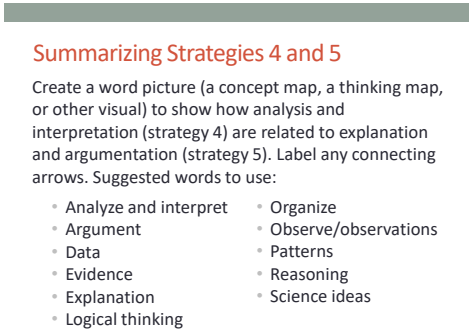
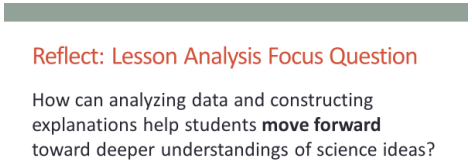
			• The example from the strategies booklet highlights the levels at which students make claims: (1) making a claim, (2) making a claim with evidence, and (3) making a claim with evidence and reasoning (using logic and science ideas). The teacher uses questioning strategies to support students in piecing together claims, evidence, and reasoning. • The transcript also shows students making arguments by presenting alternative explanations for their observations. As students think through possible alternative explanations for the phenomena they observe, they weigh evidence, engage in logical reasoning, and apply science ideas. • These are ideal examples of constructing explanations and arguments. It's unlikely that most 1st graders would construct such complete explanations or arguments. The teacher would likely need to use questioning strategies and sentence starters to help students develop their explanations and arguments.
	10-MINUTE BREAK		
			**Display Slide 17.** Lesson Analysis: Review Lesson Context, Video Clip 2 (1 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).

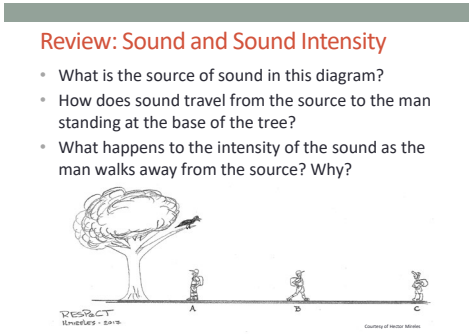
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 18.** Lesson Analysis: Identify Strategy 5, Video Clip 2 (25 min) a. "As you watch the video clip, identify instances where students are engaged in constructing explanations and arguments (strategy 5). You 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 as well as probe questions in the video clip." **Observations:** • At video segment 01:42, the student answers the teacher's question, "So where did the sound go?" by making a claim: "Everywhere." • At segment 02:49, the student answers the teacher's question ("What would be our proof or our evidence that the sound didn't stop at Odessa's ear?") by providing evidence ("It went to Giovanni, and all them could hear it too") and supporting it with logical reasoning. • Students' comments at segments 02:09 ("Because the sound wave") and 02:18 ("Our evidence [is] that the air carried the sound.") don't

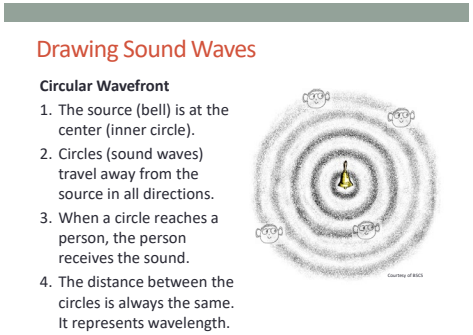
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			answer the teacher's question ("How do we know that the sound went past Odessa?"); therefore, they don't represent a claim.

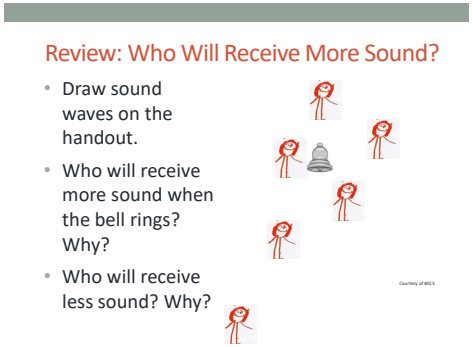
			**Display Slide 19.** Lesson Analysis: Analyze Strategy 5 and Reflect, Video Clip 2 (25 min)
			
			a. **Individuals:** "For the first analysis question on the slide, study the video transcript and come up with a claim, evidence, and reasoning to support your claim. For the second analysis question, 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.
			
