RESPeCT Summer Institute Professional Development Leader Guide (PDLG)

Grade Level	5	**Day**	3	**STeLLA Strategy**	STL Strategy 4: Analyze and Interpret Data and Observations STL Strategy 5: Construct Explanations and Arguments	**Subject Matter Focus**	Water Cycle

Focus Questions	• How can analyzing data and constructing explanations help students *move forward* toward deeper understandings of science ideas? • Approximately how many molecules are in a single drop of water? How do we know?
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). • Molecules take up an incredibly small amount of space, and a vast number of molecules are needed to make up a macroscopic whole. • If we know the approximate size of a water molecule and the size of a drop of water, we can estimate the number of molecules in a drop of water using powers of 10.

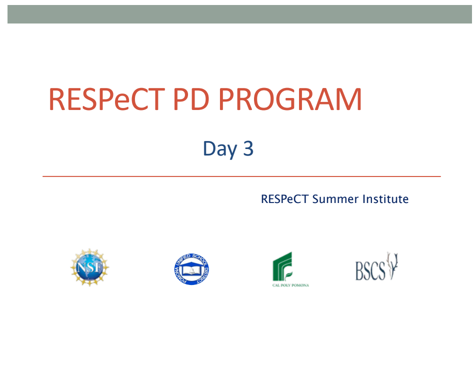
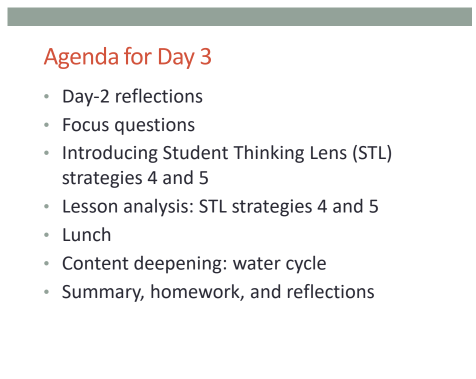
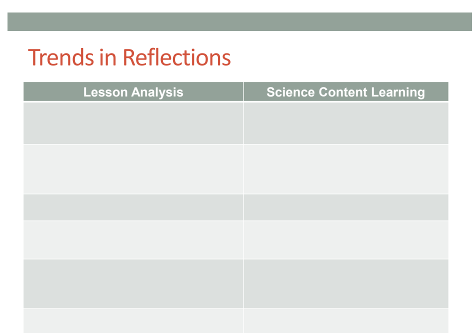
Preparation	**Materials**	**Videos**
Daily Setup Tasks • Check that video clips are correctly linked to PowerPoint (PPT) slides. • Set up PowerPoint. • Make sure video clips play correctly with good sound. • Arrange furniture and food. • Arrange participant materials. • Put up posters and charts. **Planning and Preparation Tasks** • Study the PDLG, PowerPoint slides (PPTs), video clips, and handouts. Make changes to PPTs if needed. • Review the content deepening slides and determine the amount of time to allot for each	**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: Amy Belcastro classroom (analyze and interpret, strategy 4); 3.1_stella_WC_belcastro_web_c1 • Video Clip 3.2: Anderson classroom (construct explanations and arguments, strategy 5); 3.2_stella_WC_anderson_c1

slide based on the needs of your group. Add timing cues to PPTs, if desired, to help you stay on track.
• Review the reflections from day 2 and create a summary slide.
• Watch video clips and anticipate participant responses.
• Prepare charts for the day's agenda and focus questions.
• Content deepening:
  ◦ Fill one 6-quart storage container with as many Ping-Pong balls as possible and secure the lid.
  ◦ Pop enough popcorn (2 bags) to fill another 6-quart storage container as completely as possible before securing the lid.
  ◦ Fill a 6-quart storage container with as much uncooked rice as possible (about 4 pounds) and secure the lid.
  ◦ Place the bin of Ping-Pong balls where participants will see it, but hide the other bins.
	• 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 Daily Reflections—Day 3
	
	PD Leader Masters, Days 1–4
	• PD Leader Master: Practice Identifying Strategies 4 and 5 in Student Work
	• PD Leader Master: 5th-Grade Guide to Video Clips for Day 3
	
	Supplies
	• Science notebooks
	• Chart paper and markers
	• Pencils or pens
	• For content deepening activities:
	  ◦ Three 6-quart storage containers
	  ◦ Approximately 88 Ping-Pong balls
	  ◦ One 5-pound bag of rice grains
	  ◦ Two bags of microwave popcorn.
	  ◦ Six 12-inch rulers with centimeter (cm) scale (or 1 for each participant)
	
	PD Resources
	• STeLLA strategies booklet
	• RESPeCT PD program binder
	• RESPeCT lesson plans binder
	
	Resources in Lesson Plans Binder
	Resources section:
	• Water Cycle Content Background Document
	• Common Student Ideas about Matter, Molecules, and the Water Cycle	

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 the water cycle through lesson analysis.
12:00–12:45 45 min	**LUNCH**	
12:45–3:15 150 min (Includes 10-min break)	**Math Content Deepening: Water Cycle**	• Develop a visceral understanding of the extremely small scale of a water molecule and the vast number of molecules needed to make up a macroscopic sample.
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 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.		**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.
			**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.

