RESPeCT Summer Institute Professional Development Leader Guide (PDLG)

Grade Level	2	**Day**	2	**STeLLA Strategy**	STL Strategies 1, 2, 3: Elicit, Probe, and Challenge Questions	**Subject Matter Focus**	Properties of Matter

Focus Questions	• How can lesson analysis help us better understand how elicit, probe, and challenge questions can reveal and challenge student thinking? • How does the arrangement of water molecules change when heat is added or removed? • What happens when matter starts off as one thing and changes into something different?
Main Learning Goals	Participants will understand the following: • Student thinking can be made more visible in science classrooms when the teacher asks questions that elicit and probe student ideas and predictions and challenge student thinking. • Lesson analysis allows us to slow down teaching so we can clarify our understandings of the distinct purposes of elicit, probe, and challenge questions and how they can be used effectively in science lessons. • The phenomena of matter can be explained by answering the central questions, *What is matter made of?* and *How can matter change?*

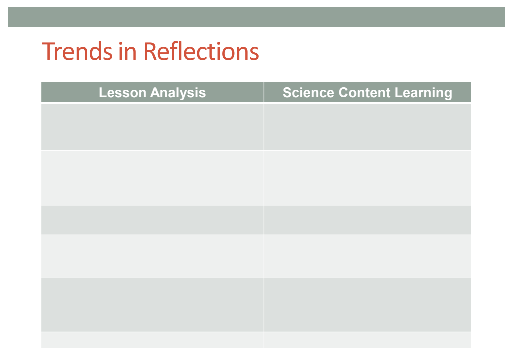
Preparation	**Materials**	**Videos**
Daily Setup Tasks • Check that video clips are correctly linked to PowerPoint (PPT) slides. • Set up PowerPoint. • Make sure video clips play correctly with good sound. • Arrange furniture and food. • Arrange participant materials. • Put up posters and charts. **Planning and Preparation Tasks** • Study the PDLG, PowerPoint slides (PPTs), video clips, and handouts. Make changes to the PPTs, if needed. • Review the reflections from day 1 and create a summary slide. • Cut apart the elicit-question cards from the PD leader master to pass out for practice interviews. • Watch video clips and anticipate participant responses. • Prepare charts for the day's agenda and	**Posters and Charts** • STeLLA Framework and Strategies poster • Day-2 Agenda (chart) • Day-2 Focus Questions (chart) • Norms for Working Together (chart) • Effective Science Teaching chart (from day 1) • Strategy charts from day 1 (STL strategies 1–3) • Common Student Ideas chart • Parking Lot poster **Handouts in RESPeCT PD Binder Front Pocket** • Z-fold summary chart: Student Thinking Lens Strategies **Handouts in RESPeCT PD Binder, Day 2** • 2.1 Transcript for Video Clip 2.1 • 2.2 Transcript for Video Clip 2.2 • 2.3 Transcript for Video Clip 2.3 • 2.4 Daily Reflections—Day 2 **Handouts in RESPeCT Lesson Plans Binder** • 3.1 Lego Model (from lesson 3a)	Video clips from one Properties of Matter lesson: Video Clip 2.1: Student Interview, Griffin classroom (elicit and probe questions); 2.1_mspcp_gr.2_matter _griffin_pre_c1 • Video Clip 2.2: Griffin classroom (probe and challenge questions); 2.2_mspcp_gr.2_matter_griffin_L2_c2 • Video Clip 2.3: Fowler classroom (probe and challenge questions); 2.3_mspcp_gr.2_matter_fowler_L5_c3

focus questions.
• On chart paper, create a Common Student Ideas chart (see resources section in lesson plans binder) and post it at the front of the class. Make sure to leave space in the left-hand margin to apply sticker dots. This chart will be used during lesson analysis (slide 19).
• Review the activity setup and instructions for the vinegar-and-baking-soda investigation in Properties of Matter lesson 1b and extension lesson 6 (in lesson plans binder).
• For content deepening:
  • Assemble one vinegar-and-baking-soda setup for each pair of participants: Place 1 teaspoon of baking soda in a sealable freezer bag. Then place 2 tablespoons of vinegar in a clear plastic vial and secure the snap-on cap. Wipe any vinegar off the outside of the vial. Then place the vial in the freezer bag with the baking soda. Remove as much air as possible before sealing the bag. To mix the vinegar with the baking soda, participants will pop the cap off the vial (without opening the freezer bag) and pour out the vinegar.
	PD Leader Masters, Days 1–4
	• PD Leader Master: Elicit Question Cards—Properties of Matter (for practice interviews)
	
	Supplies
	• Science notebooks
	• Chart paper and markers
	• Red and blue sticker dots (or pencils)
	• Sticky notes
	• Lesson materials kit
	• For content deepening:
	  • Large ice-lattice model
	  • Ball-and-stick molecular model with magnets (1 set)
	  • 6 Lego water molecules(per group) (6 red bricks, 2 × 4"; 12 white bricks, 2 × 2")
	  • Plastic sandwich bag (1 per group)
	  • Small cardboard box (about 3 1/2" × 4 1/2") (1 per group) (optional)
	  • For acid-base neutralization reaction (1 setup per pair):
	    • Samples of vinegar and baking soda in small cups or plastic bags
	    • 1 quart-sized, sealable, plastic freezer bag
	    • 1 teaspoon of baking soda
	    • 2 tablespoons of white vinegar
	    • Clear plastic vial with snap-on cap
	    • Lego bricks (2 lime green, 2 × 4"; 10 white, 2 × 2"; 6 black, 2 × 4"; 10 red, 2 × 4")
	
	PD Resources
	• STeLLA strategies booklet
	• RESPeCT PD program binder
	• RESPeCT lesson plans binder
	
	Resources in Lesson Plans Binder
	Resources section:
	• Properties of Matter Content Background Document
	• Common Student Ideas about Properties of Matter
	Pretabs section:
	• Properties of Matter Learning Goals for Students and Teachers	

DAY 2 SESSION OUTLINE

Time	Activities	Purpose
8:00–8:30 30 min	**Getting Started: Housekeeping, Day-1 Reflections, Norms, Agenda, Focus Questions, Review STL Strategies**	• Build community by sharing participants' reflections from day 1 and reviewing/revising the norms. • Set the stage for a day of learning by introducing the focus questions for day 2 and reviewing the purposes and key features of elicit probe and challenge questions. (These strategies will be the focus of today's lesson analysis work.)
8:30–9:20 50 min	**STL Lesson Analysis: Elicit and Probe Questions**	• Begin to develop an understanding of the RESPeCT lesson analysis process. • Deepen understandings of elicit and probe questions (STL strategies 1 and 2) and how they reveal student thinking. • Deepen science-content knowledge of properties of matter through lesson analysis.
9:20–11:30 130 min (Includes 10-min break)	**STL Lesson Analysis: Probe and Challenge Questions**	• Develop a deeper understanding of the RESPeCT lesson analysis process. • Deepen understandings of probe and challenge questions (STL strategies 2 and 3), how they reveal student thinking, and how they move student thinking forward. • Deepen science-content knowledge of properties of matter through lesson analysis. • Understand that science-content knowledge is essential for using probe and challenge questions effectively in the classroom.
11:30–12:00 30 min	**Practice Using Elicit and Probe Questions: Interviews**	• Deepen understandings of elicit and probe questions. • Begin to develop the ability to ask elicit and probe questions effectively. • Appreciate that science-content knowledge is essential for using elicit and probe questions effectively in the classroom.
12:00–12:45 45 min	**LUNCH**	
12:45–3:15 150 min (Includes 10-min break)	**Content Deepening: Properties of Matter**	• Deepen participants' understandings of matter and what happens to water molecules during phase changes and chemical reactions.
3:15–3:30 15 min	**Wrap-Up: Summary, Homework, and Reflections**	• Summarize and reflect on the day's learning, including progress made in understanding genetics and the relationship between lesson analysis and asking effective elicit, probe, and challenge questions.

