RESPeCT Summer Institute Professional Development Leader Guide (PDLG)

Grade Level	5	**Day**	1	**STeLLA Strategy**	The Two Lenses: Student Thinking Lens (STL) and Science Content Storyline Lens (SCSL) STL Strategies 1, 2, and 3: Elicit, Probe, and Challenge Questions	**Subject Matter Focus**	Water Cycle

Focus Questions	• What is RESPeCT? • What are the STeLLA lenses and teaching strategies, and what is the evidence that they will make a difference in your science teaching? • Why do bonds form in water? • How do water molecules interact with each other? • How do the interactions among water molecules change as energy is gained?
Main Learning Goals	Participants will understand the following: • The RESPeCT project originally included a professional development program, a leadership development program, and a research study. The district is sustaining the PD professional development program. • The goals of the RESPeCT PD program are to deepen teachers' science-content knowledge and knowledge of effective science teaching; to develop their analytical skills to improve lesson-plan development and the teaching of science; to support teachers in the practical use of new knowledge and analytical skills in their classrooms; to improve students' science learning; and to achieve sustainability by eventually reaching all K–6 teachers. • Research on teacher and student learning has shown that the STeLLA Student Thinking Lens and the Science Content Storyline Lens are important analytical tools for effective teaching and are often neglected in science teaching. • Student thinking can be made more visible in science classrooms when teachers ask questions that elicit and probe student ideas and predictions, as well as challenge student thinking. Each type of question has a specific purpose. • The phenomena of the water cycle can be explained by examining the nature of water molecules.

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. **Day-1 Setup Tasks** • Arrange participant materials on tables in grade-level meeting rooms: • Tabletop name cards	**Posters and Charts** • STeLLA Framework and Strategies poster • Day-1 Agenda (chart) • Norms for Working Together (chart) • Day-1 Focus Questions (chart) • Effective Science Teaching chart (blank except for title) • Parking Lot poster **Handouts in RESPeCT PD Binder Front Pocket** • Half-page sheet of norms for participants to paste into their science notebooks • Z-fold summary chart: Student Thinking Lens Strategies (blank)	• Video Clip 1.1: TIMSS US Lesson 3; 1.1_TIMSS_US_lesson3_c1 • Video Clip 1.2: TIMSS Japan Lesson 1; 1.2_TIMSS_Japan_lesson1_c1_1 • *Minds of Our Own Lessons From Thin Air* video, segments 3:30–5:40; 7:50–16:45

• STeLLA strategies booklet • RESPeCT PD program binder • RESPeCT lesson plans binder • Science notebooks • Materials kit (1 per topic) **Planning and Preparation Tasks** • Study the PDLG, PowerPoint slides (PPTs), video clips, and handouts. Make changes to PPTs if needed. Modify text highlighted in light-blue font on slides and/or in PDLG to make it specific for your group. • Review the content deepening slides and determine the amount of time to allot for each slide based on the needs of your group. Add timing cues to PPTs, if desired, to help you stay on track. • Make sure you know how to find the *Minds of Our Own Lessons From Thin Air* video segments: 3:30–5:40; 7:50–16:45. • Assemble science notebooks and materials. • Prepare charts for the agenda, focus questions, and norms.	**Handouts in RESPeCT PD Binder, Day 1** • 1.1 Norms for Working Together • 1.2 Transcript for Video Clip 1.1 • 1.3 Transcript for Video Clip 1.2 • 1.4 TIMSS *Educational Leadership* article • 1.5 "Synthesis of Research from *How Students Learn: Science in the Classroom*" (HSL) • 1.6 "Linus Pauling: American Hero" • 1.7 Extended Homework: RESPeCT Lesson Plan Analysis • 1.8 Daily Reflections—Day 1 **Supplies** • Science notebooks • Chart paper and markers • Pens and pencils • Ball-and-stick model kits (with magnets) • Ice-crystal lattice model • 200-ml beaker of water • Hot plate **PD Resources** • STeLLA strategies booklet • RESPeCT PD program binder • RESPeCT lesson plans binder • Setting Up Your Summer Institute Notebook (pretabs section in PD binder) **Resources in Lesson Plans Binder** *Resources section:* • Water Cycle Content Background Document *Pretabs section:* • The Water Cycle and Conservation of Matter: Learning Goals for Students and Teachers	

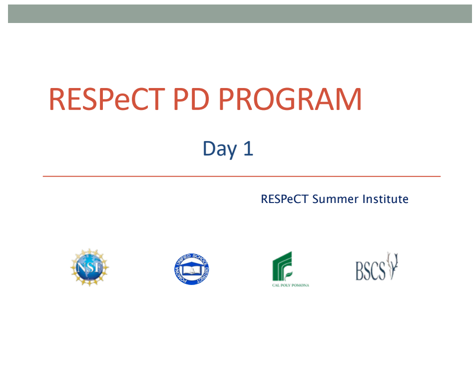
DAY 1 SESSION OUTLINE

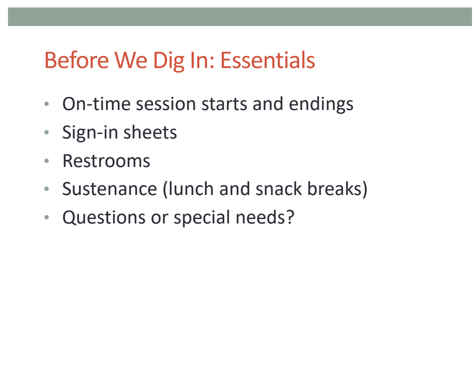
Time	Activities	Purpose
8:00–8:25 25 min	**Whole-Group Gathering: What Is RESPeCT?**	• Orient participants to the overall project. • Introduce participants to the main goals of the project. • Provide details about schedules and logistics that will address participants' immediate concerns.
8:25–8:30 5 min	**Transition to Grade-Level Study-Group Settings**	
8:30–9:20 50 min	**Getting Started: Introductions, Goals, Norms, Agenda, Focus Questions, Ideas about Effective Science Teaching**	• Build community within grade-level study groups. • Set the stage for a day of learning about the RESPeCT PD program (formerly the STeLLA PD program), the STeLLA conceptual framework, and tools for lesson analysis. • Access participants' prior knowledge/beliefs about science teaching and learning. What do participants include in their image of effective science teaching? What's missing?
9:20–10:10 50 min (Includes 10-min break)	**The Case for the Science Content Storyline Lens (SCSL)**	• Draw from the TIMSS video study to build the case for the Science Content Storyline Lens as a core analytical tool in the STeLLA conceptual framework.
10:10–10:40 30 min	**The Case for the Student Thinking Lens (STL)**	• Draw from research on science learning to build the case for the Student Thinking Lens as a core analytical tool in the STeLLA conceptual framework.
10:40–12:00 80 min	**Content Deepening: Water Cycle**	• Explain the phenomena of the water cycle by examining the nature of water molecules, starting with an exploration of bonding and molecular shape.
12:00–12:45 45 min	**LUNCH**	
12:45–2:10 85 min (Includes 10-min break)	**Content Deepening (Continued)**	• Explain the phenomenon of the water cycle by examining the nature of water molecules, with a focus on bonding and molecular shape. • Develop an initial understanding of how water molecules interact during phase changes.

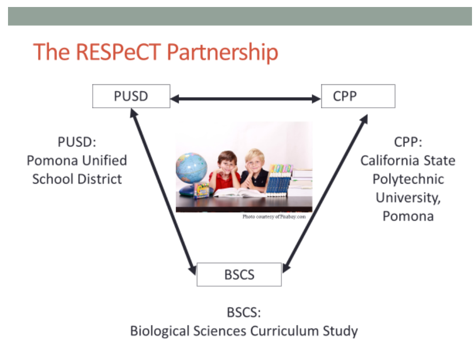
2:10–3:00 50 min	**STL Strategies: Elicit, Probe, and Challenge Questions**	• Begin to develop shared understandings of the Student Thinking Lens (STL) and STeLLA strategies 1, 2, and 3 (elicit, probe, and challenge questions).
3:00–3:30 30 min	**Wrap-Up: Summary, Homework, and Reflections**	• Summarize and reflect on key ideas from today's learning and foreshadow what will be addressed tomorrow and later in the week.

DAY 1

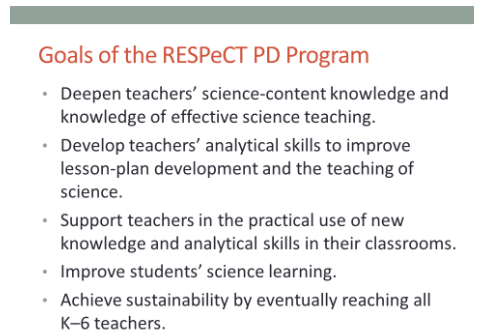
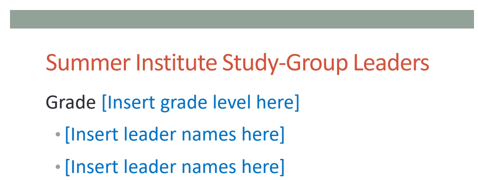
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process

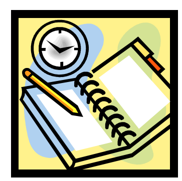
8:00–8:25
25 min
 	
Whole-Group Gathering: What Is RESPeCT?
 	
Slides 1–14
	Purpose
	• Orient participants to the overall project.
	• Introduce participants to the main goals of the project.
	• Provide details about schedules and logistics that will address participants' immediate concerns.
	