			Observations:
			• At video segments 03:28–03:58, students seem to understand that sound travels everywhere, but they don't support their answers with evidence, logical reasoning, or argumentation.
			• **Alternative:** The teacher could have students use sentence starters with CER language (claim, evidence, reasoning):
			  • "My idea is _____."
			  • "My evidence is_____."
			  • "My reason is _____."

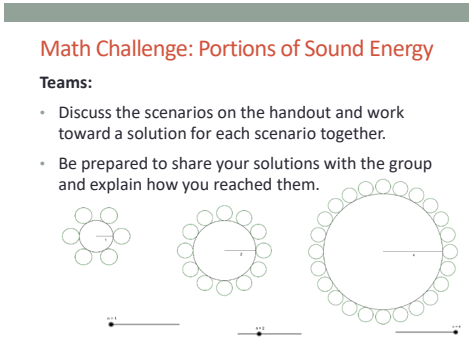
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 20.** Reflect: Key Ideas about Lesson Analysis (2 min) a. "Let's reflect on some key ideas you can take away from your lesson analysis experiences. These ideas may not reflect your personal experiences with 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.
			**Display Slide 21.** Summarizing Strategies 4 and 5 (15 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?"

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**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."
12:00–12:45 45 min	**LUNCH**		
12:45–3:15 150 min (Includes 10-min break) **Content Deepening: Sound**	**Purpose** • Deepen participants' science-content knowledge of sound and the intensity of sound. • Deepen participants' understandings of what makes a good soundmaker. **Content** • When you're closer to the source (soundmaker), the sound you		**Display Slide 23.** Content Deepening: Sound (Less than 1 min) a. "Now let's work on deepening our science-content understandings of sound and its properties." **Note:** Refer to the Sound Content Background Document and the Common Student Ideas about Sound as needed throughout this phase.

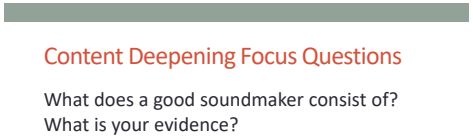
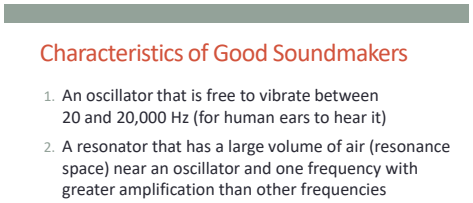
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
Slides 23–39	hear is louder because the vibrations (sound waves) are bigger and the intensity and energy of the sound are greater. As you move farther away from the source, the sound becomes softer (quieter) because the sound waves spread out more (become smaller), and the intensity and energy of the sound diminish. • A good soundmaker requires component (oscillator) that is free to vibrate between 20 and 20,000 Hz and a neighboring resonator with a large volume of air (resonance space) that amplifies one frequency more than other frequencies. • A musical sound consists of many frequencies but has a resonator that captures and amplifies a few frequencies while filtering out the rest. Noise consists of all frequencies sounding off at the same time. **What Participants Do** • Review key ideas about sound and sound intensity. • Draw sound waves using the circular wavelength convention. • Engage in a math challenge using graphical representations to illustrate why sounds get softer as distance from the		**Display Slide 24.** Review: Sound and Sound Intensity (5 min) a. "In our last content deepening session, we talked about the intensity of sound. First, let's review some key ideas about sound. What is the source of sound in this diagram?" **Ideal response:** The bird is the source of the sound, or specifically vibrations from the bird's vocal chords. b. "How does sound travel from the source to the man standing at the base of the tree?" **Ideal response:** When the bird makes a sound, it causes the air around it to vibrate. These vibrations travel through the air as sound waves in all directions. When the vibrations reach the ears of the man standing at the base of the tree, his eardrums vibrate, and the brain interprets these vibrations as sound. c. "What happens to the intensity of the sound as the man walks away from the source?" **Ideal response:** As the man walks away from the source, the sound waves become more spread out. As the distance increases, the intensity and energy of the sound diminish, and the sound becomes softer (quieter). d. During this discussion, allow participants to refer to resources from the previous session as needed (e.g., science notebooks, handouts, and the content background document).