<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"></td><td rowspan="3">

- 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.

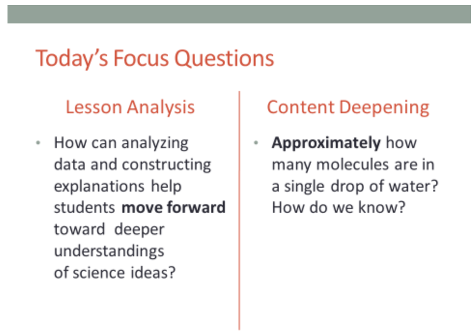
Posters and Charts

- 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

- STeLLA strategies booklet

</td><td></td><td></td></tr>
<tr><td>



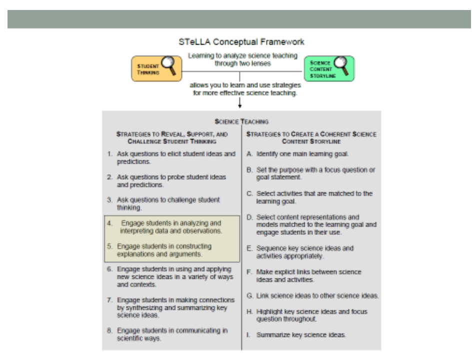
</td><td>

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?"

</td></tr>
<tr><td>



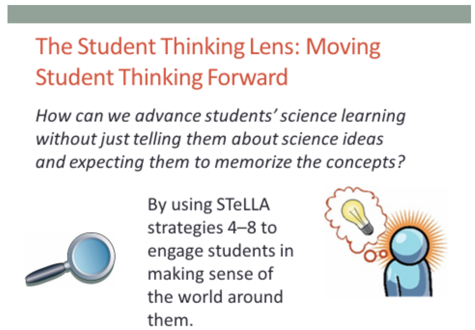
</td><td>

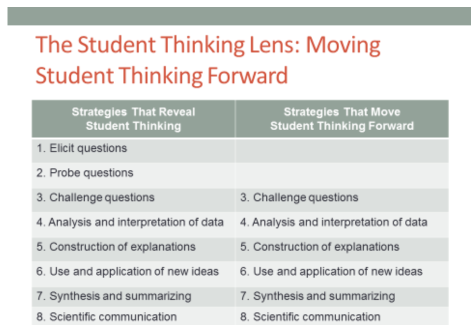
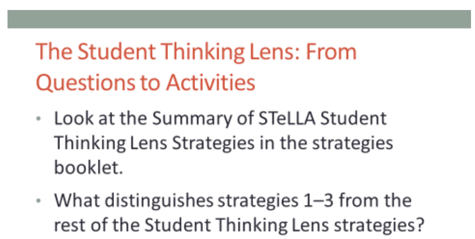
Display Slide 5. STeLLA Conceptual Framework (1 min)

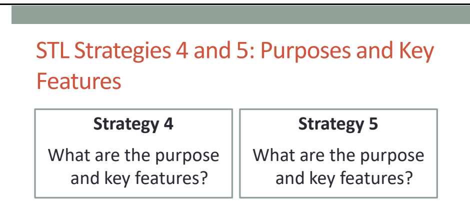
a. Point out the strategies highlighted on the slide.

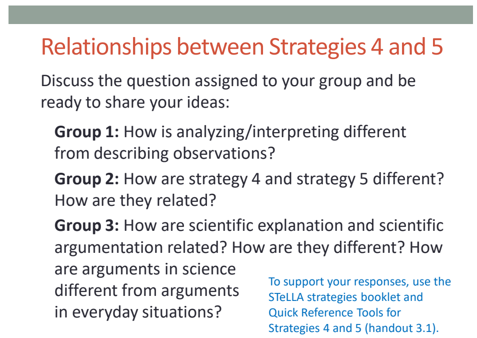
b. "We'll continue working on understanding and using the Student Thinking Lens *questioning* strategies, but today we'll focus on two closely related *activity* strategies. Strategy 4 engages students in analyzing and interpreting data and observations, and strategy 5 engages students in constructing explanations and arguments."

</td></tr>
</table>

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

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			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!**"
			**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.

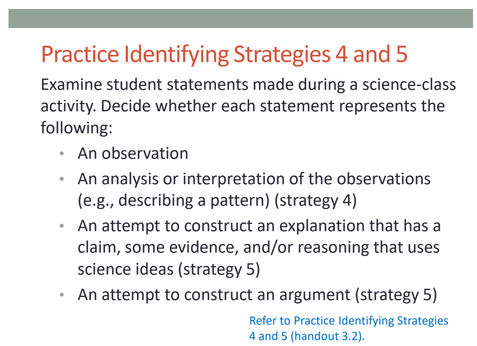
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			b. **Whole group:** "How are the first three strategies different from the rest?" **Key ideas:** • Strategies 1–3 are questions; the rest are activities. • Probe and challenge questions can and should be asked during all types of activities.
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		**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.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	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		However, each has a specific purpose and unique attributes.
			**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

<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="2"></td><td rowspan="2"></td><td></td><td>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.