	Content
	• Discuss the following with participants:
	  • Essential logistics
	  • Components of the RESPeCT project
	  • Members of the RESPeCT partnership
	  • RESPeCT PD program and goals
	  • Summer Institute schedule and overview
	  • School-year schedule and overview
	
	What Participants Do
			**Display Slide 1.** RESPeCT PD Program (5 min)
			
			a. Greet participants as they enter the room.
			b. Help them find their notebooks and table tents.

			**Display Slide 2.** Before We Dig In: Essentials (20 min for slides 2–14, averaging approximately 1 min per slide) a. Give everyone a big welcome to the RESPeCT PD program! b. Fill participants in on the essential details listed on the slide.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	• Listen to a brief introduction to the program and how it began.		**Display Slide 3.** What Is RESPeCT? (Approximately 1 min) a. **Emphasize:** The RESPeCT project began with three main components: • A professional development program • A leadership development program • A research study b. The district now sustains RESPeCT as a professional development program.
			**Display Slide 4.** The RESPeCT Partnership (Approximately 1 min) a. The original RESPeCT partners included the following: • **Cal Poly:** science, science education, and mathematics faculty, as well as the Center for Excellence in Mathematics and Science Teaching (CEMaST) • **PUSD:** district central administrators, principals, teacher specialists, and teachers • **BSCS:** an additional partner located in Colorado that provides expertise on science curriculum development, science teacher professional development, and research on science teaching and learning. **Note:** Established in 1958, BSCS stands for Biological Sciences Curriculum Study, but the organization now deals with all sciences, not just biology. • **Students:** Emphasize that students are at the center of this partnership. Their learning

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			is what the project is all about.
		The RESPeCT PD Program • Builds on the successful Science Teachers Learning from Lesson Analysis (STeLLA) program • Has a significant impact on student learning as demonstrated in two rigorous studies • Teaches videocase-based lesson analysis • Facilitates science-content deepening	**Display Slide 5.** The RESPeCT PD Program (Approximately 1 min) a. Let participants know they'll be learning more about the RESPeCT PD program and STeLLA teaching strategies as they experience firsthand what it means to perform videocase-based lesson analysis.
		The RESPeCT PD Program Extends the STeLLA approach by • Addressing grade-level standards in Next Generation Science Standards (NGSS) • Incorporating Common Core English language arts (ELA) and math standards • Addressing more explicitly the needs of English language learners (ELLs) • Addressing all grade levels, K–6	**Display Slide 6.** The RESPeCT PD Program (Approximately 1 min) a. Read the information on the slide. b. Emphasize the importance of these additions to the STeLLA approach. By integrating Common Core English language arts (ELA) and math standards into the science curriculum, the RESPeCT PD program enables teachers to invest more time in teaching science. The teaching strategies developed in the RESPeCT PD program are also valuable tools in other subject areas.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 7.** Goals of the RESPeCT PD Program (Approximately 1 min) a. **The bottom line:** improving students’ science learning—a goal that has been reached in two previous research studies of this approach.
			**Display Slide 8.** Summer Institute Study-Group Leaders (Approximately 1 min) a. Modify this slide to include the grade level of your study group and the names of the Teacher Leaders who will be facilitating the study-group sessions. b. Formally introduce yourselves to the group.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		The Key Each of us is key to the success of the RESPeCT PD program! 	**Display Slide 9.** The Key (Approximately 1 min) a. Many people are involved in organizing, planning, and leading this program, but the teacher-participants are the key to its success.
		Summer Institute Schedule 	**Display Slide 10.** Summer Institute Schedule **Note:** This is a transition slide.

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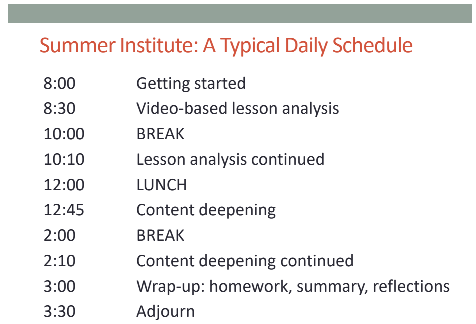
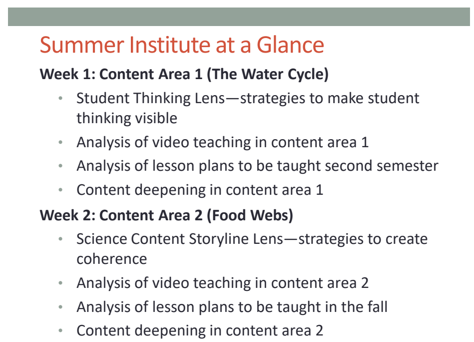
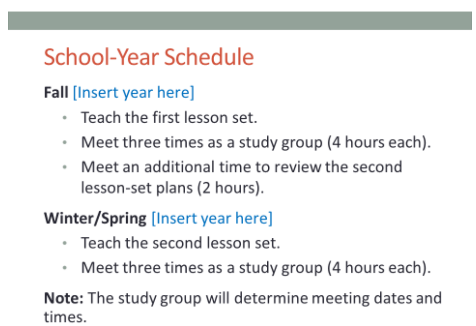
<tr><td></td><td></td><td>
</td><td>Display Slide 11. Summer Institute: A Typical Daily Schedule (Approximately 1 min)

a. A typical daily schedule includes the following:
Time spent on videocase lesson analysis
Time focused on content deepening
Short homework assignments
A morning and an afternoon break, with a 45-minute lunch break</td></tr>
<tr><td></td><td></td><td>
</td><td>Display Slide 12. Summer Institute at a Glance (Approximately 1 min)

a. During the Summer Institute, each grade level will focus on two content areas, with one week devoted to each area. Participants will deepen their science-content knowledge, study lesson plans in each content area, and analyze videocases of teachers presenting this content.</td></tr>
<tr><td></td><td></td><td>
</td><td>Display Slide 13. School-Year Schedule (Approximately 1 min)

a. “The Summer Institute is just the beginning! During the school year, you’ll continue meeting with your grade-level study group.”</td></tr>
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PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Your RESPeCT PD Program Materials • Your science notebook • STeLLA strategies booklet • RESPeCT PD program binder • RESPeCT lesson plans binder • Materials kit (1 per topic)	**Display Slide 14.** Your RESPeCT PD Program Materials (Approximately 1 min) a. **Transition slide:** “In a moment we’ll break up into grade-level study groups and dig into the RESPeCT PD program! But first let’s review this list of materials you’ll receive in your designated meeting rooms.”
8:25–8:30 5 min **Transition** Slide 15	**Transition to Grade-Level Study-Group Settings**	Transition to Grade-Level Study Groups Any questions before we break up into our grade-level study groups?	**Display Slide 15.** Transition to Grade-Level Study Groups (5 min) a. “Any questions before we head to our grade-level study groups?” b. **Send-off:** “Have a great day and be sure to let us know if there is anything we can do to support you in getting the most out of this experience!”
8:30–9:20 50 min **Getting Started** Slides 16–24	**Purpose** • Build community within grade-level study groups. • Set the stage for a day of learning about the RESPeCT PD program (formerly the STeLLA PD program), the STeLLA conceptual framework, and tools for lesson analysis. • Access participants’ prior knowledge/beliefs about	Notebook Setup • Write your name on the front cover of the notebook. • Leave two or three pages for the table of contents. (You’ll add to the TOC each day throughout the program.) • Number your pages. (Front and back pages should be numbered separately.) • Use sticky tabs to divide your notebook into two main sections: Lesson Analysis and Content Deepening. (Each section will comprise about half the notebook.) • Keep a chronological record of your activity in each section. Add a title for each entry and enter in your TOC to easily locate. • Customize and decorate your notebook any way you wish.	**Display Slide 16.** Notebook Setup (8 min) a. Welcome participants to the study group and introduce yourself as they arrive. b. Help participants find their table tents and materials so they can get settled. c. Direct them to the instructions for setting up their notebooks (Setting Up Your Summer Institute Notebook in the pretabs section of their PD program binders) and get them started working

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	science teaching and learning: What do participants include in their image of effective science teaching? What's missing? **Content** • RESPeCT PD is different from typical PD in a number of ways. • Agreed-upon norms for working together will support our learning. • Focus questions will guide our work in lesson analysis and content deepening activities. • We bring to this work a variety of ideas about effective science teaching. **What Participants Do** • Set up their Summer Institute notebooks. • Quick-write about their school experiences in science and their hopes for learning in this program. • Share their writing with a partner. • Introduce their partners to the group. • Discuss suggested norms for working together. • Brainstorm and discuss ideas		on this task. Interact informally with them and allow them to chitchat as they work.
		Getting Started: Introductions 1. Quick-write exercise: • Describe your experience learning science in school. • What do you hope to learn through RESPeCT in the coming year? 2. Share your responses with a partner. 3. Introduce each other to the group.	**Display Slide 17.** Getting Started: Introductions (15 min) a. **Individuals (3 min):** Have participants write their responses to the questions on the slide in their notebooks. Emphasize that this is an independent writing exercise. b. **Pairs (3 min):** Have participants pair up and share their responses to the questions. Encourage them to learn other things about their partners as well (e.g., school, years of teaching, favorite subjects to teach, hobbies). **Note:** If the group has an odd number of participants, pair up with one of them. c. **Whole group (9 min):** Have each participant introduce her or his partner, highlighting what that partner hopes to learn from the RESPeCT PD program. Model the first pair of introductions to demonstrate that they should be brief. **Note:** If you weren't able to pair up with someone, simply introduce yourself. **Monitor the time:** Introductions should be longer than a sentence, but not the length of a full essay!