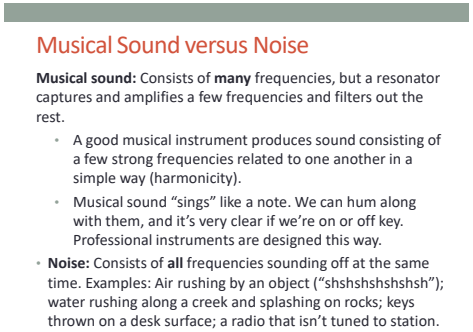
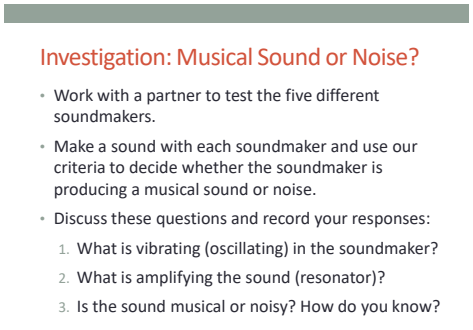
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	source increases. • Consider the characteristics of a good soundmaker. • Distinguish between musical sound and noise. • Test different soundmakers to determine whether they produce musical sound or noise and meet the criteria of a good soundmaker. • Consider how they applied STeLLA strategies 4 and 5 in the soundmaker investigation. **Handouts in PD Binder** • 3.5 Who Will Receive More Sound? • 3.6 Math Challenge: Portions of Sound Energy **Supplies** • Science notebooks • Chart paper and markers • Lesson materials kit • Tuning fork • Small plastic container and a rubber band • Small funnel • Water bottle • Graduated cylinder • Large aluminum tray		**Display Slide 25.** Review: Drawing Sound Waves (2 min) a. "As we discussed last time, there are many methods we can use to draw sounds, such as drawing lines, waves, or notes, but the best method is the *circular wavefront convention*." b. Highlight the following ideas: 1. The source is at the center of the diagram in the innermost circle. 2. Circles moving away from the center represent sound waves traveling away from the source in all directions. 3. The circles farther away from the source are bigger because these sound waves traveled away from the bell at an earlier time. The larger circles indicate weaker sound waves. 4. The energy in larger circles is spread out more thinly. 5. A person receives a sound when a circle reaches the person's ears. 6. Ears capture less sound energy farther from the source, so the sound is less intense. 7. The distance between the circles is always the same. That represents the wavelength. c. Remind participants that in a real three-dimensional world, the circles would actually be spherical shells.