• “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.</td></tr>
<tr><td>

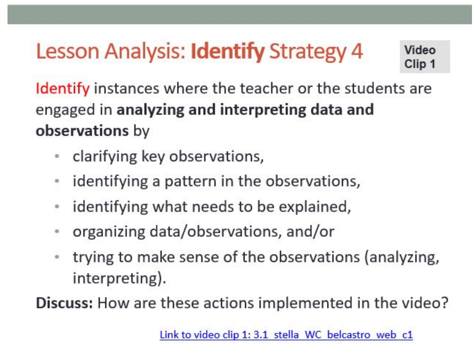


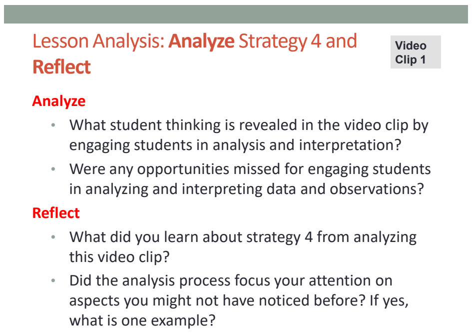
</td><td>Display Slide 11. Practice Identifying Strategies 4 and 5 (15 min)

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).</td></tr>
</table>

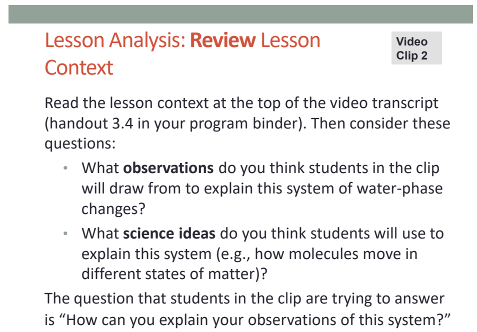
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			c. **Pairs:** Have participants work in pairs to analyze student statements in the handout. d. **Whole group:** As participants discuss and clarify their analyses of the student statements, encourage them to refer frequently 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.
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 the water cycle 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	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.

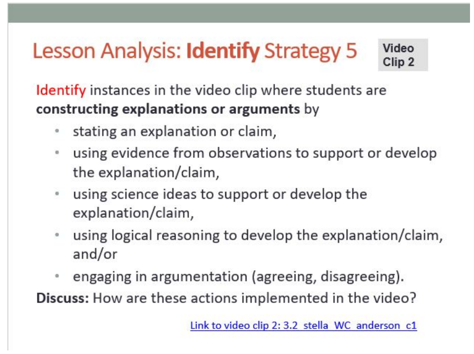
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	observed phenomena, as well as critiquing proposed explanations using scientific argumentation. **What Participants Do** • Watch a classroom video clip to identify strategy 4 and analyze student thinking that this strategy reveals and challenges. • Examine transcript excerpts in the STeLLA strategies booklet for 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, Amy Belcastro classroom • Video Clip 3.2, Anderson 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 Leader Masters** • PD Leader Master: 5th-Grade Guide to Video Clips for Day 3 **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:** • At several points in the video, the teacher tries to clarify the key observation—the key pattern—that needs to be explained: Water droplets are forming on the outside of the glass of water with ice, but not on the glass at room temperature (video segments 00:01.3–00:11.2; 00:57.8–01:02.2; 01:13.8.). • Students are trying to make sense of their observations (analyzing and interpreting), and several of them think the water droplets are coming from the ice in some way (segments 00:19.5–00:57.8). The overlapping talk makes it difficult to understand their thinking; however, one student clearly articulates her idea that the warmth of the room is causing a reaction between the ice and the air (segments 01:15.1–01:44.2). She and other students assert that the glass without ice adapted to the room temperature (segments 01:48.3–02:03.1).

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			• The teacher poses challenge questions to support students in moving their thinking forward. At one point (segment 00:13.4), she asks why water appeared on the outside of the glass. Then she asks, “How would the ice make that happen?” (segment 00:43.0). But she most clearly challenges students to move toward a more-scientific understanding at the end of the clip (segments 02:20.1–02:24.4), where she asks them to think about the role of water vapor. • There is little evidence in the clip of students organizing their data or observations. This is a missed opportunity. **Note:** For examples of strategy 4, see PD Leader Master: 5th-Grade Guide to Video Clips for Day 3.
			**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. **Note:** For examples of strategy 4, see PD Leader

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			Master: 5th-Grade Guide to Video Clips for Day 3.
		Strategy 5 Practice: Explanation and Argumentation Analyze the two water-cycle sample transcripts in the strategies booklet to find evidence of students engaged in **constructing explanations and arguments** by • making a claim that answers the investigation question, • making a claim and supporting it with evidence, • making a claim and supporting it with science ideas, • using logical reasoning to explain why the evidence supports a claim, and/or • making an argument.	**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 two transcript examples (under "About Matter, Molecules, and the Water Cycle" 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 examples of strategy 5 in the STeLLA strategies booklet. Read the two sample transcripts in the section titled 'About Matter, Molecules, and the Water Cycle' 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 transcripts of students engaging in strategy 5, noting the specific action illustrated from the list on the slide. **Observations:** • **Transcript 1:** S1 claimed that some water in the glass evaporated and then condensed on