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	about effective science teaching. **Posters and Charts** • STeLLA Framework and Strategies poster • Norms for Working Together (chart) • Day-1 Agenda (chart) • Day-1 Focus Questions (chart) • Parking Lot poster **Handouts in PD Binder** • 1.1 Norms for Working Together **Supplies** • Table tents with names • Science notebooks • Chart paper and markers **PD Resources** • RESPeCT PD program binder • RESPeCT lesson plans binder • STeLLA strategies booklet • Setting Up Your Summer Institute Notebook (pretabs section in PD binder) • Half-page copy of the norms (front pocket of PD binder)	RESPeCT PD Program Goals *Business-as-Usual PD* 1. *Not closely linked to day-to-day classroom teaching* 2. *Rarely see other teachers practice* 3. *Learning about content separate from learning about teaching* **RESPeCT PD Program** 1. Learn science content in the context of analyzing teaching and student learning. 2. Engage with one another in a collaborative analysis of content-specific videocases of other teachers. 3. Learn science content in the context of analyzing teaching and student learning.	**Display Slide 18.** RESPeCT PD Program Goals (2 min) a. Talk through this slide, emphasizing how RESPeCT PD is different from many other professional development opportunities.
		RESPeCT PD Program Goals: Lesson Analysis PD *Business-as-Usual PD* 1. *Focus on what to do tomorrow and “cool” activities* 2. *Development not sustained over time* 3. *Effectiveness measured in terms of teachers’ enjoyment* **RESPeCT Lesson Analysis PD** 1. Learn how to select and carry out science activities based on analysis of science content and student thinking and learning. 2. Be supported in using new teaching knowledge throughout the year. 3. Measure effectiveness in terms of teacher and student learning.	**Display Slide 19.** RESPeCT PD Program Goals: Lesson Analysis PD (1 min) a. Highlight the goals of RESPeCT lesson analysis PD and how it differs from other professional development opportunities.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Norms for Working Together: The Basics **Purpose:** Build trust and develop a productive study group for all participants. **The Basics** • Arrive prepared and on time; stay for the duration; return from breaks on time. • Remain attentive, thoughtful, and respectful; engage and be present. • Eliminate interruptions (turn off cell phones, email, and other electronic devices; avoid sidebar conversations). • Make room for everyone to participate (monitor your floor time).	**Display Slide 20.** Norms for Working Together: The Basics (3 min) a. “To do this kind of work together, we need to develop a strong study group where everyone feels safe sharing their ideas, questions, confusion, successes, and stumbles. Having a set of agreed-upon norms will help us build such a learning community.” b. Read over these basic norms. c. “What do you think? Are there any changes or additions you’d like to suggest?”
		Norms for Working Together: The Heart **Purpose:** Build trust and develop a productive study group for all participants. **The Heart of RESPeCT Lesson Analysis and Content Deepening** • Keep the goal in mind: analysis of teaching to improve student learning. • Share your ideas, uncertainties, confusion, disagreements, questions, and good humor. All points of view are welcome. • Expect and ask questions to deepen everyone’s learning; be constructively challenging. • Listen carefully; seek to understand other participants’ points of view.	**Display Slide 21.** Norms for Working Together: The Heart (5 min) a. “This set of norms moves beyond the basics and targets the heart of RESPeCT PD program goals.” b. Read the list. c. “Is anything unclear? Do you have any changes or additions you’d like to suggest? Do you have any concerns about these norms?” d. Direct participants to handout 1.1 (Norms for Working Together) and pass out the half-page copy of the norms for them to paste on the inside front cover of their notebooks. e. Ask participants if they’re willing to live with these norms today; then tell them they’ll have an opportunity to revise them tomorrow.

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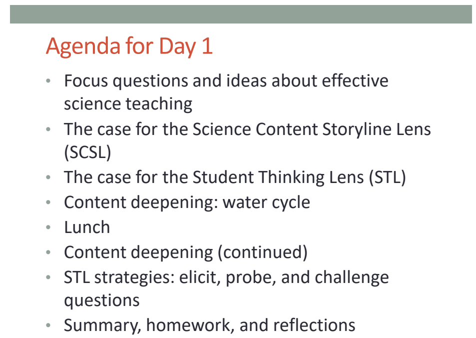
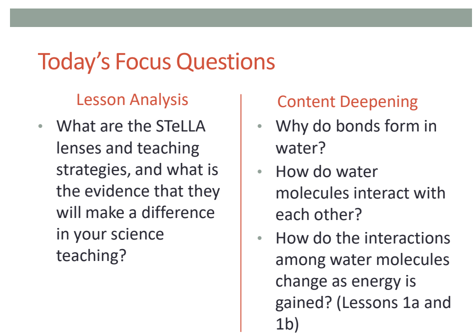
<tr><td rowspan="2"></td><td rowspan="2"></td><td>
</td><td>Display Slide 22. Agenda for Day 1 (Less than 1 min)

a. Talk through the agenda for the day.</td></tr>
<tr><td>
</td><td>Display Slide 23. Today's Focus Questions (1 min)

a. "Each day we're going to have at least one lesson analysis focus question and one content deepening focus question. These are today's focus questions."
b. Read the focus questions on the slide.</td></tr>
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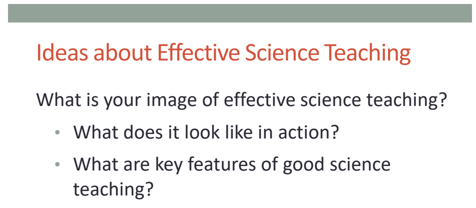
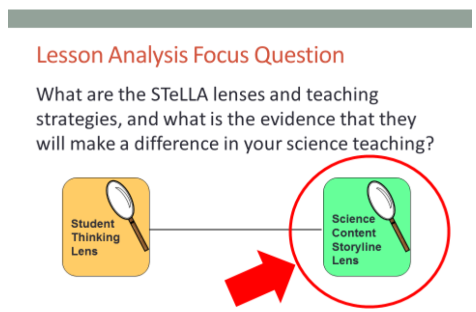
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 24.** Ideas about Effective Science Teaching (15 min) a. "Before we explore these questions, let's create a list of ideas about effective science teaching." b. **Individuals (3 min):** "Take a few minutes to think and write about the questions on the slide." c. **Whole group (10 min):** Go around the group (round-robin) asking everyone to contribute an idea. Write the ideas on chart paper and title the chart "Effective Science Teaching." d. "Throughout the sessions, we'll revisit this list to add new ideas, clarify our thinking, and make other modifications."
9:20–10:10 50 min (Includes 10-min break) **The Case for the Science Content Storyline Lens (SCSL)** Slides 25–34	**Purpose** • Draw from the TIMSS video study to build the case for the Science Content Storyline Lens as a core analytical tool in the STeLLA conceptual framework. **Content** • The TIMSS video study showed the importance of connecting lesson activities to science ideas to form a coherent science content storyline in science lessons. **What Participants Do**		**Display Slide 25.** Lesson Analysis Focus Question (2 min) a. "This PD program will focus on two lenses as analytical tools to guide our learning: the Student Thinking Lens and the Science Content Storyline Lens." b. "Today we're going to examine why these two lenses were chosen for our focus." c. "Let's begin with the Science Content Storyline Lens."

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	• Analyze a results graph from the TIMSS video study. • Watch video clips from US and Japanese classrooms and discuss observed differences. • Discuss key findings from the TIMSS video study and how they relate to the idea of a science content storyline. • Review the chart of participant ideas about effective science teaching in light of the TIMSS video study. **Posters and Charts** • Effective Science Teaching chart **Videos** • Video Clip 1.1, TIMSS US Lesson 3 • Video Clip 1.2, TIMSS Japan Lesson 1 **Handouts in PD Binder** • 1.2 Transcript for Video Clip 1.1 • 1.3 Transcript for Video Clip 1.2 • 1.4 TIMSS *Educational Leadership* article	TIMSS Video-Study Questions • What does science teaching look like in different countries? • What can we learn from looking at science-teaching practice in higher-achieving countries?	**Display Slide 26.** TIMSS Video-Study Questions (2 min) a. “A large video study of science teaching in different countries revealed the importance of the Science Content Storyline Lens.” b. “The TIMSS video study explored the research questions on this slide.” **Background info:** • TIMSS stands for Trends in Mathematics and Science Study. • TIMSS is known for its achievement studies comparing student performance in math and science internationally.
		TIMSS Video-Study Comparisons The study compared science teaching in the United States with science teaching in these higher-achieving countries: • Australia • Czech Republic • Japan	**Display Slide 27.** TIMSS Video-Study Comparisons (2 min) a. “Australia, the Czech Republic, and Japan are higher-achieving countries in science compared to the United States.” b. “In these countries, 100 eighth-grade lessons were randomly video recorded. The goal was to describe typical science teaching in each country.”