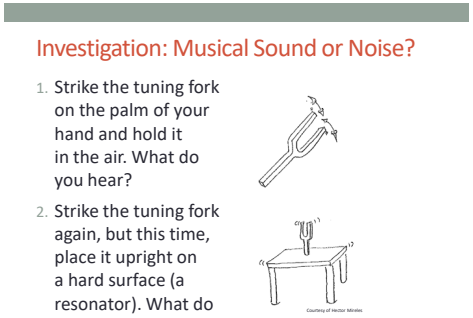
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	• Vuvuzela (stadium horn) • A clucker **PD Resources** • RESPeCT lesson plans binder **Resources in Lesson Plans Binder** *Resources section:* • Content background document • Common Student Ideas		**Display Slide 26.** Review: Who Will Receive More Sound? (8 min) a. "Next, you'll use the circular wavefront convention to draw sound waves and explain why a sound gets softer as you move away from the source." b. Distribute handout 3.5 (Who Will Receive More Sound?). c. **Individuals:** Direct participants to draw sound waves on the handout and then explain who will receive more or less sound when the bell rings. d. **Whole group:** Invite participants to share their diagrams and explanations with the group. Ask probe and challenge questions to clarify participants' thinking. **Ideal responses:** • As the sound waves/vibrations move away from the source (the bell) in all directions, they become more spread out as the distance from the source increases. As a result, the intensity and energy of the sound diminish, and the sound becomes softer. Closer to the source, the sound is louder because the vibrations are larger and the intensity and energy of the sound is greater. • The people on the diagram who are closest to the bell receive more sound energy, so the sound they perceive will be louder. Farther away from the source, the circles are so large and the sound waves are so spread out, that listeners will receive much less sound energy and hear a much softer sound. • The guy who is farthest from the bell might not hear any sound at all if the sound waves are too spread out and the sound energy has diminished too much.

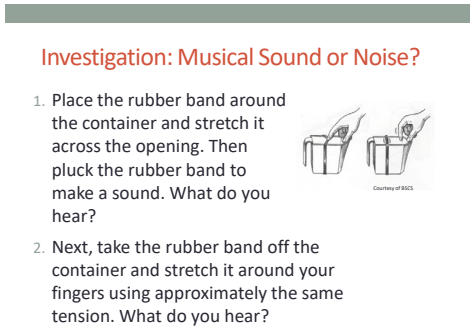
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 27.** Math Challenge: Portions of Sound Energy (50 min) a. "We've explored why sounds get softer as we move farther away from the source. Next, we'll engage in a little math challenge to help us figure out how much sound energy listeners receive at varying distances from the source." b. Distribute handout 3.6 (Math Challenge: Portions of Sound Energy) and walk participants through the instructions. c. Note that participants will use the graphical representations on the handout to illustrate the effect of sound moving in all directions and why sound gets softer as the distance from the source increases. The representation will also show the effect of background noise on sound at greater distances. d. **Small groups:** Have participants work through the handout in teams of three or four. Allow 5–10 minutes for teams to discuss each question and arrive at a solution that answers each question. (See the correct responses to the questions in the solutions section below.) e. **Whole group:** Ask each team to share their solutions for each question on the handout. Challenge team members to explain how they arrived at their solutions. Ask probe and challenge questions to clarify participants' ideas and reasoning (e.g., "What unit of sound energy would each person receive in each scenario?" "How does this unit of sound relate to the question?"). Encourage participants to listen carefully to one another's ideas and agree or disagree, ask questions, and add on. f. After the discussion, direct each team to revise

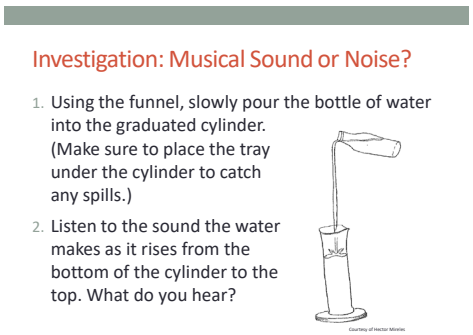
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			their solutions based on the feedback they received. Then have them graph their results on the chart on the last page of the handout and answer the challenge questions. (Each team should create only one graph.) **Solutions:** • **Scenario 1:** For n = 1, 60 units is divided by 6 (the number of listeners). Each listener receives 10 units of sound energy (60/6 = 10). • **Scenario 2:** For n = 2, 60 units is divided by 12 (the number of listeners). Each listener receives 5 units of sound energy (60/12 = 5). • **Scenario 3:** For n = 4, 60 units is divided by 24 (the number of listeners). Each listener receives 2.5 units of sound energy (60/24 = 2.5). • **Challenge questions:** 1. As the circle gets larger, each person around the circle gets a smaller share of the original sound energy. Eventually, the portion of energy is so small that it becomes indistinguishable from background noise (air conditioner, noisy playground, freeway). 2. Sound gets softer as we move farther away from the source because the sound waves spread out more, and the intensity and energy of the sound diminishes. 3. If we had very big ears, we would receive a larger portion of the sound energy. 4. If everyone receives 4 units of sound energy from the nearby freeway, the sound from the soundmaker would be very hard to hear for those in n = 4 who receive only 2.5 units of energy, since that sound is softer than the freeway sound.
	10-MINUTE BREAK		