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			the outside of the glass because it cooled down. S2 challenged this claim by using logical reasoning and evidence: The water inside the glass was red, but the water on the outside was clear. S3 proposed a new claim, saying that the water on the outside of the glass came from water vapor in the air. He then used science ideas to support this claim (water molecules slow down when cooled). • **Transcript 2:** Wyatt claimed that clouds form when water molecules evaporate from Earth and go into the sky as water vapor. He used logical reasoning to suggest that we see clouds because of dust in the sky, since water vapor can't be seen. Maria claimed that clouds are formed by water molecules cooling and coming together to make liquid drops of water. Dawn supported this claim with evidence that steam coming out of a teakettle is made of liquid-water drops, and since clouds look like steam, Maria's explanation must be right. Marco provided additional evidence to support this claim, noting that airplane windows get wet when airplanes fly through clouds.
	10-MINUTE BREAK		

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		 	**Display Slide 17.** Lesson Analysis: Review Lesson Context, Video Clip 2 (7 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. **Ask:** "What **observations** do you think students in the clip will draw from to explain this system of water-phase changes?" **Note:** If participants have not yet observed the water-changes system, make sure they understand what students in the video should have observed. d. **Ask:** "What **science ideas** do you think students will use to explain this system (e.g., how molecules move in different states of matter; molecular motion when energy is gained or lost; evaporation and condensation)?" e. **Emphasize:** Students in the clip are trying to answer the question, "How can you explain your observations of this system?"

<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></td><td></td><td>
</td><td>

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.”

Note: For examples of challenge and probe questions for strategy 5, see PD Leader Master: 5th-Grade Guide to Video Clips for Day 3.

</td></tr>
</table>

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Lesson Analysis: **Analyze** Strategy 5 and **Reflect** Video Clip 2 **Analyze** • What student thinking is revealed by engaging students in constructing explanations of the water-changes system? • Were there any missed opportunities to support students in constructing explanations and arguments? **Reflect** • What did you learn about strategy 5 from analyzing this video clip? • Did the analysis process focus your attention on aspects you might not have noticed before? If yes, what is one example?	**Display Slide 19.** Lesson Analysis: Analyze Strategy 5 and Reflect, Video Clip 2 (20 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. **Note:** For sample responses to the analysis questions, see PD Leader Master: 5th-Grade Guide to Video Clips for Day 3.
		Reflect: Key Ideas about Lesson Analysis • Lesson analysis slows down classroom events so we can focus on specific student thinking. • Making a claim based on evidence challenges us to listen carefully to what students are saying and understanding. When we make quick assessments, we might think they understand things they're actually still struggling with. • Even though events happen fast in classroom teaching, **we can get better at listening to students and making on-the-spot assessments of their understandings and confusion!**	**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
		Summarizing Strategies 4 and 5 Create a word picture (a concept map, a thinking map, or other visual) to show how analysis and interpretation (strategy 4) are related to explanation and argumentation (strategy 5). Label any connecting arrows. Suggested words to use: • Analyze and interpret • Argument • Data • Evidence • Explanation • Logical thinking • Organize • Observe/observations • Patterns • Reasoning • Science ideas	**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?"
		Reflect: Lesson Analysis Focus Question How can analyzing data and constructing explanations help students **move forward** toward deeper understandings of science ideas?	**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**		

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
12:45–3:15 150 min (Includes 10-min break) **Math Content Deepening: Water Cycle** Slides 23–36	**Purpose** • Develop a visceral understanding of the extremely small scale of a water molecule and the vast number of molecules needed to make up a macroscopic sample. **Supplies** • Science notebooks • Chart paper and markers **Resources in Lesson Plans Binder** *Resources section:* • Content background document • Common Student Ideas		**Display Slide 23.** Math Content Deepening **Note:** Throughout this content deepening phase, refer as needed to the Water Cycle Content Background Document and Common Student Ideas about Matter, Molecules, and the Water Cycle. **PD leader talk:** "In this content deepening phase, we'll practice using STL strategies 4 and 5 to deepen our own science-content understandings. This work will be helpful as you prepare to teach the Water Cycle lessons in your own classrooms." **PD leader talk:** "Specifically, we'll use elementary-level mathematics to reinforce our understandings of the scale and quantities of molecules involved in the water cycle. This addresses NGSS crosscutting concept 3: Scale, Proportion, and Quantity, which states that 'in considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change.'" **Timing note:** To keep things moving so you don't run out of time during this phase, adhere as closely as possible to the time you've allotted for each slide. If you're running short on time, you may need to abridge or skip some of the group discussion.

<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></td><td></td><td>Content Deepening Focus Question

Approximately how many molecules are in a single drop of water? How do we know?</td><td>Display Slide 24. Content Deepening Focus Question

PD leader move: Read the content deepening focus question that will guide the work during this phase.</td></tr>
<tr><td></td><td>Activity 1

Purpose
• Work through a progression of three activities designed to develop skill and comfort with power-of-10 estimates of large quantities.