DAY 2

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
8:00–8:30 30 min **Getting Started** Slides 1–8	**Purpose** • Build community by sharing participants' reflections from day 1 and reviewing/revising the norms. • Set the stage for a day of learning by introducing the focus questions for day 2 and reviewing the purposes and key features of elicit, probe, and challenge questions. (These strategies will be the focus of today's lesson analysis work.) **Content** • Norms enable the group to build trust and productivity. • Probe questions seek to understand what students are saying/writing and encourage them to explain their ideas more clearly or fully (**not** to change their thinking). • Challenge questions seek to engage students in ways that will challenge them to think, reconsider their ideas, change	 	**Display Slide 1.** RESPeCT PD Program (3 min) a. Take care of any housekeeping issues.
		 	**Display Slide 2.** Trends in Reflections (5 min) b. Give participants time to review your summary of their reflections from day 1 and offer reactions and comments or ask follow-up questions.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	their initial ideas, and move toward more-scientific understandings. **What Participants Do** • Discuss the reflections from day 1 and how the group is doing with the norms. • Study a short transcript example from the STeLLA strategies booklet to identify probe and challenge questions. • Review and contrast the purposes and key features of probe and challenge questions. **Posters and Charts** • STeLLA Framework and Strategies poster • Norms for Working Together (chart) • Day-2 agenda (chart) • Day-2 focus questions (chart) **PD Resources** • STeLLA strategies booklet • Half-page sheet of norms (pasted into science notebooks)	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 3.** Norms for Working Together: The Basics (5 min) a. **Provide context:** "Since we'll be working together throughout the Summer Institute and the academic year, we need norms that will enable us to build trust and productivity as a group. Today we'll start our analysis of other teachers' classroom videos. In the fall, we'll analyze videos from each other's classrooms. For this work to be meaningful, we'll need to push and challenge each other. This will require mutual respect and a common understanding of our goals." b. "Do you want to clarify or revise any of these norms?" **Note:** Have participants locate the half-page sheet of norms they pasted into their science notebooks on day 1. Remind them to leave space for revising the norms. c. Encourage participants to ask clarifying questions regarding the meaning of any of the norms and jot notes in their science notebooks. d. Ask participants if they're willing to live with these norms today, and let them know they'll have an opportunity to revise them tomorrow. Remind them of this at the end of the session.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		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 4.** Norms for Working Together: The Heart (5 min) a. "Now let's review the norms at the heart of the RESPeCT PD program." b. "Do you want to clarify or revise any of these norms?" c. "Do you want to add any norms to this list?" d. Ask participants if they're willing to live with these norms today, and announce that they'll have an opportunity to revise them tomorrow.
		Agenda for Day 2 • Day-1 reflections • Focus questions • Review of STL strategies 1–3 • STL lesson analysis: elicit and probe questions • STL lesson analysis: probe and challenge questions • Practice using elicit and probe questions • Lunch • Content deepening: properties of matter • Summary, homework, and reflections	**Display Slide 5.** Agenda for Day 2 (Less than 1 min) a. Talk through the agenda for the day.

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Time/Phase</th><th>Purpose, Content, and
What Participants Do</th><th>Slides</th><th>Process</th></tr>
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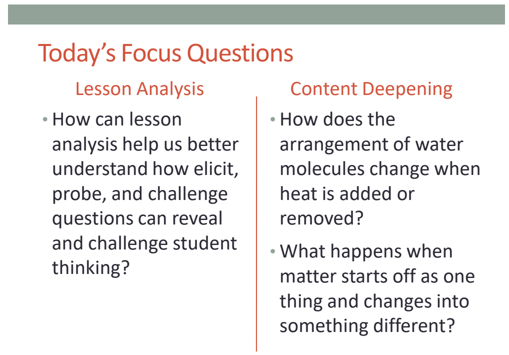

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Display Slide 6. Today's Focus Questions (1 min)

a. Introduce the focus questions that will guide today's session.

b. "Each day we're going to have at least one lesson analysis focus question and one content deepening focus question."

c. "Here are our focus questions for today's session."

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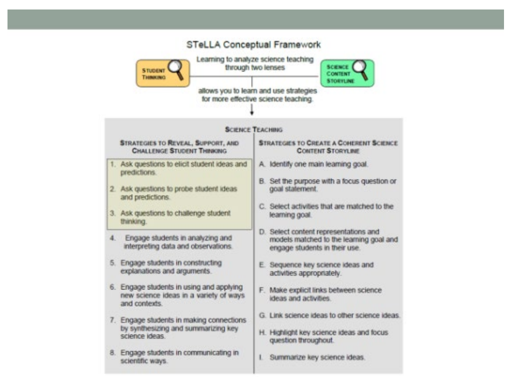

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Display Slide 7. The STeLLA Conceptual Framework (1 min)

a. Point out the strategies highlighted on the slide.

b. "During today's session, we'll focus again on the first three Student Thinking Lens strategies: elicit, probe, and challenge questions."

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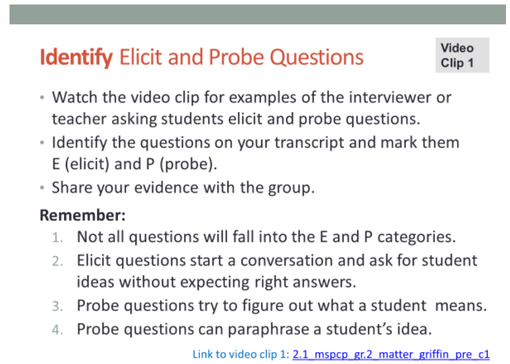
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Probe versus Challenge Questions • Read one of the dialogue examples for STL strategy 3 in the STeLLA strategies booklet. • With an elbow partner, try to justify why each question is labeled probe or challenge. • For help, refer to the STL Z-fold summary chart and the explanations, examples, and general questions for strategy 3 in the strategies booklet. • Be ready to share your ideas.	**Display Slide 8.** Probe versus Challenge Questions (10 min) a. Have participants look in the STeLLA strategies booklet at a dialogue example for STL strategy 3 that highlights probe and challenge questions. b. The purposes of this activity are as follows: 1. To get participants' heads back into the questioning strategies discussed on day 1. 2. To make sure participants understand the distinct purposes of probe and challenge questions: • **Probe questions** seek to understand what students are saying/writing and encourage them to explain their ideas more clearly or fully (*not* to change their thinking). • **Challenge questions** seek to engage students in ways that will challenge them to think, reconsider their ideas, change their initial ideas, and move toward more-scientific understandings.
8:30–9:20 50 min **STL Lesson Analysis: Elicit and Probe Questions**	**Purpose** • Begin to develop an understanding of the RESPeCT lesson analysis process. • Deepen understandings of elicit and probe questions (STL strategies 1 and 2) and how they reveal student thinking. • Deepen science-content knowledge of properties of matter through lesson analysis.	**Lesson Analysis Focus Question** How can lesson analysis help us better understand how elicit, probe, and challenge questions can reveal and challenge student thinking?	**Display Slide 9.** Lesson Analysis Focus Question (Less than 1 min) a. "Today we'll explore this focus question: How can lesson analysis help us better understand how elicit, probe, and challenge questions can reveal and challenge student thinking?" b. "But first let's discuss what lesson analysis involves."

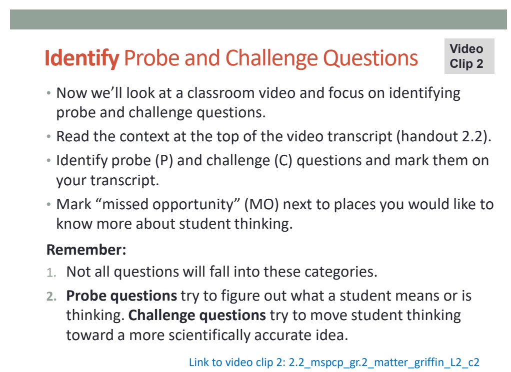
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
Slides 9–15	**Content** • Elicit questions are designed to reveal a variety of ideas, misconceptions, and experiences that students bring with them when learning new science content. • Probe questions follow up on student statements to find out more about what students are trying to say. • Lesson analysis involves a three-step protocol: (1) Identify the strategy, (2) analyze the use of the strategy in classroom videos, and (3) reflect on learning from the lesson analysis. • The lesson analysis protocol follows a five-step process: (1) Review the lesson content, (2) identify and discuss the STeLLA strategy in focus, (3) watch the video clip, (4) analyze the clip using the three-step protocol, and (5) reflect on the lesson analysis experience. • The analysis phase of lesson analysis involves making claims related to the STeLLA framework and providing evidence and reasoning to support the claims. **What Participants Do** • Review the lesson analysis video viewing basics.		
		RESPeCT Lesson Analysis Protocol 1. Identify the strategy • What STeLLA lens and strategy was the teacher using in the video clip? 2. Analyze the video • What student thinking was made visible (or not)? • How did the use of the STeLLA strategy impact student thinking? 3. Reflect and apply • What did you learn from identifying and analyzing the strategy in the video?	**Display Slide 10.** RESPeCT Lesson Analysis Protocol (3 min) a. “This is the three-step protocol that will guide our video-based lesson analysis work. Although we’ll follow the protocol a bit more loosely during the Summer Institute, we’ll rely heavily on this explicit three-step format as we move into the fall study groups.” b. Review the steps on the slide; then tell participants, “Framing our analysis in this way and following specific steps will help us focus more holistically on the teaching and the impact of the STeLLA strategies on student thinking and learning and the storyline students are constructing (i.e., the Student Thinking Lens and the Science Content Storyline Lens).”
		Lesson Analysis Process 1. Review the lesson context: • What is the ideal student response to the focus question? • How is the clip situated in the content storyline? 2. Identify and discuss the strategy that is the focus of analysis for each clip. 3. Watch video clip(s). 4. Analyze the lesson using the lesson analysis protocol. 5. Reflect on the lesson analysis experience: • As a reviewer • As a teacher in the clip	**Display Slide 11.** Lesson Analysis Process (3 min) a. “The lesson analysis protocol includes this five-step process.” b. Review the steps on the slide and note that in the study groups, these steps will be followed more explicitly than they will be during the Summer Institute.