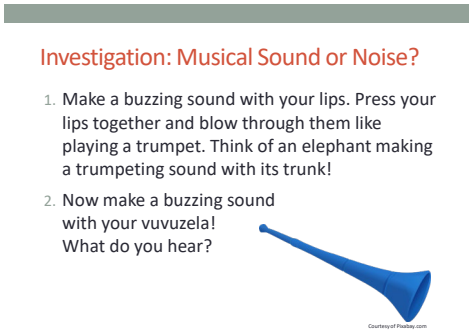
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 28.** Content Deepening Focus Questions (3 min) a. Introduce the focus questions on the slide. b. Elicit ideas from participants based on prior knowledge and experience. c. As participants share, record their ideas and evidence on chart paper.
			**Display Slide 29.** Characteristics of Good SoundMakers (2 min) a. Review the characteristics of good soundmakers on the slide. b. "Today we'll test the characteristics of five homemade soundmakers to determine whether they satisfy the criteria for good soundmakers." c. "All good soundmakers have an oscillator that vibrates and a resonator that amplifies the sound." d. Have participants copy these characteristics into their science notebooks to refer to during the investigation.

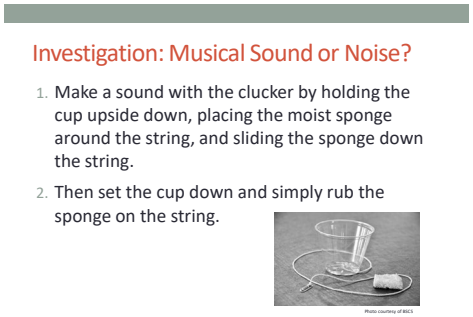
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 30.** Musical Sound versus Noise (4 min) a. "Anyone can make a sound!" b. Throw your keys on the desk to demonstrate this point. c. "But some sounds are louder, more uniform, more repeatable, more memorable, and more sustainable than other sounds. To understand what constitutes a good soundmaker from a poor soundmaker, we have to distinguish between musical sound and noise." d. Read through the distinctions between musical sound and noise on the slide. e. **Emphasize:** "Soundmakers that generate musical sounds amplify a few select frequencies and filter out the rest. Musical sound "sings" notes we can hum along with, but noise consists of all frequencies sounding off at the same time." f. Have participants write key distinctions in their science notebooks to refer to during the following investigation.
			**Display Slide 31.** Investigation: Musical Sound or Noise? (3 min) a. "Next, you'll work with a partner to test five different soundmakers: a tuning fork, a plastic container with a rubber band stretched across the top, a graduated cylinder containing water, a stadium horn called a *vuvuzela*, and a clucker." b. "Using the criteria we just discussed, you and your partner will produce a sound with each soundmaker and decide whether the sound is