Content
• Upper and lower bounds are used for estimation purposes.

What Participants Do
• Estimate the number of Ping-Pong balls enclosed in a clear-plastic storage container.

Supplies
• 6-quart clear-plastic storage container with lid and enough Ping-Pong balls (approximately 88) to fill the bin and close the lid).</td><td>Activity 1: Ping-Pong Balls in a Bin
1. Estimate the number of Ping-Pong balls in the container.
2. Rules:
a. You are not allowed to open the container.
b. Derive an estimate that you have confidence in. Be ready to express that confidence by identifying a lower bound and an upper bound for your estimate.
3. A lower bound is a number you're sure is less than the number of balls in the bin.
4. An upper bound is a number you're sure is greater than the number of balls in the bin.</td><td>Display Slide 25. Activity 1: Ping-Pong Balls in a Bin

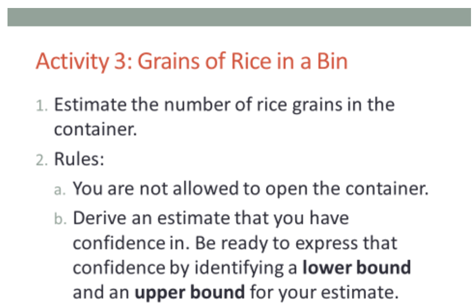
PD leader move: Draw participants' attention to the closed storage container filled with Ping-Pong balls. Review the instructions for estimating the number of balls and emphasize that participants will need to identify a lower bound and an upper bound for their estimates.

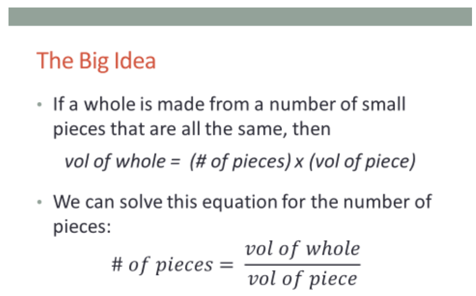
PD leader move: Allow a few minutes for participants to work independently on their estimates and bounds.

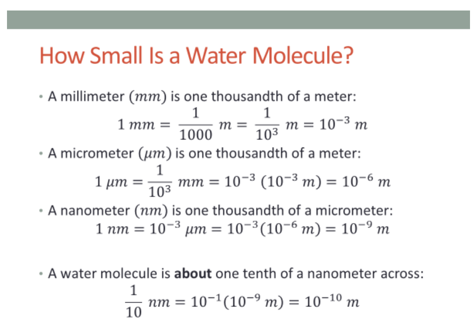
PD leader talk: "Now let's share our estimates and bounds, and I'll record them on chart paper."

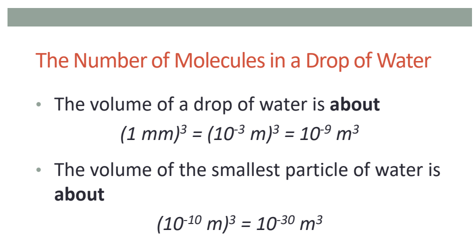
PD leader move: Using the following format, record participants' estimates and bounds on chart paper:
<table><tr><th>Lower Bound</th><th>Estimate</th><th>Upper Bound</th></tr><tr><td>40</td><td>65</td><td>200</td></tr><tr><td>25</td><td>74</td><td>120</td></tr></table></td></tr>
</table>

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			| … | | | **Note:** It's unlikely that anyone will estimate the exact number of Ping-Pong balls or come up with the same bounds, though they should be similar. **PD leader talk:** "Although our numbers vary, it looks as if we all agree that there are more than 10 balls and fewer than 1,000 balls in the bin. In fact, all of our estimates are in the neighborhood of 100 balls." **PD leader move:** Invite a participant to count the balls and confirm the exact number. **PD leader move:** Write on the chart, "lower bound of 10 = 10^1; upper bound of 1,000 = 10^3; estimate of about 100 = 10^2."
	Activity 2 **Purpose** • Work through a progression of three activities designed to develop skill and comfort with power-of-10 estimates of large quantities. **Content** • Upper and lower bounds are used for estimation purposes. **What Participants Do** • Estimate the number of popcorn kernels enclosed in a clear-plastic storage container. **Supplies**	Activity 2: Popcorn in a Bin 1. Estimate the number of popcorn kernels in the container. 2. Rules: a. You are not allowed to open the container. b. Derive an estimate that you have confidence in. Be ready to express that confidence by identifying a **lower bound** and an **upper bound** for your estimate.	**Display Slide 26.** Activity 2: Popcorn in a Bin **PD leader move:** Bring out the next container filled with popcorn kernels. Prompt participants to estimate the number of popped kernels in the bin and give lower and upper bounds for their estimates. Direct them to work together in pairs. **PD leader move:** Allow time for pairs to discuss and formulate their estimates and bounds. Circulate among the groups and listen to their reasoning. **PD leader talk:** "One powerful idea I want to hear is that if you estimate the number of popped kernels it would take to occupy the same space as a Ping-Pong ball, then you can multiply your previous estimate and bounds by this number to obtain new estimates and bounds. Roughly 10 popped kernels