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TIMSS Video-Study Results

- Although each higher-achieving country had its own approach, they all had strategies for engaging students with core science concepts and ideas.
- In US lessons, content played a less central role, and sometimes no role at all. Instead, lessons engaged students in carrying out a variety of activities.
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Display Slide 28. TIMSS Video-Study Results (2 min)

a. “The TIMSS video study showed these results.”
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TIMSS Video-Study Results

- Although each higher-achieving country had its own approach, they all had strategies for engaging students with core science concepts and ideas.
- In US lessons, content played a less central role, and sometimes no role at all. Instead, lessons engaged students in carrying out a variety of activities.
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Display Slide 29. TIMSS Video-Study Results (2 min)

a. Call attention to the text highlighted in red to emphasize the difference between US science lessons and science lessons in higher-achieving countries.
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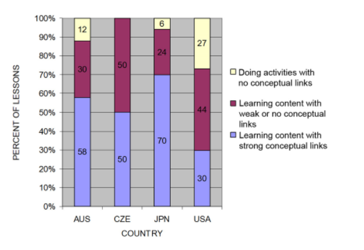
TIMSS: Conceptual Links



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Display Slide 30. TIMSS: Conceptual Links (3 min)

a. **Ask:** “What do you notice from this graph? What do you make of this data?”

b. **Emphasize:** “In the US, more than a quarter of the lessons had no science content; whereas in the other countries, the majority of the randomly selected lessons (or typical lessons) had content with strong conceptual links.”

c. **Example of a lesson with no science content:**
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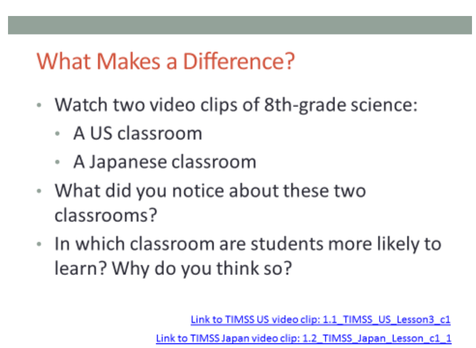
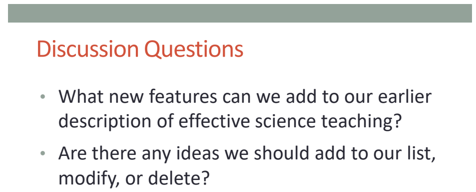
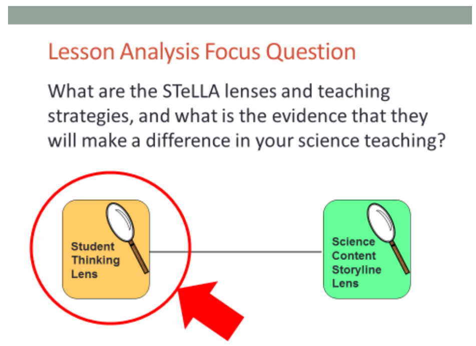
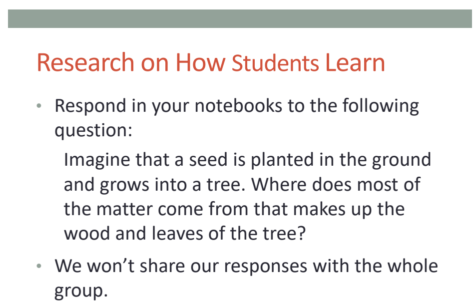
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			"What's a science lesson with no content? In this research, a lesson with at least one complete statement of a science idea was scored as 'learning content.' Lessons with 'no content' had **only** topic-level mentions of science concepts. For example, one teacher started a lesson by telling students to take out their rockets and get to work. They had directions to follow, but the teacher's only focus in his interactions with students was on how to build the rockets. At the end of the lesson, he told students to clean up and then dismissed them. This is a lesson with no science content!" **Other key ideas to highlight:** • Each higher-achieving country engaged students with core science concepts and ideas (more consistently than the US). • All the higher-achieving countries linked ideas and activities (more consistently than the US). • In US lessons, the focus was on performing activities with less attention to content and even less attention to linking activities and science ideas.
			**Display Slide 31.** What Makes a Difference? (20 min) a. Direct participants to the transcripts for Video Clips 1.1 and 1.2 (handouts 1.2 and 1.3) before showing each clip. b. **Show US classroom video:** Ask participants to focus on what is going on with the science content and storyline.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			c. **Discuss:** "What did you notice?" **Key ideas to emphasize and link back to the results include the following:** • The teacher focuses on the activity and the procedure needed to complete the activity. • The teacher and students place no real focus on important science ideas. • There's only a topic-level mention of science ideas ("pulleys," "effort distance," "resistance force"). d. **Show Japanese classroom video:** Ask participants to focus on what is going on with the science content. e. **Discuss:** "What did you notice?" **Key ideas to emphasize and link back to the results include the following:** • Content ideas are made clear to students (focus question, pairs talk) before doing any activity. • Students are asked to talk about science ideas, not just procedures. • The lesson purpose is made clear to students. f. **Ending discussion:** "In which classroom are students more likely to learn science concepts? Why?" **Note:** Participants may be critical of both classrooms because student thinking isn't made visible. This is true, but bring their focus back to the science content and storyline. They should see a clear distinction between the science content storylines in the Japanese and US lessons. Students in the Japanese classroom are more likely to learn because science-content ideas are made visible, and students

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			are engaged in thinking about these ideas, not just science activities.
		The TIMSS Findings Show … • Each higher-achieving country engaged students with core science concepts and ideas. • All the higher-achieving countries linked ideas and activities. • In US lessons, the focus was on performing activities with less attention to content and even less attention to linking activities and science ideas.	**Display Slide 32.** The TIMSS Findings Show … (1 min) a. Use this slide and the next to summarize key ideas from the TIMSS video study.
		What Can We Learn from the Research? **A coherent science content storyline can …** • make science ideas more prominent in science lessons, • strengthen connections among science-content ideas, • strengthen connections between science-content ideas and activities, and • improve lesson coherence by shaping science lessons as stories that make sense to students. For more insights, see TIMSS *Educational Leadership* article, "What Science Teaching Looks Like: An International Perspective" (handout 1.4 in binder).	**Display Slide 33.** What Can We Learn from the Research? (1 min) a. After reading this slide, share with participants that the Science Content Storyline Lens addresses the need uncovered in the TIMSS video study: to strengthen the links between science ideas and lesson activities. b. Encourage participants to read handout 1.4 (TIMSS *Educational Leadership* article) for further insight.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 34.** Discussion Questions (5 min) a. "What features on our list of ideas about effective science teaching are consistent with the TIMSS video-study findings?" b. "Are there any ideas you'd like to add to our list, delete, or modify?" **Note: Use a different color** to add/delete/modify ideas. Encourage participants to keep an open mind about changing their ideas. Provide opportunities for them to reflect on any changes and the reasons for those changes. c. **Transition:** "During week 2 of the Summer Institute, we'll focus on strategies for creating a strong, coherent science content storyline. This week, we'll focus on the Student Thinking Lens. Right now, let's consider the reasons for this focus."
10:00–10:10 10 min	**BREAK**		

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
10:10–10:40 30 min **The Case for the Student Thinking Lens (STL)** Slides 35–39	**Purpose** • Draw from research on science learning to build the case for the Student Thinking Lens as a core analytical tool in the STeLLA conceptual framework. **Content** • Research on science teaching and learning shows that learners cling to important misconceptions even after what we usually consider to be good hands-on science instruction. • To help students change their ideas and truly understand science concepts, we need to engage them in more thinking and sensemaking. • Making students' ideas and misconceptions visible is essential to effective science teaching. • For teachers, knowledge of students' ideas can guide them in designing instruction to provide evidence and support that will help students change their ideas and find science ideas meaningful. • For students, making their thinking visible engages them actively in the learning process. **What Participants Do**	 	**Display Slide 35.** Lesson Analysis Focus Question (Less than 1 min) a. "At this point, we'll transition from a focus on the Science Content Storyline Lens (SCSL) to the Student Thinking Lens (STL)." b. "We'll be focusing on the Student Thinking Lens the rest of the day and throughout this week."
		 	**Display Slide 36.** Research on How Students Learn (3 min) a. **Individuals:** Have participants answer the question on the slide in their science notebooks. **Background for PD leaders:** Participants will likely have the same misconceptions revealed in the video, but they may not yet be comfortable sharing their confusion. At this point, don't ask them to share their ideas with the group. It will be interesting to see if some of them voluntarily share their "wrong" ideas after they see the video.

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<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">
• Write about where the added mass comes from when a tiny seed becomes a full-grown tree.
• Watch Minds of Our Own Lessons From Thin Air video clips in which Harvard graduates and an 8th-grade student answer the same question.
• Discuss ideas about research on student thinking addressed in the video.
• Review the chart of participant ideas about effective science teaching in light of this research.

Posters and Charts
• Effective Science Teaching chart

Videos
• Minds of Our Own

Handouts in PD Binder
• 1.5 “Synthesis of Research from How Students Learn: Science in the Classroom”