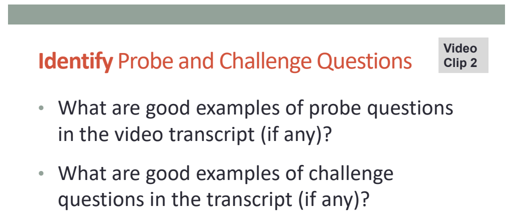
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	• Use the five-step lesson analysis process to identify and analyze the use of elicit and probe questions in a student interview (video clip 1). **Videos** • Video Clip 2.1, student interview **Handouts in PD Binder** • 2.1 Transcript for Video Clip 2.1 **Supplies** • Science notebooks **PD Resources** • STeLLA strategies booklet • STL Z-fold summary chart		
		Lesson Analysis: Viewing Basics • **Viewing basic 1:** Look past the trivial, or little things, that bug you. • **Viewing basic 2:** Avoid the "This doesn't look like my classroom!" trap. • **Viewing basic 3:** Avoid making snap judgments about the teaching or learning in the classroom you're viewing. **Note:** Find out more about the viewing basics on page 1 of in the STeLLA strategies booklet.	**Display Slide 12.** Lesson Analysis: Viewing Basics (2 min) a. **Ask:** "Why is each of these viewing basics important? Which will be hardest for you?" b. Tell participants they can find further details on the viewing basics in the STeLLA strategies booklet and refer to this information later. c. **Highlight:** "The videos we'll be viewing throughout the program aren't necessarily exemplary, but rather they provide real-world examples of teachers implementing the STeLLA strategies. Examples like these deepen our thinking because we can see the sometimes unintended results of teacher decisions and consider missed opportunities." d. **Honor the videocase teachers!** All of these courageous teachers are not only working hard to improve their own teaching practice but are also willing to make their practice public so that others can learn from it. None of them would claim to be exemplary science teachers.
		Our First Video Clip Video Clip 1 **Context:** • An interview with a 2nd-grade student before the teacher begins a unit on properties of matter. • The student and the interviewer are talking about similarities and differences between a cup of ice and a cup of water and whether ice can change into liquid or vice versa.	**Display Slide 13.** Our First Video Clip (2 min) a. Describe the context of the first video clip participants will watch. (See the top of the transcript—handout 2.1 in the PD program binder.) b. "This interview showcases the use of elicit and probe questions. Even though this clip doesn't take place in the context of an actual classroom, the idea is to look at the quality and form of the questions. Our second video clip will feature probe

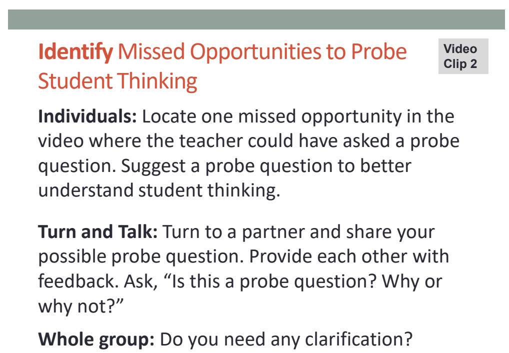
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			and challenge questions in a classroom context.”
			**Display Slide 14.** Identify Elicit and Probe Questions, Video Clip 1 (20 min) a. Provide instructions for watching video clip 1 and using the transcript to identify questions that elicit (E) and probe (P) student ideas and predictions. b. Remind participants that the purpose of watching the video clip is to deepen their shared understandings of these strategies and to build their individual and collective lesson analysis skills. c. **Individuals:** Allow time for participants to review the video transcript and mark E and P questions. d. **Whole group:** Discuss what participants found in the transcript. Encourage them to use evidence from the transcript and reasons from their Z-fold summary charts or the STeLLA strategies booklet to support their ideas. Participants should work to differentiate elicit and probe questions and distinguish them from other types of teacher questions or statements. **Examples of elicit questions:** • **Video segment 00:00.01:** “There's ice and water. Do you think ice and water are the same or different?” • **Segment 00:00:55:** “OK. Hmm. Can you ever change ice into water?” • **Segment 00:01:32:** “Oh, OK. OK. Hmm. Can you ever change this water into this?” • **Segment 00:02:33:** “OK? So if you were that small, or maybe even use a … a real strong microscope, what would that water look like?” • **Segment 00:03:31:** “What would you see in the ice?”

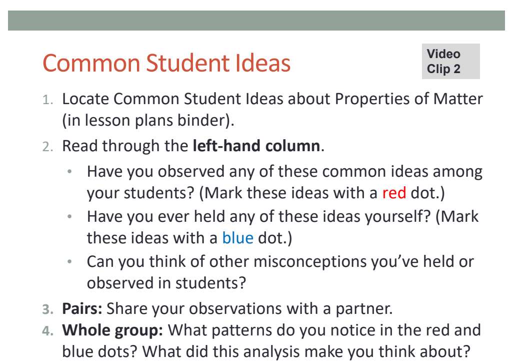
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			Note: Although elicit questions are typically used in a classroom setting to elicit a variety of student ideas, this video clip shows an interview with a student conducted before the Properties of Matter unit began. The interviewer in the clip asks the student questions to elicit ideas about similarities and differences between ice and water, whether ice can change to water or vice versa, and what the student would see if she were small enough to fit inside an ice cube. These questions framed the entire discussion in this portion of the interview. **Examples of probe questions:** • **Video segment 00:00:09:** "OK. What do you mean by 'kind of solid'?" • **Segment 00:00:21:** "OK. So this one's kind of a … you said a semisolid. Was that right?" • **Segment 00:00:29:** "What do you mean by a semisolid? And did you say not quite a liquid?**"** • **Segment 00:00:52:** "Ah, so it can be a little softer. That's kind of what you mean by semisolid?" • **Segment 00:01:16:** "Ah, so the Sun makes ice melt?" • **Segment 00:01:49:** "Tell me more what you think about 'ice is already the liquid.'" • **Segment 00:01:59:** "Oh, so you can't turn the water back to ice?" • **Segment 00:02:53:** "OK. Tell me a little more what you mean by 'the ice that was gone.'" • **Segment 00:03:08:** "Oh, there might look like there's still ice in it … like ice pieces?" • **Segment 00:03:13:** "Oh. So if you were very small, or if you had a very strong microscope, and you were … could look inside there, and you're inside there, you would see little … maybe little ice pieces still?"