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	• 6-quart clear-plastic storage container with lid and enough popped popcorn to fill the bin (approximately two microwave bags' worth).		will occupy the same space as a Ping-Pong ball." **PD leader move:** When the pairs work is complete, have pairs share their estimates and bounds while you record them on a new chart. Highlight the agreed-upon powers of 10 for the bounds and estimates. Share any reasoning you overheard during the pairs work. Challenge participants with the question, "Why are you confident in your bounds?"
	Activity 3 **Purpose** • Work through a progression of three activities designed to develop skill and comfort using power-of-10 estimates of large quantities. **Content** • Upper and lower bounds are used for estimation purposes. **What Participants Do** • Estimate the number of uncooked grains of rice enclosed in a clear-plastic storage container. **Supplies** • 6-quart clear-plastic storage container with lid and enough uncooked rice to fill the bin (approximately 5 lbs).		**Display Slide 27.** Activity 3: Grains of Rice in a Bin **PD leader move:** Bring out the third container filled with rice grains. Prompt the group to estimate the number of grains in the bin and identify bounds for the estimate. **Note:** Expect participants to struggle with this task. Rice grains are much smaller than popcorn kernels and pack together much more tightly. Even if the group is able to formulate an estimate, participants will likely have much less confidence in their bounds. **PD leader move:** After the group struggles with their estimate for a minute or two, point out that each participant has a ruler with a centimeter scale. **PD leader move:** Ask questions to elicit this **big idea**: Since the rice grains are packed tightly together, the total volume of the rice in the container is approximately equal to the number of rice grains multiplied by the volume of each grain. Thus, by estimating the total volume of the rice and the volume of each grain, the group can estimate the number of grains. A rice grain is about 5 mm x 1 mm x 1 mm and therefore has a volume of about 5

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			mm^3 = 5(10^{-1} cm)^3 = 5 x 10^{-3} cm^3. **PD leader move:** When the group agrees on an estimate and bounds, write them on a new chart. Emphasize the agreed-upon powers of 10 for the estimate and bounds. It's important to realize that since the number of grains is so large, a round-number estimate like 100,000, instead of 106,532, is just as meaningful. It's not as if participants have time to count every single grain of rice.
	10-MINUTE BREAK		
			**Display Slide 28.** The Big Idea **PD leader talk:** "This slide highlights the big idea that emerged from our investigation: If a whole consists of a number of small pieces that are all the same, then the volume of the whole equals the sum of the volumes of all the pieces, which is the same as the number of pieces multiplied by the volume of one piece. We can then solve this equation for the total number of pieces. We were able to estimate the volume of all the rice grains in the bin and a single grain of rice in cubic centimeters and divide these numbers to estimate the total number of rice grains, which was too large to count." **Note:** In an estimate, we can safely assume that all of the rice grains in the bin are identical. Any variations would be too small to significantly impact the power-of-10 estimate. **PD leader talk:** "If we wanted to apply this idea to estimate the number of water molecules in a single drop of water, what would we need to know?" **PD leader move:** Elicit responses to this question from the group. They'll need to know the volume of