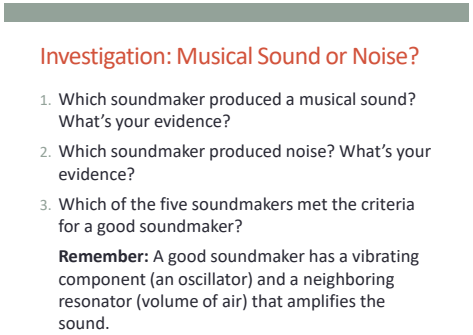
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			musical or noisy. In other words, you'll distinguish good soundmakers from poor soundmakers." c. "As you test each soundmaker, discuss the questions on the slide and write your responses in your notebooks." d. Have participants copy the questions into their science notebooks. Then demonstrate how to make sounds with each soundmaker.
			**Display Slide 32.** Investigation: Musical Sound or Noise? (10 min) a. Have participants pair up with an elbow partner. Then give each pair a tuning fork. b. Note that tuning forks are harder to use than they appear. c. Walk participants through the following steps for making sounds with their tuning forks: 1. Strike the tuning fork on a firm object like the palm of your hand, the corner of your knee, your ankle, or the sole of your shoe. 2. Do *not* strike the tuning fork against a table, a chair, or any other hard surface because this will damage it. You also shouldn't strike it against anything metallic. This will create a series of sharp rings instead of the correct sound. 3. The strike must be abrupt or brisk, like striking a drum. Don't let the arms of the tuning fork touch anything immediately after striking them. 4. If you strike the tuning fork correctly, the arms will move as if they're squeezing a piece of air between them. d. Give participants an opportunity to practice making sounds with the tuning fork before

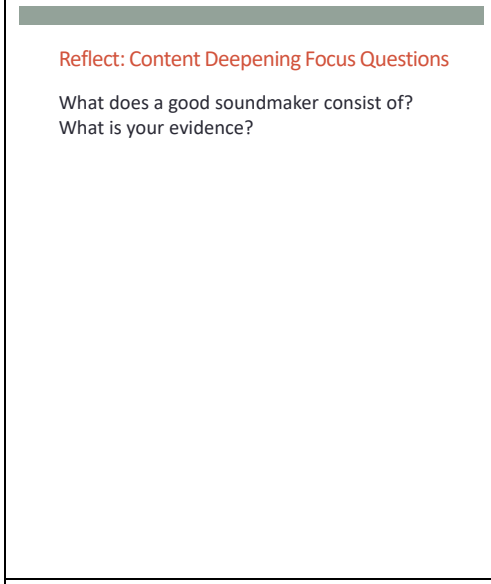
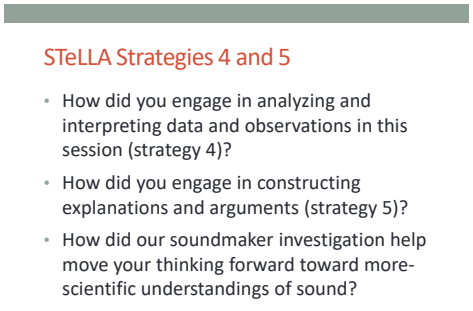
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			beginning their investigation. e. Review the instructions on the slide and then have pairs begin the investigation. Remind them to discuss the three questions in their notebooks and write down their answers. f. **Whole group:** Following the investigation, invite a few pairs to briefly share their observations and answers to the questions. g. **Emphasize:** "If you hold a vibrating tuning fork in the air, you can hear it only if you place it near your ear. If you hold the base of the tuning fork on a hard surface, such as a table, a file cabinet, or a box, the object becomes a resonator and amplifies the sound so that everyone in the room can hear it. If used correctly, a tuning fork is a good soundmaker that produces a musical sound."
			**Display Slide 33.** Investigation: Musical Sound or Noise? (10 min) a. Give each pair a plastic container and a rubber band. b. Direct participants to place the rubber band around the container and stretch it across the opening. Then have them hold the container by the rim without touching the base and pluck the rubber band to make a sound. c. Then have participants take the rubber band off the container and stretch it around their fingers. Have them pluck the rubber band and see if they can produce the same sound. d. Remind pairs to discuss the three questions in their notebooks and write down their answers. e. **Whole group:** Following the investigation, invite