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Analyze Student Thinking Video Clip 1 Review the interview transcript. • What student thinking was revealed through the interviewer's elicit and probe questions? • What ideas did Shamini have about ice, liquid water, and changes in matter? • Were there places you wished the interviewer had probed Shamini's thinking more? Why?	**Display Slide 15.** Analyze Student Thinking, Video Clip 1 (20 min) a. Give participants time to review the video transcript and develop an answer to one of the analysis questions on this slide. Encourage them to write down their answers in their science notebooks. b. For this first video analysis, do a round-robin and have each participant share. Ask probe and challenge questions to support participants in communicating their ideas clearly and completely: • **Probe question:** "Can you say more about what you mean by …?" • **Challenge question:** "Can you point to a specific place in the transcript that supports your idea?" c. As participants share, encourage others to respond by asking questions like these: • Do others have additional evidence to support (or challenge) this idea? • Do others have a different interpretation? **Observations:** • Shamini's answers reveal an understanding that ice is a solid and the water in the glass is a liquid (video segment 00:00:05). Shamini also understands that heat from the Sun can cause ice to melt into liquid water (segments 00:01:02–01:18). • Shamini has an interesting idea that ice is "kind of solid," referring to it as "sesame solid" (semisolid) because it's softer than hard solids like the table (segments 00:00:05–00:35). This is different from

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			how a scientist would define a semisolid substance. • Shamini doesn’t believe that water can be turned back into ice, although she might mean at room temperature (segments 00:01:32–02:03). The interviewer could have clarified this by asking, “If you could move the liquid water and put it somewhere else, could you turn it back into ice?” • Shamini doesn’t seem to realize that ice and water are made up of molecules. For example, she doesn’t mention anything about the structure of water or ice when asked to imagine what she might see under a powerful microscope or if she could shrink small enough to fit inside ice or water (segments 00:02:09–03:58).
9:20–11:30 130 min (Includes 10-min break) **STL Lesson Analysis: Probe and Challenge Questions** Slides 16–26	**Purpose** • Develop a deeper understanding of the RESPeCT lesson analysis process. • Deepen understandings of probe and challenge questions (STL strategies 2 and 3), how they reveal student thinking, and how they move student thinking forward. • Deepen science-content knowledge of properties of matter through lesson analysis. • Understand that science-content knowledge is essential for using probe and challenge questions effectively in the classroom. **Content** • Probe questions follow up on student statements to find out more about what students are		**Display Slide 16.** Identify Probe and Challenge Questions, Video Clip 2 (20 min) a. Provide instructions for watching video clip 2 and using the transcript (handout 2.2) to identify questions that probe student ideas and predictions and challenge student thinking. b. Encourage participants to refer to the strategy charts from day 1 (STL strategies 1–3), their Z-fold summary charts, and the STeLLA strategies booklet for help differentiating probe and challenge questions. Remind them that not all questions will be identified as either elicit, probe, or challenge. c. **Set the context:** Read the context for video clip 2 (at the top of the transcript). d. Emphasize that the students in this class haven’t yet studied anything about properties of matter. e. Show the video clip and allow time for participants to study the transcript before advancing to the next slide.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	trying to say. • Challenge questions are designed to push students to think hard, make new connections, change their ideas, and move toward more-scientific understandings. • The lesson analysis process involves making claims related to the STeLLA framework and providing evidence and reasoning to support those claims. • Viewing basics and analysis basics guide the lesson analysis process. **What Participants Do** • Identify probe and challenge questions in a classroom video (video clip 2). • Review common student ideas about properties of matter. • Analyze the use of probe and challenge questions in a classroom video (video clip 2). • Identify and analyze the use of probe and challenge questions in another classroom video (video clip 3). • Discuss the importance of science-content knowledge in using probe and challenge questions effectively in the classroom. **Posters and Charts** • Strategy charts from day 1 (STL strategies 1–3)		**Display Slide 17.** Identify Probe and Challenge Questions, Video Clip 2 (5 min) a. After each suggested probe or challenge question, ask participants the following: • "What makes this a probe/challenge question?" • "Did others mark this as a probe/challenge question?" • "Can you point to any of our resources (the Z-fold summary chart, our strategy charts from day 1, or the STeLLA strategies booklet) to support your answer?" b. Don't worry about debate and lack of agreement on some questions. **The important thing** is that participants clearly understand the difference between the purposes of probe and challenge questions. Sometimes it's hard to tell whether the teacher in the video intended to find out what a student meant (probe) or move student thinking toward more-scientific understandings (challenge). The teacher may also be asking elicit questions to reveal student ideas and misconceptions. **Examples of probe questions:** • **Video segment 00:00:49:** "OK. OK. So if you put [the chocolate in] an oven in a bowl, it would melt? OK. Because what are you … what are you adding?" [*Justification:* The teacher asks probe questions to better understand student thinking about what might cause the chocolate to melt.] • **Segment 00:03:32:** "It … it's … it's not hot anymore? Like the lava. Is that what you're talking about?" [*Justification:* After a student talks about volcanic eruptions and fire (lava), the teacher probes the student's thinking to clarify how this relates to chocolate melting.]

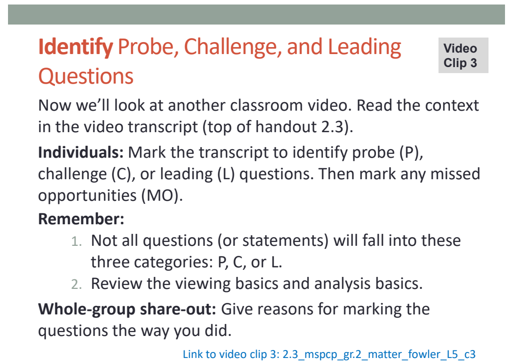
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	• Common Student Ideas chart • Parking Lot poster **Videos** • Video Clip 2.2, Griffin classroom • Video Clip 2.3, Fowler classroom **Handouts in PD Binder** • 2.2 Transcript for Video Clip 2.2 • 2.3 Transcript for Video Clip 2.3 **Supplies** • Red and blue sticker dots (or pencils) • Sticky notes **PD Resources** • STeLLA strategies booklet • STL Z-fold summary chart **Resources in Lesson Plans Binder** *Resources section:* • Common Student Ideas		**Example of challenge questions:** • **Segment 00:01:12:** “Can you summarize what caused the matter—the ice and the chocolate—to change in these two examples that we've been thinking about? What has caused it to change?” [*Justification:* The teacher asks a student to connect two ideas to deepen his or her science-content understanding.] **Note:** In this clip, the teacher sometimes puts words in students’ mouths and says what she assumes they’re thinking rather than asking questions that prompt students to clarify their ideas. These aren’t good examples of probe questions: segments 00:00:39–00:45; 00:01:32; 00:02:21–02:47; 00:03:37–03:55.
			**Display Slide 18.** Identify Missed Opportunities to Probe Student Thinking, Video Clip 2 (10 min) a. **Individuals:** “Identify a missed opportunity for a probe question in the video transcript.” b. **Turn and Talk:** Have participants pair up and discuss their suggested probe questions. Listen to their conversations to assess whether they truly comprehend that a probe question is designed to help them understand what students are thinking. c. **Whole-group share-out:** Participants may need guidance about when to ask probe questions. Remind them that probe questions are appropriate when students make vague or abbreviated statements, or when they simply use a vocabulary term without saying what it means. Do they really understand the term or concept, or do they have misconceptions? Ask a probe question to find out! d. **Remind participants:** “Don’t probe everything a student says. Just probe responses that seem

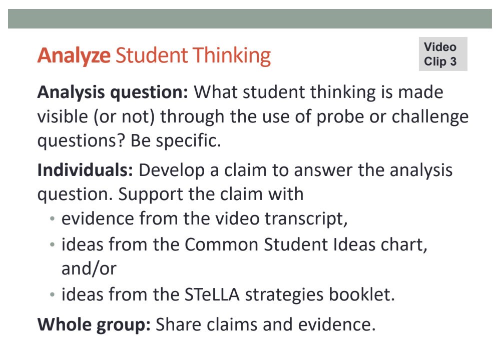
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			relevant to the lesson's main learning goal and might reveal interesting student thinking." **Possible missed opportunities:** • **Video segment 00:01:32:** Instead of assuming what "it" means, the teacher could have probed student thinking to find out whether the reference was to chocolate, ice, or both. • **Segments 00:02:21–02:47:** To determine what the student meant by the butter freezing, the teacher could have asked the probe question, "How do you define *freezing*?" This might have prompted the student to talk about the phase change from liquid to solid instead of the teacher mentioning it. Also, to see whether the student had any ideas about how cold the butter would need to be for freezing to occur, the teacher could have asked, "Why do you say, 'It must've been really cold'?"
	10-MINUTE BREAK		
			**Display Slide 19.** Common Student Ideas, Video Clip 2 (15 min) a. "Now let's consider some commonly held student ideas (misconceptions) about properties of matter. Then we can analyze whether any of these ideas appear in our video clips." b. Have participants locate the Common Student Ideas chart in the resources section of their lesson plans binders. c. "This Common Student Ideas chart shows some commonly held student ideas that are interesting but aren't scientifically accurate." d. **Individuals:** Have participants mark with a red

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			sticker dot any ideas they've observed among their students, and mark with a blue sticker dot any ideas they've had themselves. e. **Pairs:** Have participants discuss their observations with a partner. f. **Whole group:** Ask participants to share which ideas they've observed in their students and themselves. During this share-out, apply sticker dots to the Common Student Ideas chart at the front of the room as participants to highlight patterns in the results. Then discuss the following questions: • "What conceptual patterns do you notice in the red and blue dots?" • "What reactions do you have to this analysis? What did it make you think about?" **Note:** If time is short, skip this pattern analysis and discussion. g. "We've recognized these common ideas in students or held them ourselves. It's important to be aware of them when we're analyzing student thinking in the video clips or planning and teaching lessons in the future." h. "Now let's look for evidence of these common student ideas in a video clip."