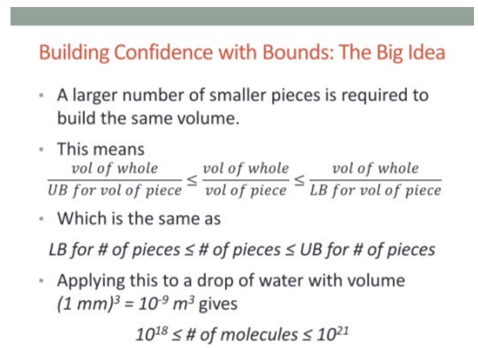
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			a drop of water and the volume occupied by the smallest particles of water (i.e., water molecules). Use **probe questions** to help participants clarify their answers. It's important to recognize that they need to use the same units of measurement for these two volumes. Otherwise, the division won't produce a result that can be interpreted as the total number of particles. **PD leader talk:** "To apply this idea, we need to know the volume of a drop of water and the volume of the smallest particle of water (a water molecule). Imagine squishing a tiny water droplet into the shape of a cube. To compute the volume of the cube of water, we would measure its width and then 'cube' that number, multiplying its length, width, and height." **PD leader talk:** "If we imagine dividing this water cube into cubical pieces so small and tightly packed that each one contains a single water molecule, we can then estimate the volume of a water molecule by cubing its width, which is a very small distance."
	Purpose • Review units of measurement for small quantities; namely, *millimeter*, *micrometer*, and *nanometer*. Scientifically estimate the width across a water molecule to construct an estimate for the number of molecules in a drop of water. **Content** • A water molecule is about one tenth of a nanometer across, which is one tenth of one thousandth of one thousandth of		**Display Slide 29.** How Small Is a Water Molecule? **PD leader move:** Remind participants that 1 millimeter is one thousandth of a meter. To demonstrate just how small a distance that is, hold up a meter stick and place your fingernails on either side of two adjacent millimeter tick marks. Then talk through the equations on the slide. Emphasize that if you zoomed in so that the space between your nails looked as large as a meter stick, a micrometer would be one thousandth of that. Demonstrate this with your fingernails again. Repeat this analogy for the relationship between nanometers and micrometers.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	one thousandth of a meter. **What Participants Do** • Estimate the width across a water molecule to build a volume estimate for a tiny cube containing a single water molecule. Then apply division to compute an estimate of the number of water molecules in a single drop of water squished into the shape of a small cube.		**Note:** Participants may need some reminders about working with exponents. Many basic rules are used in the slide calculations: 1,000 is 10 x 10 x 10 = 10^3. 10^{-a} is defined as $1/10^a$ when *a* is a positive integer. The product of two powers of 10 is also a power of 10, and the new power is the sum of the two powers. For example 10^5 = 10 x 10 x 10 x 10 x 10, a product of five factors of 10, which is the same as 10^2 x 10^3, the product of two factors of 10 with the product of three factors of 10. These rules work with negative integer exponents as well. For example, 10^{-3} x 10^{-3} = 10^{-6} because 10^{-3} means $1/10^3$, and to multiply fractions, we multiply the numerators and denominators. So, 10^{-3} x 10^{-3} = $1/10^3$ x $1/10^3$ = (1 x 1) / (10^3 x 10^3) = $1/10^6$ = 10^{-6}.
			**Display Slide 30.** The Number of Molecules in a Drop of Water **PD leader talk:** “Putting this together, the volume of a drop of water is 1 millimeter cubed or, in other words, 10 to the minus-3 meters cubed. Using properties of exponents, that’s 10 to the minus-9 cubic meters. Using the scientific estimate for the width across a water molecule of 10 to the minus-10 meters, we can estimate that the volume of the smallest particle of water is 10 to the minus-10 meters cubed, which is 10 to the minus-30 cubic meters.” **PD leader talk:** “So how many molecules are in a single drop of water? Work with an elbow partner to compute an estimate.” **PD leader move:** Give participants time to figure this out before advancing to the next slide. Circulate to help them with manipulating exponents.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		The Number of Molecules in a Drop of Water • The volume of a drop of water is **about** *(1 mm)*^{3} *=* *(10*$^{-3}$ *m)*^{3} *= 10*$^{-9}$ *m*^{3} • The volume of the smallest particle of water is **about** *(10*$^{-10}$ *m)*^{3} *= 10*$^{-30}$ *m*^{3} • So the number of molecules in a drop of water is **about** $\frac{10^{-9}m^3}{10^{-30}m^3} = 10^{30}(10^{-9}) = 10^{30-9} = 10^{21}$ • So there are 10^{21}, or 1,000,000,000,000,000,000,000 molecules in a single drop of water!	**Display Slide 31.** The Number of Molecules in a Drop of Water **PD leader talk:** “Bravo! We’ve arrived at an estimate for the number of molecules in a single drop of water: 10 to the 21st power. That’s one sextillion or one thousand billion billions of molecules in a single drop of water. You may have thought you understood how small water molecules are, but you probably didn’t realize they are **that** small.” **PD leader talk:** “In the Water Cycle lessons, students learn to explain evaporation and condensation from a molecular viewpoint. We teach them to draw diagrams of water molecules close together or far apart and have them look at simulations of tiny molecules moving around. All of this is done to help students understand the ways water molecules interact, and how those interactions contribute to the large-scale behavior of water we observe. But these diagrams greatly exaggerate size to make these minuscule objects visible and greatly reduce the quantities we consider. When a single water droplet evaporates, all one thousand billion billion water molecules spread apart in the air. Water-vapor molecules are so small that unless many, many of them are close together, they can’t be seen.”

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	Purpose • Establish bounds for the number of molecules in a drop of water, building confidence in the previous estimate. **Content** • Bounds for the width across a water molecule can be used to derive bounds for the number of molecules in a drop of water. **What Participants Do** • Reason that dividing a whole into smaller pieces results in a larger number of pieces, while dividing the same whole into larger pieces results in a smaller number of pieces. This idea can be used to produce bounds for the number of molecules in a drop of water, building confidence in the previous estimate.	Building Confidence with Bounds How do we know that 10^{21} is roughly correct? Can we find lower and upper bounds for our estimate to give us confidence?	**Display Slide 32.** Building Confidence with Bounds **PD leader talk:** "So how do we know that 10 to the 21st power (10^{21}) is roughly correct? We derived this number through reasoning, using estimation and computation, and yet it's only an estimate. How good of an estimate is it? Can we find lower and upper bounds to give us confidence?"
		Building Confidence with Bounds • How do we know that 10^{21} is roughly correct? Can we find lower and upper bounds for our estimate to give us confidence? • The width across a water molecule is about 10^{-10} m. More precisely, scientists can say with confidence that $10^{-10}\ m \leq \text{width of } H_20 \leq 10^{-9}\ m$ • Use this equation to find lower and upper bounds for the volume occupied by the smallest particle of water.	**Display Slide 33.** Building Confidence with Bounds **PD leader talk:** "We said before that the width across a water molecule is about 10 to the minus-10 meters (10^{-10} m), but this is only an estimate. Each hydrogen atom in H_2O is close to 10^{-10} meters, or one tenth of a nanometer across, while the oxygen atom is a bit larger. But the three atoms are arranged in a V shape like the diagrams we've been drawing, so estimating the width is more complicated. If we limit ourselves to working with powers of 10, we can say with confidence that the width across a water molecule is larger than one tenth of a nanometer, or 10^{-10} meters, but smaller than a nanometer, which is 10^{-9} meters." **PD leader talk:** "Using the equation on the slide for the width across a water molecule, work with an elbow partner to find lower and upper bounds for the volume occupied by the smallest particle of water." **PD leader move:** Circulate and help participants with their calculations, asking questions to evoke the following ideas: To estimate the volume of the smallest particle of water, we computed the volume