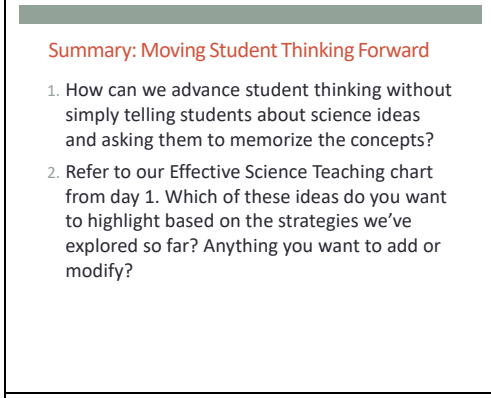
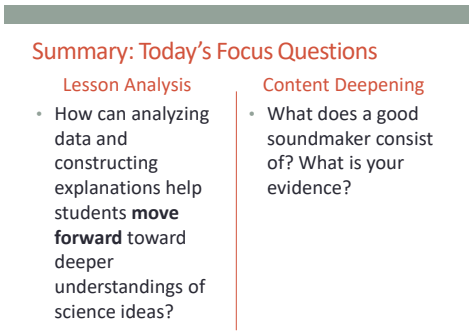
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			a few pairs to briefly share their observations and answers to the questions. f. Emphasize that the vibrating rubber band acts as an oscillator, and the container acts as a resonator. A tighter rubber band will produce a higher pitch. This primitive soundmaker should produce a sound that's more musical than noisy, making it a good soundmaker. When the rubber band is simply stretched across participants' fingers instead of a container, it will produce a poor-quality sound with low volume. Without the container acting as a resonator, the rubber band isn't a good soundmaker.
			**Display Slide 34.** Investigation: Musical Sound or Noise? (8 min) a. Give each pair a graduated cylinder, a small funnel, a bottle of water, and a tray to catch spills. b. Have participants place the tray under the cylinder and then pour water into the cylinder using the funnel. c. Ask participants to pay close attention to the sound the water makes as it rises from the bottom of the cylinder to the top. d. Remind pairs to discuss the three questions in their notebooks and write down their answers. e. **Whole group:** Following the investigation, invite a few pairs to briefly share their observations and answers to the questions. f. Emphasize that the oscillator in this soundmaker is the gurgling water, and the resonator is the column of air or resonance space in the cylinder that gets smaller as the water rises. The gurgle of water at the bottom of the cylinder isn't very musical. However, the spout hits the surface of

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			the water and creates a noisy sound that is somewhat filtered. As the water rises to the top of the cylinder, a lot of frequencies seem to increase in pitch, but the resonator selects and amplifies some of them. The graduated cylinder is a very, very primitive soundmaker and isn't very loud.
			**Display Slide 35.** Investigation: Musical Sound or Noise? (8 min) a. Distribute a vuvuzela to each pair of participants. b. First, have participants make a buzzing sound with their lips. **Note:** To make this sound, participants should press their lips together and blow hard through them, a bit like playing a trumpet. It may also help to think of an elephant making a trumpeting sound with its trunk. c. Next, have participants press their lips together and blow into the mouthpiece of the vuvuzela. The horn should create loud honking sound. d. Ask participants to compare the sound they made with their lips and the sound they made with the vuvuzela. e. Remind pairs to discuss the three questions in their notebooks and write down their answers. f. **Whole group:** Following the investigation, invite a few pairs to briefly share their observations and answers to the questions. g. **Emphasize:** "In the first instance, your buzzing lips were the oscillator, and the volume of air in your mouth acted as a resonator. When you blew into the vuvuzela, your lips were acting as an oscillator again, and the volume of air in the neck of the vuvuzela was the resonator. The horn