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Common Student Ideas Video Clip 2 **Individuals:** Read the scientific explanations for your assigned idea on the Common Student Ideas chart. **Pairs:** Discuss these explanations briefly with a partner. What was new to you? Write on sticky notes any content questions you have and place them on the Parking Lot poster.	**Display Slide 20.** Common Student Ideas, Video Clip 2 (10 min) a. Have participants count off in ones and twos (1, 2, 1, 2). "Ones" will focus on odd-numbered ideas on the Common Student Ideas chart, and "twos" will focus on even-numbered ideas. b. **Individuals:** "Read the scientific explanations for your assigned idea on the Common Student Ideas chart." c. **Pairs:** "Discuss these explanations briefly with a partner. What was new to you? Write on sticky notes any content questions you have and place the notes on the Parking Lot poster."
		Lesson Analysis Basics • **Analysis basic 1:** Focus on student thinking and the science content storyline. • **Analysis basic 2:** Look for evidence to support any claims. • **Analysis basic 3:** Look more than once (in the video and transcript). • **Analysis basic 4:** Consider alternative explanations and teaching strategies. **Note:** Find out more about the analysis basics on page 2 of the STeLLA strategies booklet.	**Display Slide 21.** Lesson Analysis Basics (5 min) a. "Before we analyze the video clip, let's think about our lesson analysis process." b. Review the analysis basics on the slide. **Note:** Direct participants to page 2 in the strategies booklet if they have specific questions that require more information. c. **Why the analysis basics are important:** "The analysis basics will help us dig deeper and learn more from our videocase analyses while keeping us focused on the ultimate goal of improved student learning." **Note:** This lesson analysis process is **not** about critiquing teachers but about improving student learning. d. "We'll use a more structured lesson analysis protocol when we begin reviewing each other's

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			videos in the fall study-group sessions.”
		Analyze Questions That Probe and Challenge Student Thinking Video Clip 2 **Analysis question:** What student thinking is made visible (or not) through the use of probe or challenge questions? Be specific. Consider whether you observed any of the common student ideas or correct scientific explanations in the video. **Individuals:** Make notes or highlight questions/responses on the video transcript. Develop a claim to answer the question. Support the claim with • evidence from the transcript, • ideas from the Common Student Ideas chart, and/or • ideas from the STeLLA strategies booklet. **Whole group:** Share claims and evidence.	**Display Slide 22.** Analyze Questions That Probe and Challenge Student Thinking, Video Clip 2 (15 min) a. Remind participants of the purposes of video analysis: to deepen understandings of STeLLA strategies; to develop their ability to analyze student thinking; and, ultimately, to improve student learning. b. **Tell participants:** “Remember to refer to your Common Student Ideas chart as you analyze the video clip.” c. **Individuals:** Review the slide instructions before participants begin working independently on the tasks. d. **Whole group:** • Have several participants share their claims and evidence. • **Ask:** “Did you recognize any of the common student ideas in the students’ responses?” • **Ask:** “What probe or challenge questions might you ask to better understand student thinking?” **Note:** Remember to use probe and challenge questions as you interact with participants.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		 	**Display Slide 23.** Identify Probe, Challenge, and Leading Questions, Video Clip 3 (20 min) a. Read the context for this video clip at the top of the transcript (handout 2.3). b. Provide instructions for watching video clip 3 and using the transcript to identify questions that probe student ideas and predictions and challenge student thinking. **Participants should also be on the lookout for leading questions and missed opportunities.** (**Note:** Leading questions provide hints or make it easy for students to give the "right" answer.) Remind participants that other types of questions (such as elicit questions) may appear in this video clip. c. Show the video clip. d. **Individuals:** Review the slide instructions before participants begin working independently on the tasks. e. **Whole group:** • Challenge participants to clearly state their reasons for identifying a question as probe, challenge, or leading. • Encourage participants to provide evidence from the STeLLA strategies booklet to support their claims. **Possible probe questions:** • **Video segment 00:00:46:** "Can you show me?" [*Justification:* The teacher asks the student to expand on his thinking by demonstrating his point.] • **Segment 00:02:26:** "Why do you think so? Why do you think?" [*Justification:* The teacher asks probe questions to clarify what the student is thinking.]

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			• **Segment 00:02:45:** “Why do you think?” [*Justification:* The teacher asks probe questions to prompt students to explain and expand on their yes or no responses to a question about whether weighing items on a balance will let them know if atoms are being created or destroyed.] **Possible challenge question:** • **Video segment 00:03:22:** “OK, and what could I say about the number of atoms on the heavier side?” [*Justification:* The teacher is challenging the student to consider new ideas and connect weight to the number of atoms in matter.] **Possible leading question:** • **Video segment 00:02:19:** “And if [two different objects] have the same weight, can we kind of determine that they have the same number of atoms and molecules?” [*Justification:* The teacher poses a yes-or-no question with an inflection that indicates yes is the desired answer.]
			**Display Slide 24.** Analyze Student Thinking, Video Clip 3 (10 min) a. **Emphasize:** “Remember to refer to your Common Student Ideas chart as you analyze the video.” b. **Individuals:** Review the slide instructions before participants begin working independently on developing a claim to answer the analysis question. c. **Whole group:** • Have several participants share their claims and evidence. • **Ask:** “Did you recognize any of the common student ideas in the students’ responses?” • **Ask:** “What probe or challenge questions

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			might you ask to better understand student thinking?” **Note:** Remember to use probe and challenge questions as you interact with participants. **Example of a common student idea:** • In the video clip, students continue thinking that the weight of the frozen water and liquid water pertains to the weight and size of atoms rather than the number of atoms. Evidence of this is found at video segments 00:03:19, 00:03:28, and 00:03:49. At segment 00:03:59, the teacher asks a question about creating or destroying matter in an attempt to shift student thinking to the number of atoms and how weight can indicate a change in matter.
		Summarize: Elicit, Probe, and Challenge Questions 1. What makes a good elicit question? A good probe question? A good challenge question? 2. What do you need to know to ask good elicit, probe, and challenge questions? To ask good questions that make student thinking visible, you need a clear understanding of a. the science concepts you are teaching, and b. alternative ideas that students may hold.	**Display Slide 25.** Summarize: Elicit, Probe, and Challenge Questions (5 min) a. Pose the first question on the slide. If participants need support, point them to the descriptions of strategies 1, 2, and 3 in the STeLLA strategies booklet (especially the Summary of STeLLA Student Thinking Lens Strategies). b. Pose the second question. Do participants come up with the idea that science-content knowledge is essential for asking good elicit, probe, and challenge questions? c. Use the rest of the time to highlight the importance of knowing science content and being aware of common student ideas.