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			of the cube containing this particle of water by measuring its width and then cubing that number. So the volume of the particle of water equals its width cubed (vol of particle) = (width of H_2O)^3. If *a* is smaller than *b*, then a^3 is smaller than b^3, so the cube of the lower bound for the width gives a lower bound for the volume, while the cube of the upper bound for the width gives an upper bound for the volume.
		Building Confidence with Bounds • Now we have lower and upper bounds for the **volume** of a single water molecule: *10^{-30} m^3 ≤ vol of particle ≤ 10^{-27} m^3* • Can we use these bounds to find lower and upper bounds for the **number** of molecules in a cubic millimeter of water?	**Display Slide 34.** Building Confidence with Bounds **PD leader talk:** "By cubing the lower and upper bounds for the width across a water molecule, we can compute lower and upper bounds for the smallest cube of space containing a water molecule. But what we want are lower and upper bounds for the **number of molecules** in a single drop of water. Can we use the lower and upper bounds for the **volume of a water cube** to find the lower and upper bounds for the **number of molecules in a water droplet**?" **PD leader move:** Elicit ideas from the group, asking probe and challenge questions to guide the group's thinking toward this key idea: If it takes a certain number of particles to build the volume of a drop of water, it will take a larger number of smaller particles to build that same volume. The lower bound for the volume of each particle is the volume of a cube that is tinier than the water molecule. The number of these tinier cubes needed to build the drop of water would then be larger than the number of water molecules in the drop. Encourage participants to try to compute the number of particles in each case and write down comparisons

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			in their notebooks using this idea.
			**Display Slide 35.** Building Confidence with Bounds: The Big Idea **PD leader talk:** "The big idea is that a larger number of smaller pieces is required to build the same volume. We estimated the number of molecules in a drop of water by dividing the volume of the drop by the volume of the smallest particle of water. To build an upper bound, we divide the volume of the drop of water by the volume of the cube we imagined, which is tinier than the smallest particle of water. This gives an upper bound because that quotient is the number of these tinier cubes needed to make up the drop of water." **PD leader move:** Point out that the first calculation (or equation) on the slide represents what you just said, giving rise to the second calculation (or equation). **PD leader talk:** "Likewise, dividing the volume of the whole by the upper bound for the volume of each piece gives a lower bound for the number of pieces. Applying this to a cubic-millimeter drop of water gives us our previous estimate of 10^{-9} m^3 divided by 10^{-30} m^3, which gives us 10^{21} as an upper bound. For the lower bound, we compute 10^{-9} m^3 divided by 10^{-27} m^3 to obtain 10^{18}, or 1 quintillion. So we can confidently say that the number of molecules in a cubic millimeter of water is somewhere between 1 quintillion and 1 sextillion."

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Reflect: Content Deepening Focus Question **Approximately** how many molecules are in a single drop of water? How do we know?	**Display Slide 36.** Reflect: Content Deepening Focus Question **PD leader move:** Direct participants to write this focus question in their science notebooks and reflect on today's content deepening work before answering the question.
3:15–3:30 15 min **Wrap-Up: Summary, Homework, and Reflections** Slides 37–40	**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 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	Summary: Moving Student Thinking Forward 1. How can we advance student thinking without just telling students about ideas and asking them to memorize those concepts? 2. Refer to our Effective Science Teaching chart from day 1. Which of these ideas do you want to highlight based on the strategies we've explored so far? Anything you want to add or modify? Summary: Today's Focus Questions Lesson Analysis • How can analyzing data and constructing explanations help students **move forward** toward deeper understandings of science ideas? Content Deepening • **Approximately** how many molecules are in a single drop of water? How do we know?	**Display Slide 37.** 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 38.** 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

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	• Strategy charts created today for STL strategies 4 and 5 **Handouts in PD Binder** • 3.5 Daily Reflections—Day 3 **Supplies** • Science notebooks **PD Resources** • STeLLA strategies booklet • STL Z-fold summary chart (front pocket of PD binder)		ideas?" c. **Ask:** "What key ideas do you now have about how to address our content deepening focus question?"
		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 39.** 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.
		Reflections on Today's Session Complete the Daily Reflections sheet (handout 3.5). 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 matter, molecules, and the water cycle (i.e., something you're unclear or wonder about)?	**Display Slide 40.** 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 3.5 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.