Supplies
• Science notebooks
</td><td>
Minds of Our Own
Minds of Our Own is a video that visually summarizes a large body of research on student learning in science classrooms.
As you watch, think about the following questions:
• How do Harvard graduates answer the question about the mass of a tree? Is their response the same as or different from yours?
• Does this give you any new ideas about effective science teaching?
Link to Minds of Our Own video clip.
</td><td>
Display Slide 37. Minds of Our Own (10 min)

a. Read the information and instructions on the slide.
b. Watch the Minds of Our Own Lessons From Thin Air video. Total viewing time is approximately 10 minutes. (https://www.learner.org/series/minds-of-our-own/2-lessons-from-thin-air/?jwsource=cl)
• MIT/Harvard interview—start at segment 3:30 and end at 5:40.
• John preinterview, class, and postinterview—start at segment 7:50 and end at 16:45.
Note: If time is short, stop after Phil Sadler. If you have enough time, you can show the entire segment from 3:30 to 16:45.
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<tr><td>
Discussion Questions
• What did you notice in the Minds of Our Own video?
• What does research on learning say to us about effective science teaching?
• What new features can we add to our description of effective science teaching?
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Display Slide 38. Discussion Questions (15 min)

a. There’s a lot to talk about in this video! Here are some additional questions you might pose:
• Did John’s ideas about photosynthesis change through instruction?
• What did the teacher say about his instruction?
• What did the experts say?
• How do the Harvard students’ responses compare with your own? What ideas does this give you about your own science learning experiences?
Key idea to emphasize: Research shows that we not only need to engage students in more thinking and sensemaking, but we also need to listen to their ideas—especially when they’re
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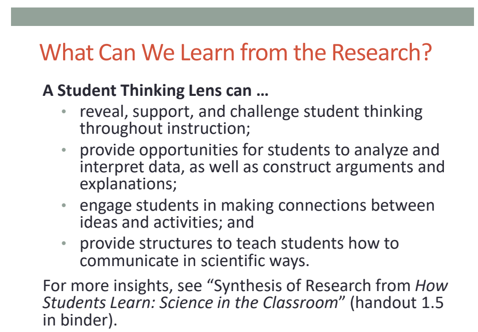
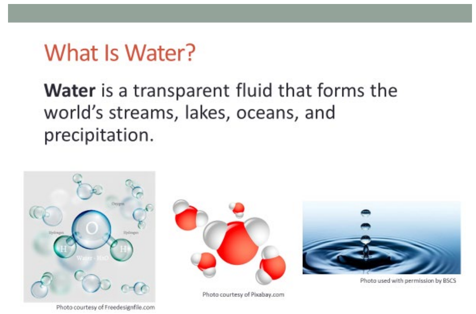
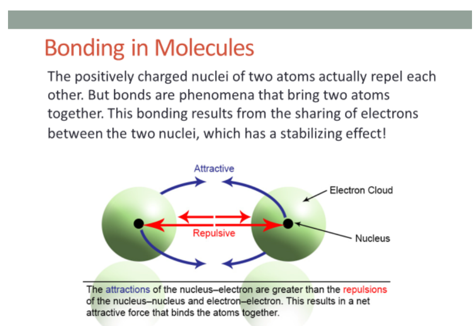
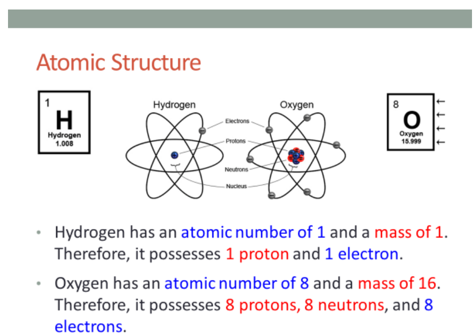
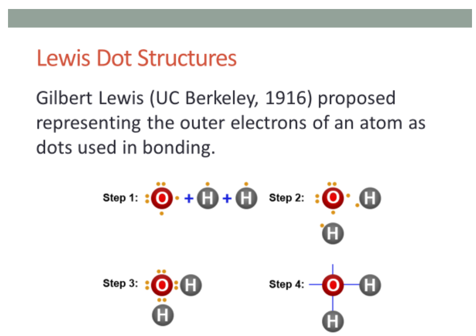
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			wrong—and use them to guide our instruction. b. Modify the chart of ideas about effective science teaching as participants share features from the research.
			**Display Slide 39.** What Can We Learn from the Research? (2 min) a. "This slide nicely summarizes some of the ways we get students thinking and make their thinking visible." **Note:** Encourage participants to read handout 1.5 ("Synthesis of Research from *How Students Learn: Science in the Classroom*") for further insight. b. **Transition:** "Today we'll start learning some particular strategies for making student thinking more prominent in science lessons." **Background for PD leaders:** The STeLLA conceptual framework addresses the need uncovered in this and other studies on how people learn and, more specifically, how students learn science. 1. If students' initial knowledge is not engaged, they may fail to grasp the new concepts and information that are taught and may distort the new information to make it fit their prior experience. 2. This idea of learning with understanding has two parts: (1) factual knowledge *must* be placed in a conceptual framework (a big idea or a set of big ideas) organized in ways that enable students to use and apply that knowledge to make predictions, solve problems, explain new situations, and so

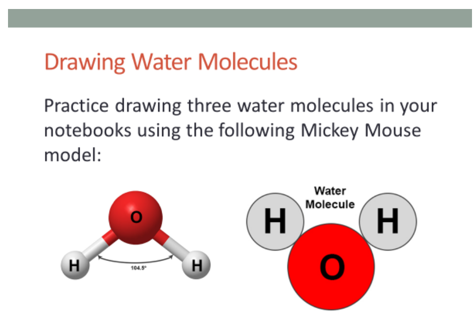
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			forth; and (2) multiple representations that are rich in science ideas and details give concepts meaning. 3. This idea helps students monitor their developing understandings, engaging them in reflecting on their learning experiences, their changing ideas, and their remaining questions and musings.
10:40–12:00 80 min **Content Deepening: Water Cycle** Slides 40–48	**Purpose** • Explain the phenomena of the water cycle by examining the nature of water molecules, starting with an exploration of bonding and molecular shape. **Content** • Discuss previous knowledge regarding how bonds form in water as polar covalent molecules that can participate in hydrogen bonding. **What Participants Do** • Explore the nature of a polar covalent bond.	 	**Display Slide 40.** Content Deepening: Water Cycle **Note:** Throughout this content deepening phase, refer as needed to the Water Cycle Content Background Document and The Water Cycle and Conservation of Matter: Learning Goals for Students and Teachers. **PD leader talk:** "Now let's begin our content deepening work on the water cycle." **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.

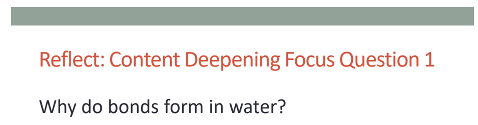
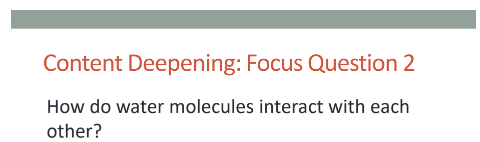
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	• Develop a model of a water molecule using a Mickey Mouse drawing, ball-and-stick kits with magnets, and an ice-crystal lattice to further understand the phase change of liquid water to water vapor with the addition of heat energy. **Handouts in PD Binder** • 1.6 “Linus Pauling: American Hero” **Supplies** • Science notebooks • Chart paper and markers • Pens and pencils • Ball-and-stick model kits (with magnets) • Ice-crystal lattice model **Resources in Lesson Plans Binder** *Resources section:* • Content background document *Pretabs section:* • Learning Goals for Students and Teachers	Main Learning Goal Explain the phenomena of the water cycle by examining the nature of water molecules.	**Display Slide 41.** Main Learning Goal **PD leader talk:** “The main goal of this content deepening phase is to explain the phenomena of the water cycle by examining the nature of water molecules.”
		Content Deepening Focus Questions 1. Why do bonds form in water? 2. How do water molecules interact with each other? 3. How do the interactions among water molecules change as energy is gained? (Lessons 1a and 1b)	**Display Slide 42.** Content Deepening Focus Questions **PD leader move:** Read each focus question on the slide and assure participants that they’ve acquired knowledge about water over the years, and you hope to enrich their ability to teach the water cycle. To ensure that all Teacher Leaders feel prepared to elicit, probe, and challenge student thinking that will be made visible during the actual lesson, some topics covered will exceed the students’ level of knowledge. **Note:** Throughout this content deepening phase, refer as needed to The Water Cycle and Conservation of Matter: Learning Goals for Students and Teachers and the Water Cycle Content Background Document.

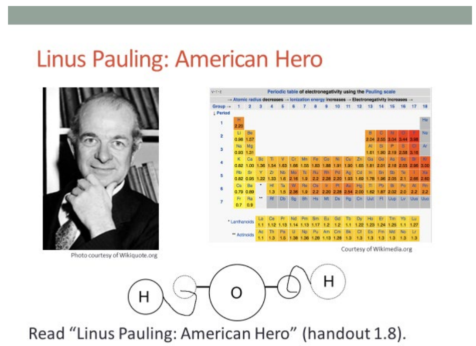
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 43.** What Is Water? **PD leader talk:** "**Water** is a transparent fluid that forms the world's streams, lakes, oceans, and precipitation. I'd like you to perform a 30-second quick write charting any physical and chemical properties of water you can recall." **PD leader move:** Following the quick write, ask participants to form small groups and chart their responses on chart paper. **PD leader move:** Each small group should share their compiled lists with the whole group. Don't offer any feedback. Simply use this time to make group knowledge visible and note similarities among the small groups. **PD leader talk:** "Among some of the similarities on your charts, I noticed the words *atoms* and *bonds*. To further explore the meanings of these terms, we may need to review a few aspects of the periodic table and quantum mechanics."
			**Display Slide 44.** Bonding in Molecules **Note:** Hide the diagram on the slide initially. **PD leader talk:** "Similar to hydrogen and oxygen in water, each atom consists of a nucleus that contains protons (+) and neutrons (-). The presence of negatively charged electrons balances the positive charge of the nucleus. For the next 2 minutes, work with your elbow partner to develop a picture or model to explain why atoms bond with each other." **PD leader move:** When time is up, have one or two volunteers share their drawings with the group.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			Remind participants that you would like them to include a nucleus in their pictures; then advance the PowerPoint animation so the diagram of two atoms is visible. Have participants add to their models to reflect the model on the slide. **PD leader talk:** “The positively charged nuclei of the two atoms actually repel each other. This makes sense because two friends with tempers usually can’t coexist. But in all relationships, bond formation is a phenomenon that brings two atoms or two people together. In life, even when it’s difficult to get along with spouses, partners, other staff members, or teammates, we find a way to make things work because there is strength in numbers. In atoms this results from two nuclei sharing electrons. The attraction of the nuclei to the negatively charged electrons overcomes the repulsion I mentioned earlier. The sharing of electrons has a stabilizing effect and explains why bonds form between atoms. Likewise, sharing our resources as teachers has a stabilizing effect on our jobs from day to day.”
			**Display Slide 45.** Atomic Structure **Note:** Show only the atomic model on the slide initially. **PD leader talk:** “I’m sure this discussion has raised even more questions for you! So let’s use this atomic model developed by a scientist named Ernest Rutherford to see how the atomic number we identified relates to atomic structure. Take a few minutes to see if you can unlock the code.” **PD leader move:** When time is up, (1) chart any patterns the group is able to identify; (2) then reveal and discuss the findings on the slide. **PD leader talk:** “You’ve discovered the code!