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		Reflect on Your Learning Respond to these questions in a quick write: 1. What did you learn about student thinking from analyzing these videos? 2. How did the analysis process help you better understand the questioning strategies? Be prepared to share your ideas.	**Display Slide 26.** Reflect on Your Learning (5 min) a. Ideally, participants will first respond to the questions in a quick write and then share their ideas with the group. But if time is running short, you can have them simply think for a minute and then share their ideas. But be sure to give them time to think before opening up the discussion.
11:30–12:00 30 min **Practice Using Elicit and Probe Questions: Interviews** Slides 27–29	**Purpose** • Deepen understandings of elicit and probe questions. • Begin to develop the ability to ask elicit and probe questions effectively. • Appreciate that science-content knowledge is essential for using elicit and probe questions effectively in the classroom. **Content** • Understanding the purposes and key features of elicit and probe questions is essential for implementing the STeLLA	Practice Elicit and Probe Questions: Interview Planning • **The challenge:** Pair up and practice using elicit and probe questions. First ask your partner an elicit question and then ask **only** probe questions to find out what your partner thinks. • **To prepare:** a. Read your elicit question(s). b. Read the common student ideas and scientific explanations that relate to your question(s). c. Plan probe questions to clarify ideas you think might emerge.	**Display Slide 27.** Practice Elicit and Probe Questions: Interview Planning (12 min) a. **Describe the challenge:** “Next, you and a partner will practice using elicit and probe questions by interviewing each other. The challenge is to ask your partner an elicit question and then follow up by asking **only** probe questions.” b. Give each participant a different elicit question (from the PD leader master cards). c. Direct participants to prepare for the interviews by following the slide instructions. **Note:** Participants may refer to the Common Student Ideas chart as a resource for this activity.

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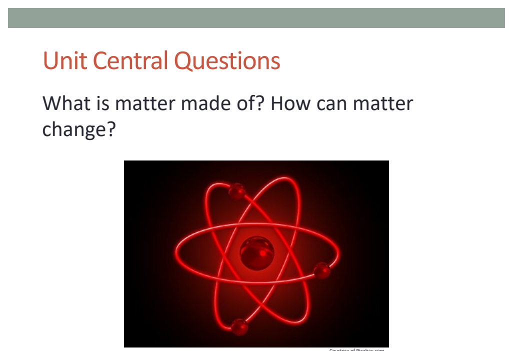
	questioning strategies effectively in the classroom. **What Participants Do** • Consider possible responses an elicit question (related to properties of matter) might produce, and plan probe questions to follow up on these responses. • Work in pairs, taking turns being the interviewer and asking each other an elicit question and then following up with only probe questions. • Participate in a group discussion afterward that focuses on the difficult aspects of the pairs work and the interesting thinking it revealed. **Posters and Charts** • Common Student Ideas chart **PD Leader Masters** • PD Leader Master: Elicit Question Cards (cut apart) **Resources in Lesson Plans Binder** *Resources section:* • Common Student Ideas	Practice Elicit and Probe Questions: Interview Process 1. Ask your partner the elicit question(s). 2. Probe your partner's thinking without providing any new information. (Keep going for at least 2 minutes!) 3. Debrief with your partner: • What probe questions did you ask? • Did you ask questions that weren't probe questions? • What did your probe questions reveal about your partner's understanding of the concept? 4. Switch roles and repeat the interview process, with the other partner asking the questions.	**Display Slide 28.** Practice Elicit and Probe Questions: Interview Process (12 min) a. Review the instructions on the slide. b. "Each interviewer will have 5 minutes to ask questions. Try to keep going with your probe questions for at least 2 minutes." c. **Interviewees:** "Don't pretend to be an elementary student; be yourself. Help your partner by pushing yourself to explain things in more depth than you actually understand. Try to come up with possible explanations that go beyond the surface vocabulary. Don't worry about being wrong; this will actually make the task more like what you might encounter in the classroom."
		Group Discussion 1. How did the interviews go? What did you find difficult as an interviewer? As a responder? 2. Which probe questions revealed some interesting clarifications or elaborations? 3. Did any of your questions end up challenging your partner's thinking? (Did your questions move your partner's thinking toward a more scientifically accurate response?)	**Display Slide 29.** Group Discussion (6 min) a. **Whole group:** Discuss the questions on the slide. b. If there's time, ask participants, "How might it help your teaching to do more of this type of practice (with a partner or small group)?"
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) **Content Deepening: Properties of Matter** Slides 30–52	**Purpose** • Deepen participants' understandings of matter and what happens to water molecules during phase changes and chemical reactions. **Content** • Exploring the structure of water molecules and how they're organized in solid and liquid states is essential to understanding state changes. **What Participants Do** • Use Legos to construct water molecules in solid and liquid states. • Make molecular drawings of water in the liquid state. • Explore chemical changes that occur in photosynthesis and a neutralization reaction when baking soda and vinegar are combined. **Handouts in Lesson Plans Binder** • 3.1 Lego Model (from lesson 3a) **Supplies** • Science notebooks • Chart paper and markers • Large ice-lattice model • Ball-and-stick molecular model with magnets • 6 Lego water molecules (per	 	**Display Slide 30.** Content Deepening: Properties of Matter (Less than 1 min) a. "Next, we'll focus on deepening our science-content understandings of matter." **Note:** Throughout this content deepening phase, refer as needed to the Properties of Matter Content Background Document and Common Student Ideas about Properties of Matter.
		 	**Display Slide 31.** Unit Central Question (7 min) a. Revisit the unit central questions that will guide student learning throughout the Properties of Matter lesson sequence. b. "Today we'll focus on the second question, especially how matter can change on a molecular level. So get ready to draw more Mickey Mouse water molecules!" c. **Individuals (3 min):** "First, take a moment to reflect on what we've learned so far that might help us answer these questions. Then write your ideas in your science notebooks." **Note:** Participants may refer to their notes and other resources as needed. d. **Whole-group share-out (4 min):** Invite participants to share their ideas with the group.

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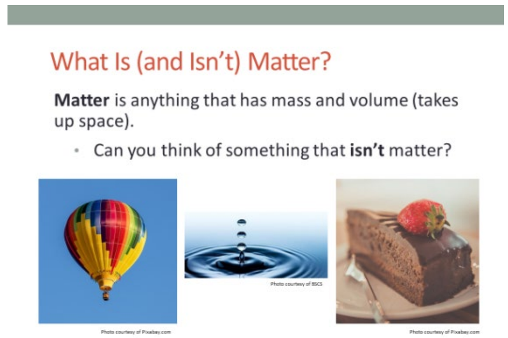
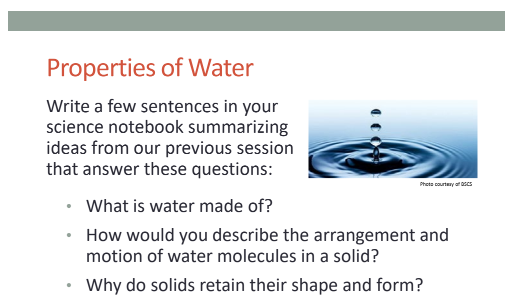
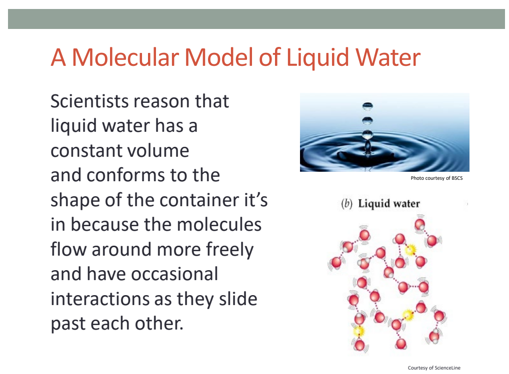
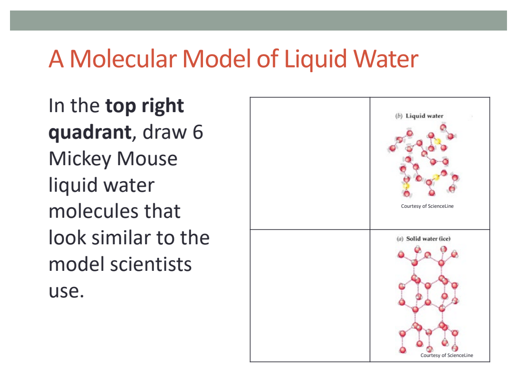
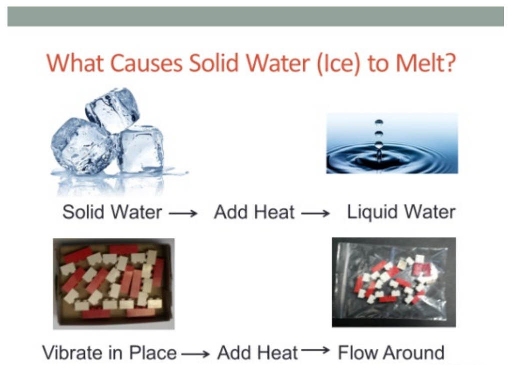
	group) • Small cardboard box and plastic sandwich bag (per group) • Materials for acid-base neutralization reaction (1 setup per pair) (see overview page) **PD Resources** • RESPeCT lesson plans binder **Resources in Lesson Plans Binder** *Resources section:* • Content background document • Common Student Ideas *Pretabs section:* • Properties of Matter Learning Goals for Students and Teachers		Probe and challenge participants' thinking by asking questions like the following: • "What do you mean when you say …?" • "Can you tell us more about …?" • "Can you link that to things we discussed about …?" • "Why do you think …?"
			**Display Slide 32.** What Is (and Isn't) Matter? (3 min) a. "*Matter* is anything that has mass and volume or takes up space. Can you think of something that *isn't* matter?" **Note:** Participants may find it difficult to think of something that isn't matter. If it doesn't come up, point out that energy (light, heat, motion) isn't a thing and doesn't have mass or volume. Although some participants might think that air isn't matter, it's actually made up of molecules (oxygen and carbon dioxide) that take up space and have mass. (Think of a balloon full of air. It has volume!)
			**Display Slide 33.** Properties of Water (6 min) a. "In our last content deepening session, we talked about the properties and characteristics of water, as well as the arrangement and movement of water molecules in solid matter. Let's take a few minutes and review what we've learned." b. **Individuals:** Read the questions on the slide and have participants write a few sentences in their science notebooks summarizing key ideas from