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			creates a more musical sound than your buzzing lips alone, and the bell-shaped end of the vuvuzela selects a sequence of frequencies."
			**Display Slide 36.** Investigation: Musical Sound or Noise? (8 min) a. Give each pair a clucker and demonstrate again how to make a sound by holding the cup upside down (with the string dangling down from inside the cup), placing the moist sponge around the string, and sliding the sponge down the string. b. Direct pairs to first make a sound with their cluckers. Then have them set the cup down and simply a rub the sponge on the string. Ask them to compare the results. c. Remind pairs to discuss the three questions in their notebooks and write down their answers. d. **Whole group:** Following the investigation, invite a few pairs to briefly share their observations and answers to the questions. e. Emphasize that the string in this soundmaker is the oscillator, and the volume of air beneath the cup is the resonator. When the clucker is used correctly, the wet sponge rubbing against the string causes the string to vibrate, and as the string touches the cup, these vibrations generate many frequencies that the resonator amplifies. The sound the clucker produces is musical only if the cup is in direct contact with the string.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 37.** Investigation: Musical Sound or Noise? (5 min) a. Read the questions on the slide and discuss the results of the investigation. b. Ask probe and challenge questions to help participants correctly identify the oscillator and resonator in each soundmaker and recognize the importance of the resonator (air, table, etc.) in producing a musical sound rather than noise (or no sound at all). **Key ideas:** • A good soundmaker consists of a vibrating component (oscillator), such as string, lips, water, the metal arms of a tuning fork, and a rubber band, and a neighboring volume of air (resonance space) that acts as a resonator to amplify selected frequencies while filtering out other frequencies. • The tuning fork vibrating on a hard surface, the plastic container with a rubber band, the vuvuzela, and the clucker are all examples of good soundmakers. The tuning fork held in the air, rubber bands around fingers, buzzing lips, and the sponge rubbing the string are examples of poor soundmakers.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 38.** Reflect: Content Deepening Focus Questions (8 min) a. Review the focus questions on the slide. b. Pairs: Have participants pair up and answer the focus questions based on the results of today's investigation. c. **Whole group:** Invite pairs to share their ideas and evidence with the group. Record key ideas and evidence on chart paper. **Ideal response:** All good soundmakers must have a vibrating component (an oscillator) and a volume of air, or resonance space, that acts as a resonator and amplifies certain frequencies more than others. For humans to hear the sound, the frequency must fall between 20 and 20,000 Hz.
			**Display Slide 39.** STeLLA Strategies 4 and 5 (6 min) a. "As we wrap up today's content deepening work, let's think about how we applied STeLLA strategies 4 and 5 in our investigation of various soundmakers." b. Read the questions on the slide. c. **Pairs:** Have participants discuss these questions with an elbow partner and write their answers in their science notebooks. d. **Whole group:** Invite participants to share their responses with the group. e. During this share-out, challenge participants to be clear about when they were simply observing something and when they were actually analyzing and interpreting data and observations. Also

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			challenge participants to identify which type of analysis they were doing: (1) Using logic and evidence (data), and/or (2) using evidence, science ideas, and logic.
3:15–3:30 15 min **Wrap-Up: Summary, Homework, and Reflections** Slides 40–43	**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 thinking forward. • Add to/modify 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**		**Display Slide 40.** 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.
			**Display Slide 41.** 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 content deepening focus questions?"

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	• 3.7 Daily Reflections—Day 3 **Supplies** • Science notebooks **PD Resources** • STeLLA strategies booklet • STL Z-fold summary chart (front pocket of PD binder)	Homework 1. Review strategy 6 in the STeLLA strategies booklet and complete the STL Z-fold summary chart for this strategy: Engage students in using and applying new science ideas in a variety of ways and contexts. 2. Be prepared to share your assigned lesson plan review.	**Display Slide 42.** Homework (1 min) a. "Tomorrow we'll focus on another strategy to help move student thinking forward toward a deeper understanding of science ideas." b. Review the homework assignment and have participants copy it into their science notebooks.
		Reflections on Today's Session Complete the Daily Reflections sheet (handout 3.7). 1. What new idea or insight did you have today related to strategy 4 (analyzing and interpreting data and observations) and strategy 5 (constructing explanations and arguments)? 2. What ideas do strategies 4 and 5 give you about things to try or change in your science teaching? 3. Answer one of these questions: (1) What important science idea are you taking away from our content deepening work today? Remember to state the idea in a complete sentence. (2) What question do you have about sound (i.e., something you're unclear or wonder about)?	**Display Slide 43.** Reflections on Today's Session (4 min) a. Have participants reflect on today's session and answer the questions on the Daily Reflections sheet (handout 3.7 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.