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			Atomic number indicates how many electrons are in an atom. So hydrogen has 1 electron to match its atomic number of 1. Hydrogen also has a mass of about 1 atomic mass unit (amu), which indicates the nucleus of hydrogen has 1 proton. In the end, the number of protons and electrons balance each other." **PD leader move:** Someone in the group may wonder why the mass of hydrogen is 1.008 instead of exactly 1.00. Explain that this is a *weighted average* that also accounts for hydrogen isotopes that can have various numbers of neutrons in the nucleus. But since this is rare, it should be emphasized. **PD leader move:** Next, have the group unlock the code for oxygen.
			**Display Slide 46.** Lewis Dot Structures **PD leader talk:** "Gilbert Lewis, a professor from UC Berkeley, was the first scientist to propose the dot-structure model to illustrate electrons in 1916. Lewis displayed only the outermost electrons in the outermost shell because bonds are made using the outermost surface of an atom. Electrons in the inner core are unaffected. Likewise, humans typically form initial bonds and attractions based on outward appearances. We don't form close friendships until we really get to know what others are like at the core. Atoms are the same." **PD leader talk:** "Let's use this Lewis dot-structure model to show how hydrogen and oxygen atoms share electrons by forming bonds: "**Step 1:** A water molecule has 1 oxygen atom with 6 outer-shell electrons and 2 hydrogen atoms

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			with 1 outer-shell electron. “**Step 2:** Each hydrogen atom needs to share 1 electron from the oxygen atom (and vice versa) to gain stability. So the atoms arrange themselves to make this a reality. “**Step 3:** Once the atoms are close enough, the electrons are shared, and two bonds are formed. “**Step 4:** A single line between these bonds indicates that the electrons of each atom are being shared.” **PD leader move:** Explain that the additional electrons surrounding the oxygen atom that are not involved in a bond with the hydrogen are key for the next content deepening phase.
			**Display Slide 47.** Drawing Water Molecules **PD leader talk:** “The Lewis dot-structure theory has been awarded four Nobel Prizes in chemistry and physics over the years. Our students won’t need to know the theory itself, but they’ll need to recognize water as a molecule with 1 oxygen and 2 hydrogen atoms and be able to draw a Mickey Mouse model. Take 5 minutes to (1) build a water molecule using a ball-and-stick model in which the wooden pegs represent a bond; and (2) draw three Mickey Mouse water molecules in your notebooks.” **PD leader talk:** “The hydrogen atoms are drawn as smaller circles because hydrogen has a smaller mass and fewer shells. This explains why the hydrogen atoms form Mickey’s ears, while the larger oxygen atom represents his head.”

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 48.** Reflect: Content Deepening Focus Question 1 **PD leader talk:** “Reflect on our initial content deepening focus question for a moment; then take 5 minutes to write an answer in your notebooks, highlighting any additional understandings you’ve gained regarding this topic.”
12:00–12:45 45 min	**LUNCH**		
12:45–2:10 85 min (Includes 10-min break) **Content Deepening (Continued)** Slides 49–63	**Purpose** • Explain the phenomenon of the water cycle by examining the nature of water molecules, with a focus on bonding and molecular shape. • Develop an initial understanding of how water molecules interact during phase changes. **Content** • Discuss previous knowledge regarding how bonds form in water as polar covalent molecules that can participate in hydrogen bonding. **What Participants Do**		**Display Slide 49.** Content Deepening: Focus Question 2 **PD leader move:** Read the second focus question and let participants know this content deepening work will (1) build upon previous knowledge they’ve gained, and (2) support their ability to elicit, probe, and challenge student thinking that will be made visible during the actual lesson.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	• Explore the nature of a polar covalent bond. • Develop a model of a water molecule using ball-and-stick kits with magnets and an ice-crystal lattice to further understand the phase change of liquid water to water vapor with the addition of heat energy. **Supplies** • Science notebooks • Chart paper and markers • Pens and pencils • Ball-and-stick model kits (with magnets) • Ice-crystal lattice model • Hot plate • 200-ml beaker of water		**Display Slide 50.** Linus Pauling: American Hero **PD leader talk:** "To understand how water molecules interact with each other, we need an additional model that explains the nature of these bonds. Let's take a moment and read the handout titled "Linus Pauling: American Hero." **PD leader move:** Before participants begin reading, instruct them to underline any information they already understand and highlight any information that's new to them. **PD leader move:** Draw the group's attention to the hydrogen-oxygen diagram on the slide and probe whether anyone can explain bonding in a water molecule using the hook-and-eye analogy. **PD leader talk:** "What insights have you gained from the article regarding Gilbert Lewis's description of a covalent bond in relation to an ionic bond?" **PD leader move:** Give participants time to flesh out their thoughts. **PD leader talk:** "Now let's focus on developing definitions for an ionic bond and a covalent (nonpolar) bond." **PD leader move:** Develop group definitions on chart paper.

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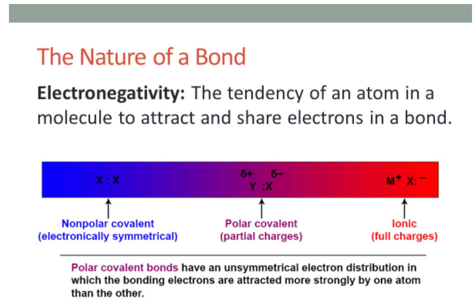

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Display Slide 51. The Nature of a Bond

PD leader talk: “Linus Pauling proposed a type of bond represented in water that is known as a *polar covalent bond*. This notion was based on his theory of **electronegativity**—the tendency of an atom in a molecule to attract a shared electron in a bond. According to the Pauling electronegativity scale, oxygen has a greater attraction to the electrons shared in a water molecule.”

PD leader move: Ask participants to develop an *electropotential map* of a water molecule by placing a δ+ and δ– over the atoms to show the difference in how they will share electrons.

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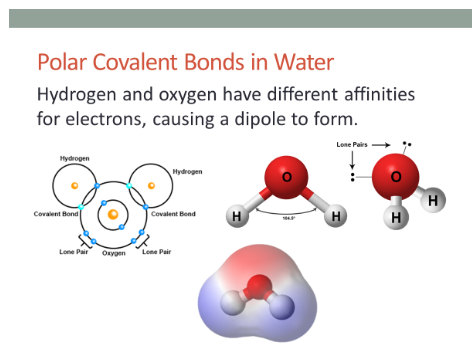

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Display Slide 52. Polar Covalent Bonds in Water

PD leader talk: “Using the Pauling scale, we can develop three models of water molecules that incorporate all of our developed understandings. As we go around the room, would someone explain each of these diagrams?”

PD leader move: Highlight that the oxygen electrons that aren’t participating in a bond are sources of electron-density regions that are negatively charged based on polarity.

PD leader talk: “So if a water molecule has an electron-poor area and an electron-rich area, it’s almost as if it has poles (just like a magnet, where one region is negative and another region is positive). To simulate the electronegativity in a polar covalent bond, we’re now going to build another