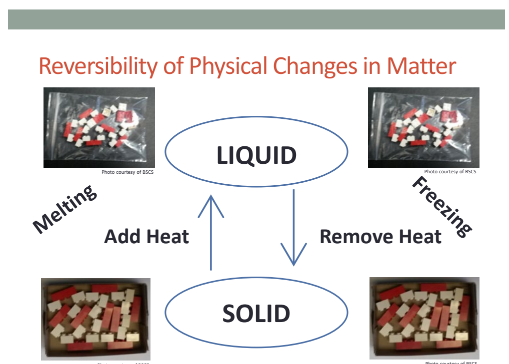
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			the previous session that answer these questions. c. **Whole-group share-out:** “How would you answer these questions? Let’s hear your ideas.” d. As participants share their responses, record key ideas on chart paper. **Key science ideas:** • Water is made up of hydrogen and oxygen atoms that combine to form molecules. • In a solid, such as ice, the molecules are tightly arranged in a lattice-like structure and vibrate in place. This is how a solid retains its shape and form.
		Molecules in Liquid Water • In a liquid, molecules are arranged more loosely than they are in a solid, but they’re still attracted to one another. • Liquid water molecules move around more freely and slide or flow past each other.  Photo courtesy of BSCS	**Display Slide 34.** Molecules in Liquid Water (3 min) a. “In today’s content deepening session, we’ll investigate different changes in matter. But first, let’s talk about how water molecules are arranged and move in a liquid.” b. Walk participants through the information on the slide.

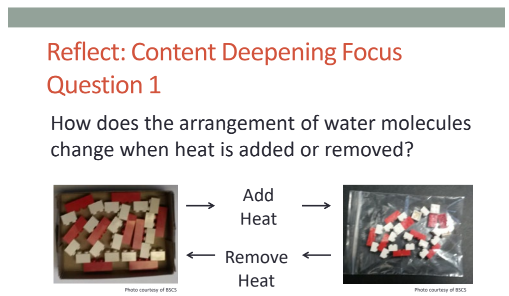
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		A Molecular Model of Liquid Water • Build 6 Lego water molecules with red and white Lego bricks. • Place all 6 molecules in the plastic sandwich bag without taking the molecules apart. The bag represents **liquid water** in a system. • After sealing the bag, move the molecules around and observe what happens.  	**Display Slide 35.** A Molecular Model of Liquid Water (7 min) **Note:** As needed, have participants review the information on atoms and molecules in handout 3.1 (Lego Model). a. "To help us to visualize how molecules are arranged and move in a liquid state, let's use our Lego model again." b. Have participants form the same small groups from the previous PD session. Then distribute a set of Legos, a cardboard box (optional), and a plastic sandwich bag to each group. c. "First, make six Lego water molecules using one red Lego brick to represent oxygen and two white Lego bricks to represent hydrogen. Then place the molecules in the plastic sandwich bag without taking the molecules apart." d. "After sealing the bag, move the molecules around and observe what happens. Think about the movement of the Lego molecules in the cardboard box."
		A Molecular Model of Liquid Water In the **top left quadrant**, draw 6 Mickey Mouse liquid water molecules that look similar to Lego molecules of liquid water in a plastic bag.	**Display Slide 36.** A Molecular Model of Liquid Water (10 min) a. Have participants locate their quadrant drawings from the previous lesson. b. "Last time, we drew pictures of *solid water* molecules on a quadrant. The first picture represented our Lego molecules in a cardboard box, and the second picture represented an ice-lattice model that scientists use. Today we'll draw pictures of liquid water molecules to complete our

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			quadrant." c. **Individuals:** "In the top left box of your quadrant, draw six Mickey Mouse water molecules to represent a puddle of liquid water from a melted ice cube. Your drawings should look similar to your Lego molecules in a plastic bag." d. Give participants 1 or 2 minutes to draw their liquid water molecules. e. **Turn and Talk:** Have participants share their drawings with an elbow partner and discuss any similarities or differences they observe. f. **Whole group:** Invite participants to share their drawings and descriptions with the group. Ask them to identify similarities and differences among the drawings.
			**Display Slide 37.** A Molecular Model of Liquid Water (10 min) **Note:** Initially, hide the scientific model of liquid water on the slide. a. "Interestingly, scientists reason that liquid water has a constant volume and conforms to the shape of the container it's in because the molecules around more freely and have occasional interactions as they slide past each other." b. **Whole group:** Using your six Lego water molecules, see if you can figure out the overall configuration or arrangement of *liquid water* molecules in a larger system. c. Give small groups 1 or 2 minutes to manipulate their Lego water molecules. **Note:** It will be interesting to see whether participants identify the weaker, less organized H-

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			bonds or temporary attractions between the hydrogen atoms of one water molecule and the oxygen atom of a neighboring molecule. The nonbonding electrons are again responsible for these intermolecular attractions, which are represented by the dotted lines in the diagram on the slide. The weaker, less organized interactions between molecules explain why liquid water molecules can move around more freely and flow past each other compared with solid water molecules. d. Reveal the scientific model of liquid water on the slide and discuss the overall shape or configuration of water molecules in a liquid.
			**Display Slide 38.** A Molecular Model of Liquid Water (10 min) a. **Individuals:** "Now in the top right quadrant of your chart, draw six Mickey Mouse liquid water molecules that look similar to the model scientists use." b. Using a ball-and-stick model with magnets, show participants the arrangement of liquid water molecules participating in H-bonds. c. Give participants 1 minute to draw the scientific model of liquid water molecules. d. **Turn and Talk:** "Next, share your diagrams with an elbow partner and discuss any similarities and differences you notice." e. **Whole group:** Invite participants to share their drawings and descriptions with the group. Ask them to compare the drawings and identify and similarities and differences.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Content Deepening Focus Questions 1. How does the arrangement of water molecules change when heat is added or removed? 2. What happens when matter starts off as one thing and changes into something different?	**Display Slide 39.** Content Deepening Focus Questions (Less than 1 min) a. Read the focus questions on the slide. b. "To answer these questions, we'll need to pay close attention to the arrangement of water molecules as we investigate different changes in matter." c. "Let's start with the first question."
			**Display Slide 40.** What Causes Solid Water (Ice) to Melt? (10 min) **Note:** At first, show only the ice cubes on the slide and the caption underneath. a. "In our last session, we talked about solid water or ice and how the molecules vibrate in place in a rigid, lattice-like structure. What causes water in its solid form to melt or change from a solid to a liquid? What happens to the molecules?" **Note:** Display the large ice-lattice model. b. **Turn and Talk:** "Discuss these questions with an elbow partner. Be as specific as possible as you describe the changes that happen." c. **Whole-group discussion:** Invite pairs to share their ideas with the group. Challenge them to think on a molecular level as they describe how adding heat causes water molecules to change from a solid to a liquid. Probe participants' ideas about what happens to the molecules of ice when they absorb heat from their environment.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			d. Advance the slide animation to reveal the photo of liquid water and the remaining captions. Don't display the Lego images and captions at the bottom of the slide yet. e. "Many of you stated that at room temperature an ice cube will melt into a puddle of liquid water. This physical change from a solid to a liquid is controlled by adding heat to the system. Heat from the environment is sufficient to cause some solids to melt into a liquid state." f. Advance the animation to show the Lego models and captions at the bottom of the slide. Discuss the arrangement and movement of water molecules when they change from a solid to a liquid. g. Emphasize the ability of liquid water molecules to spread out when heat is added to a solid and melting occurs. h. Ask participants, "How do you think your students will respond to the Lego model?"
			**Display Slide 41.** Reversibility of Physical Changes in Matter (6 min) a. "The reversibility of a physical change in matter is another key aspect of the lesson sequence. *Reversibility* refers to the ability of matter to change back and forth from a solid to a liquid and from a liquid to a solid when heat is added or removed." b. Remind participants that the process of changing from a solid to a liquid is *melting*, and the process of changing from a liquid to a solid is *freezing*. c. "Who can summarize the melting process shown on the slide? Make sure to include how the