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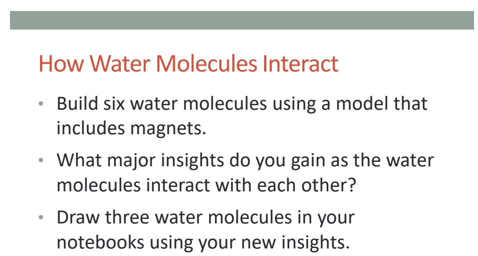
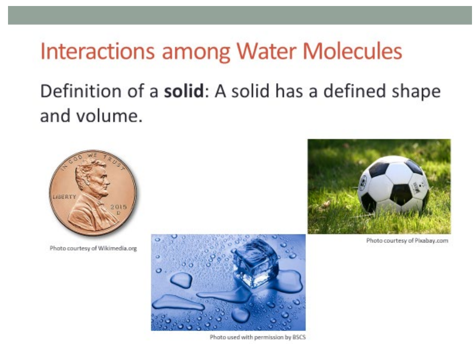
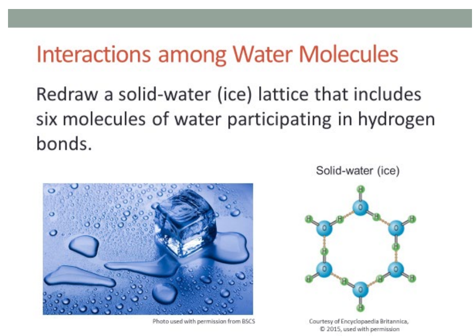
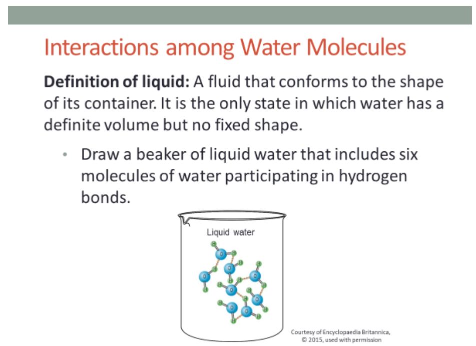
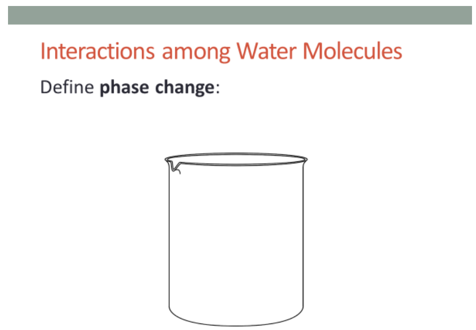
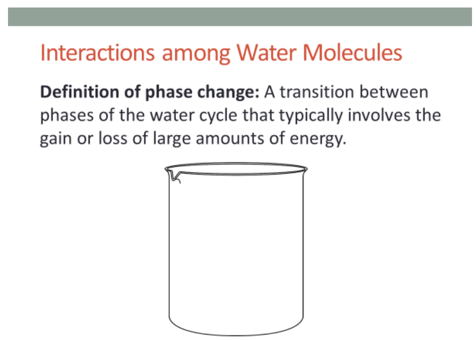
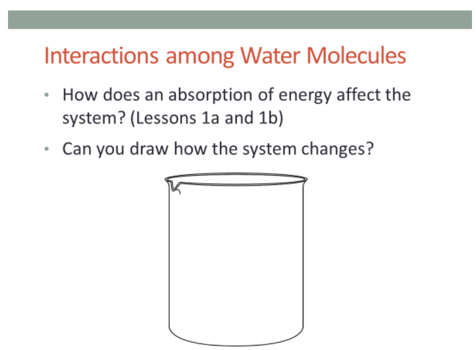
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			model of a water molecule that includes magnets with positive and negative poles.“ **PD leader move:** Instruct participants to build six water molecules using red oxygen atoms, white hydrogen atoms, and plastic sleeves. **PD leader talk:** “Add magnets with the negative pole facing outward near the lone-pair electrons of the oxygen atoms.” **PD leader talk:** “Next, add magnets with the positive pole facing outward near the hydrogen atoms.” **PD leader move:** Use your own water molecule as a reference point to ensure that participants’ magnets are oriented correctly. Don’t answer questions, but if the construction is wrong, probe participants’ thinking.
			**Display Slide 53.** How Water Molecules Interact **PD leader talk:** “Now that you’ve built your six water molecules, have them interact one on one and in large groups using the different poles.” **PD leader move:** Have the group develop a response to the slide questions. Once a consensus is reached, have a discussion about how water molecules interact with each other. Participants should reach a conclusion that based on the polarity of the bond, water molecules have temporary attractions to one another. Don’t call this interaction a hydrogen bond yet!

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Reflect: Content Deepening Focus Question 2 How do water molecules interact with each other?	**Display Slide 54.** Reflect: Content Deepening Focus Question 2 **PD leader talk:** “Take a few moments to reflect on our second content deepening focus question, and then write down your thoughts in a 2-minute quick write.”
		Content Deepening: Focus Question 3 How do the interactions among water molecules change as energy is gained? (Lessons 1a and 1b)	**Display Slide 55.** Content Deepening: Focus Question 3 **PD leader move:** Read the third focus question and remind the group that this content deepening work will (1) build upon the previous knowledge everyone has gained, and (2) support their ability to elicit, probe, and challenge student thinking that will be made visible during the actual lessons.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 56.** Interactions among Water Molecules **PD leader talk:** “Let’s begin by reviewing the definition of a solid. A penny, a soccer ball, and a cube of ice have a defined shape and volume, which makes each of them a solid.”
			**Display Slide 57.** Interactions among Water Molecules **Note:** Initially, reveal only the task and the ice-cube photo on the slide. **PD leader move:** Have participants redraw a solid-water (ice) lattice that includes six water molecules participating in hydrogen bonds. **PD leader move:** After participants have drawn their pictures, perform a gallery walk to identify key facets of various drawings that they would like to include in their own. Encourage discussion to make their thinking visible. **PD leader move:** Identify one drawing in which molecules are packed closely together. **PD leader move:** Next, reveal the drawing of a solid-water (ice) lattice on the slide. **PD leader talk:** “Can anyone find an interesting pattern in this drawing?” **PD leader move**: Probe the thinking of group members to elicit the response that hydrogen bonds

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			are visible through attractive (magnetic) forces in polar covalent bonds. These forces are shown with dotted lines because they aren’t actual bonds. They are temporary attractions between neighboring, partially negative oxygen atoms and hydrogen atoms with partial positive charges (similar to the attraction between magnets). **PD leader move:** Have participants build a hexagon of water using the magnetic water molecules and highlighting H-bonds through magnetic attractions. **PD leader talk:** “Finally, let’s explore this ice-crystal lattice model and then improve our individual solid-water drawings based on our new learning.”
		Interactions among Water Molecules Define a **liquid**:	**Display Slide 58.** Interactions among Water Molecules **PD leader talk:** “Next, I’d like you to develop a working definition of a liquid in your notebooks.” **PD leader move:** Give participants enough time to develop a definition. Then have them compare definitions with their elbow partners.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 59.** Interactions among Water Molecules **PD leader talk:** "According to one definition I found, a **liquid** is 'a fluid that conforms to the shape of its container. It is the only state in which water has a definite volume but no fixed shape.' Are we all right with this as our working definition?" **PD leader move:** Draw the group's attention to the 200-ml beaker of water on a hot plate. Fill the beaker halfway with water and make sure to mark the starting volume. Ask participants to draw the beaker containing six water molecules. Encourage them to emphasize the magnetic interactions between the molecules. **PD leader move:** Identify one drawing that emphasizes the proper hydrogen bonds, with the molecules a bit more spaced out compared to the solid-water (ice) version. **PD leader talk:** "Remember, in a flowing liquid, water molecules are able to tumble past each other and are held together by temporary attractive forces." **PD leader move:** Start heating the beaker on the hot plate. **Note:** Warn participants to stay away from the hot surface!

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 60.** Interactions among Water Molecules **PD leader talk:** "Now I'd like you to develop a working definition of a **phase change** in your notebooks." **PD leader move:** Have participants compare definitions with their elbow partners.
			**Display Slide 61.** Interactions among Water Molecules **PD leader talk:** "According to one definition I found, a **phase change** is 'a transition that typically involves the gain or loss of large amounts of energy.' Are we all right with this as our working definition?"
			**Display Slide 62.** Interactions among Water Molecules **PD leader talk:** "Now that the water is boiling and a considerable amount of energy has been added to the system, draw another picture of how this system changes, using six water molecules." **PD leader move:** Participants will focus on the bubbles, but this is not the key finding. Probe their thinking as they consider what new phase some of

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			the water molecules are transitioning to. **PD leader move:** Encourage participants to include in their drawings water molecules in the liquid and gaseous phases in and around the beaker. **PD leader move:** Ask participants to share their improved drawings with their elbow partners. Then facilitate a discussion of how energy absorbed by the water molecules increases their kinetic energy, thereby disrupting the H-bonds. **PD leader move:** Point out that once enough energy is gained, the water molecules become a gas with no intermolecular attractions. The gas completely fills the environment above and beyond the beaker.
			**Display Slide 63.** Reflect: Content Deepening Focus Question 3 **PD leader talk:** “Take a few moments to reflect on our last content deepening focus question, and then write down your thoughts in a 2-minute quick write to conclude this phase.”
2:00–2:10 10 min	**BREAK**		

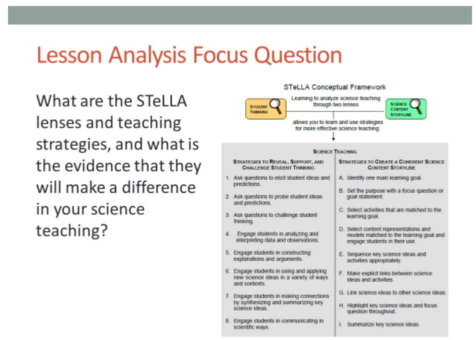
<table>
<tr><th>PD Model: Time/Phase</th><th>Purpose, Content, and What Participants Do</th><th>Slides</th><th>Process</th></tr>
<tr>
<td rowspan="2">2:10–3:00

50 min

STL Strategies: Elicit, Probe, and Challenge Questions

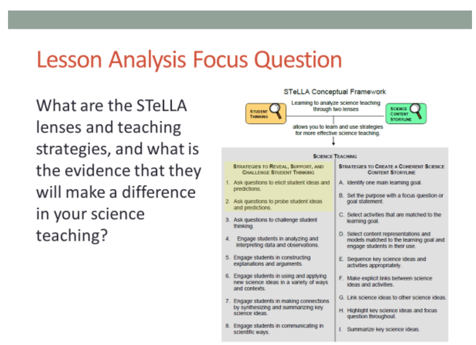
Slides 64–70</td>
<td rowspan="2">Purpose
• Begin to develop shared understandings of the Student Thinking Lens (STL) and STeLLA strategies 1, 2, and 3 (elicit, probe, and challenge questions).

Content
• Participants are introduced to the purposes and key features of Student Thinking Lens strategies 1, 2, and 3 (elicit, probe, and challenge questions). This is the first step in learning about these strategies. Learning will continue on day 2 when participants watch video footage of these strategies in action.
• Elicit questions are designed to reveal a variety of student ideas, misconceptions, and experiences before they learn new content.
• Probe questions follow up on something a student has already said to find out more.
• Challenge questions are designed to push students toward more-scientific understandings by making new connections and changing their thinking.

What Participants Do</td>
<td>
</td>
<td>Display Slide 64. Lesson Analysis Focus Question (1 min)

a. Read the focus question on the slide.

b. “The visual on this slide tells us a little about the first part of our focus question: What are the STeLLA lenses and teaching strategies? As you can see, there are eight specific science teaching strategies to support the Student Thinking Lens.”

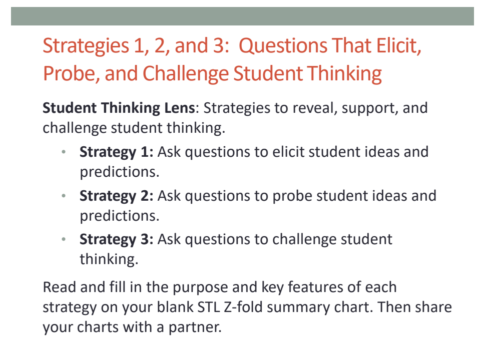
c. Acknowledge: “I know you have existing frameworks (ideas and language) regarding teaching and learning, and I expect you’ll continuously draw from them throughout the Summer Institute.”</td>
</tr>
<tr>
<td>
</td>
<td>Display Slide 65. Lesson Analysis Focus Question (1 min)

a. “Today we’ll begin learning about three of the Student Thinking Lens teaching strategies.

b. Read the strategies highlighted on the slide.

c. “These three types of questions will help reveal, support, and challenge student thinking.”

d. Emphasize: “Even though we’re studying the strategies this summer, you’ll better understand them as you start trying them out in your teaching next fall.”</td>
</tr>
</table>

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	• Read about STeLLA strategies 1, 2, and 3 and write summaries on their blank STL Z-fold summary charts. • Chart and discuss the purposes and key features of strategies 1, 2, and 3. • Discuss key similarities and differences among the three strategies. **Supplies** • Chart paper and markers **PD Resources** • STeLLA strategies booklet • STL Z-fold summary chart (blank copy in front pocket of PD binder)		**Display Slide 66.** Strategies 1, 2, and 3: Questions That Elicit, Probe, and Challenge Student Thinking (20 min) a. Orient participants to the STeLLA strategies booklet. Forecast that you'll come back to this resource repeatedly to ensure consistent use of ideas, meaning, and language that match the STeLLA conceptual framework. b. **Individuals:** Have participants read about all three strategies and write on their blank STL Z-fold summary charts the purpose(s) and key features of each strategy. State that in the future, they'll do this kind of reading and writing as homework. c. **Pairs:** Have participants pair up and share their Z-fold summary charts. Encourage them to provide evidence from the readings to support their ideas and ask each other questions consistent with the norms for working together, such as "Where did you find that?" or "I interpreted that differently."

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Elicit Questions • What are the purpose and key features of questions that **elicit** student ideas and predictions? • Which question from the examples in the strategies booklet do you think would elicit the highest number of *different* student responses in your classroom? Why do you think so? (Cite ideas from the strategies booklet.)	**Display Slide 67.** Elicit Questions (5 min) a. As a group, discuss the purpose and key features of questions that elicit student ideas and predictions. Write these features on chart paper and hang the chart where it can be referenced later. b. Sample chart: **Key Ideas about Elicit Questions** **Purpose:** To reveal student ideas, predictions, misconceptions, and experiences *before* they learn about the content. **Key features:** • Asked anytime, but often at the beginning of a lesson • Phrased in everyday language that students can understand even before studying the related content • Addressed to multiple students (usually the whole class) • Reveals a variety of student ideas • Useful to teachers in adapting instruction • Useful to students so they see that others have different ideas • Can be a prediction • Can set up a discrepant event

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Probe and Challenge Questions **Probe Questions** What are the purpose and key features of questions that probe student ideas and predictions? **Challenge Questions** What are the purpose and key features of questions that challenge student thinking? Remember to cite ideas from the strategies booklet!	**Display Slide 68.** Probe and Challenge Questions (13 min) a. **Small groups (5 min):** Split participants into two groups—one group for probe questions and one group for challenge questions. Have each group create a chart of the purpose and key features of the assigned strategy *from the STeLLA strategies booklet* (not from experience). b. **Whole group (8 min):** Share the charts with the entire group. Encourage participants to add to, delete from, and modify them as needed to ensure they're accurate and match the language in the strategies booklet.
		Elicit versus Probe Questions What are some key differences between questions that elicit and questions that probe student ideas and predictions?	**Display Slide 69.** Elicit versus Probe Questions (5 min) a. **Turn and Talk:** "Discuss this question with an elbow partner." b. **Whole-group share-out:** Invite participants to share their ideas with the group. **Key ideas about elicit questions versus probe questions:** • Elicit questions are addressed to the whole class; probe questions are addressed to individual students. • Elicit questions are used before students have studied a concept; probe questions can be asked at any time. • Elicit questions start a discussion; probe questions follow up on something a student has already said.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Elicit/Probe Questions versus Challenge Questions What are some key differences between questions that elicit and probe student ideas and predictions and questions that challenge student thinking?	**Display Slide 70.** Elicit/Probe Questions versus Challenge Questions (5 min) a. **Turn and Talk:** "Discuss this question with your elbow partner." b. **Whole-group share out:** Invite participants to share their ideas with the group. **Key ideas about elicit/probe questions versus challenge questions:** • Elicit and probe questions focus on understanding students' existing ideas rather than trying to change students' thinking. • In contrast, challenge questions are designed to push students' thinking toward more-scientific understandings and support them in changing their thinking.
3:00–3:30 30 min **Wrap-Up: Summary, Homework, and Reflections** Slides 71–75	**Purpose** • Summarize and reflect on key ideas from today's learning and foreshadow what will be addressed tomorrow and later in the week. **What Participants Do** • Review the lesson plans binder. • Summarize today's learning and discuss the focus questions. • Go over directions for an extended homework assignment related to the Water Cycle lesson plans (content area 1).	The RESPeCT Lesson Plans Binder **What comes before the lessons?** • Scope and sequence • Learning goals • California NGSS • Student pretest/posttest • Features analysis chart • Working with English language learners (ELLs) in science **Overview of lesson format and structure:** • Lesson overview • Lesson outline • Detailed lesson plan	**Display Slide 71.** The RESPeCT Lesson Plans Binder (5 min) a. **Foreshadow:** "In a moment, we'll review the details of a homework assignment related to the lesson plans you'll be teaching in the upcoming school year." b. "But before we look at the assignment, let's review the organization and contents of the lesson plans binder." c. Use the slide to guide participants through the binder contents.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	• Write reflections on today's session. **Handouts in PD Binder** • 1.7 Extended Homework: RESPeCT Lesson Plan Analysis • 1.8 Daily Reflections—Day 1 **PD Resources** • RESPeCT lesson plans binder	Let's Summarize Today's Work! • We thought about what constitutes effective science teaching. • We examined the rationale for the Science Content Storyline Lens and analyzed the US and Japanese video clips from the TIMSS video study. • We examined the rationale for the Student Thinking Lens and watched the video of the Harvard and MIT graduates and John and his teacher. • We deepened our understandings of the interactions between water molecules. • We read and talked about the purposes and key features of elicit, probe, and challenge questions.	**Display Slide 72.** Let's Summarize Today's Work! (5 min) a. Remind participants of the various activities they've been involved in today. b. **Foreshadow:** Let participants know that you're going to ask them to reflect on what they've learned from these activities.
		How Did Today's Work Help You Think about Our Focus Questions? • What are the STeLLA lenses and teaching strategies, and what is the evidence that they will make a difference in your science teaching? • Why do bonds form in water? • How do water molecules interact with each other? • How do the interactions among water molecules change as energy is gained? (Lessons 1a and 1b)	**Display Slide 73.** How Did Today's Work Help You Think about Our Focus Questions? (10 min) **Note:** If time is running short, you may want to skip the Turn and Talk or the entire slide. a. **Turn and Talk:** "Discuss these questions with an elbow partner." b. **Whole-group share-out:** Invite participants to share their ideas with the group.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Extended Homework • Locate handout 1.7 (Extended Homework: RESPeCT Lesson Plan Analysis) in your PD program binder. • Between now and Friday, read the scope and sequence for the set of lessons and your assigned lesson plan in the lesson plans binder. • Be prepared to share your findings about your assigned lesson plan in a study-group conversation on Friday.	**Display Slide 74.** Extended Homework (5 min) a. Assign each participant one of the lessons in the Water Cycle lesson-plan sequence. There are six 2-part lessons in this content area. Each teacher should take responsibility for one 2-part lesson. That is, Teacher 1 will study lessons 1a and 1b; Teacher 2 will study lessons 2a and 2b; and so forth. b. If the study group is small, figure out who will be assigned an extra lesson (or when you, as the PD leader, will cover any extra lessons). c. If the study group is large, assign lessons to more than one teacher later in the sequence. d. Go over the homework sheet (handout 1.7) with participants. If time allows, have them read the assignment sheet before discussing.
		Reflections on Today's Session Complete the Daily Reflections sheet. • What were your first reactions to the STeLLA claim that it's important to plan and analyze science teaching through the Student Thinking Lens and the Science Content Storyline Lens? What was convincing or not so convincing for you and why? • What questions do you have about what happens to molecules of water at various points of the water cycle? • Provide feedback about today's session and the program so far (likes, dislikes, questions, concerns, suggestions).	**Display Slide 75.** Reflections on Today's Session (5 min) a. Review the questions on the Daily Reflections sheet (handout 1.8). b. Ask participants to think about these questions and write down their reflections.