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			arrangement and movement of the molecules change.” d. As participants share their ideas, record them on chart paper. e. “Now who can explain the freezing process or how removing heat affects the arrangement and movement of liquid water molecules? What temperature do you think is needed to change liquid matter back to a solid?” f. Record key ideas on chart paper.
			**Display Slide 42.** Reflect: Content Deepening Focus Question 1 (1 min) a. Review the focus question on the slide. b. Have participants answer this question in their science notebooks by engaging in a 30-second quick write.
	10-MINUTE BREAK		

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Content Deepening: Focus Question 2 What happens when matter starts off as one thing and changes into something different? 	**Display Slide 43.** Content Deepening: Focus Question 2 (3 min) a. Read the focus question on the slide and remind participants that to answer this question, they'll need to pay close attention to the arrangement of the molecules. b. "Baking cookies is a good example of matter starting off as one thing and ending up as something entirely different. Think about all of the different ingredients that are mixed together to make a chocolate-chip cookie. What we start with is completely different from the finished product, isn't it? For example, the molecules of an egg are arranged very differently in the cookie batter than they are in a baked cookie. This might even make the cookie taste better!" c. "Let's consider some other examples."
		Matter in Nature • What do you think this oak tree is made of? • How do you think a tiny seed becomes a huge tree? • Where did the matter come from? 	**Display Slide 44.** Matter in Nature (6 min) a. "Look at the oak tree on this slide. What do you think it's made of? How do you think a tiny seed becomes a huge tree like this? Where did the matter come from?" b. **Think-Pair-Share:** "Think about these questions for a moment and then share your ideas with an elbow partner." c. **Whole-group share-out:** Invite participants to share their ideas with the group. Record key ideas on chart paper. **Note:** The most common student misconception is that a tree's matter comes from dirt. If that were true, the soil around the tree would slowly disappear as

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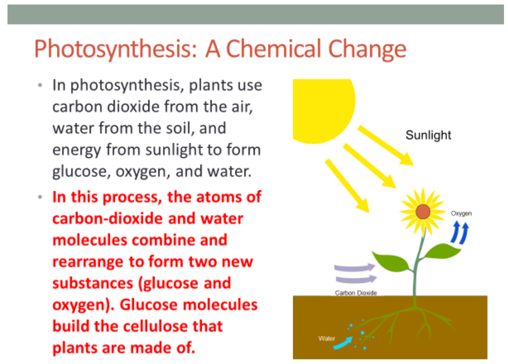
			the tree grows, but this doesn't happen. Another common idea is that a tree's matter comes from the water the tree absorbs from the soil. But the tree isn't made of just water! So where does the matter come from?
			**Display Slide 45.** Photosynthesis: A Chemical Change (10 min) a. "The change in matter that happens when a tiny seed grows into a huge oak tree isn't a physical change. The matter isn't simply changing state from a solid a liquid or from a liquid to a solid. Instead, the matter changes from the original substances into entirely new substances with different properties. This is called a *chemical change*." b. "Photosynthesis is one example of a chemical change. In photosynthesis, plants use carbon dioxide from the air, water from the soil, and energy from sunlight to produce glucose, oxygen, and water. In this process, the atoms of carbon-dioxide and water molecules combine and rearrange to form two *new* substances (glucose and oxygen). Glucose molecules are the building blocks of the cellulose that plants are made of." c. "How might you represent this chemical change in an equation?" d. **Pairs:** Have participants work in pairs to create a chemical equation or word equation that represents what happens in photosynthesis. **Note:** Some participants might remember the chemical formulas for carbon dioxide, water, and glucose. If so, they can create a chemical equation. Others can construct a word equation (e.g., "In the presence of sunlight, water and

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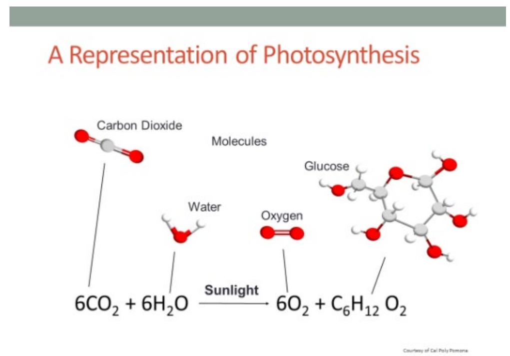
			carbon dioxide produce glucose and oxygen”). e. **Whole group:** Invite participants to share their equations with the group. Record the equations on chart paper.
			**Display Slide 46.** A Representation of Photosynthesis (3 min) a. “Photosynthesis is a classic reaction between carbon-dioxide and water molecules that produces oxygen and glucose molecules, from which cellulose is made.” b. Emphasize that content representations of photosynthesis can vary. c. “Look at the molecular diagrams on the slide. What do you notice about the individual atoms in this reaction?” d. As participants share their ideas and observations, record them on chart paper. e. Point out that the gray-colored atoms in this reaction are carbon atoms participating in double bonds. See if anyone brings up the reaction coefficients used to balance the equation for the conservation of matter (i.e., six carbon atoms go into the reaction, and six carbon atoms are produced).

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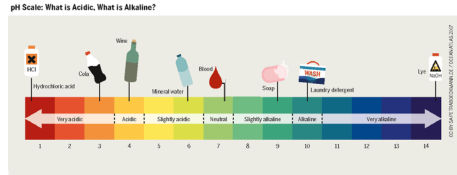
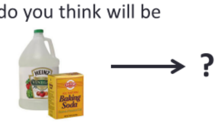
		Investigation: A Neutralization Reaction When an acid (vinegar) and a base (baking soda) combine in a chemical reaction, new substances are formed with a neutral or balanced pH. pH Scale: What is Acidic, What is Alkaline?  Adapted from Heinrich-Boll-Stiftung/Wikimedia Commons	**Display Slide 47.** Investigation: A Neutralization Reaction (1 min) a. “Photosynthesis is difficult to visualize, so let’s consider a classic example of a chemical change that occurs when an acid is combined with a base. This kind of change is called a *neutralization reaction*. For this investigation, we’ll combine vinegar or acetic acid, which has a pH of 3, with baking soda or sodium carbonate, which has a pH of 9, to create substances with a more neutral pH of 7.” **Note:** The pH scale ranges from 1 to 14. Acids, with a pH of 1–6, are sour, and bases, with a pH of 8–14, are bitter. A substance that is neutral or balanced has a pH of 7.
		Investigation: A Neutralization Reaction • Examine the vinegar and baking soda using your senses (sight, touch, smell). Discuss your observations with your partner and record the characteristics of each reagent in your science notebook. • What new substances do you think will be produced when the baking soda and vinegar are combined?  Photo used with permission from BSCS	**Display Slide 48.** Investigation: A Neutralization Reaction (15 min) a. Have participants pair up for the investigation. Then give each pair a sample of vinegar and baking soda to examine using their senses. b. **Pairs:** “First, let’s explore the two reagents in this reaction using our senses of sight, smell, and touch. Examine the vinegar and baking soda using your senses and share your observations with your partner. Identify the characteristics of each reagent and record them in your science notebooks.” c. Give pairs time to examine the reagents, discuss their observations, and record characteristics in their notebooks. d. “What new substances do you think will be produced when the vinegar and baking soda are

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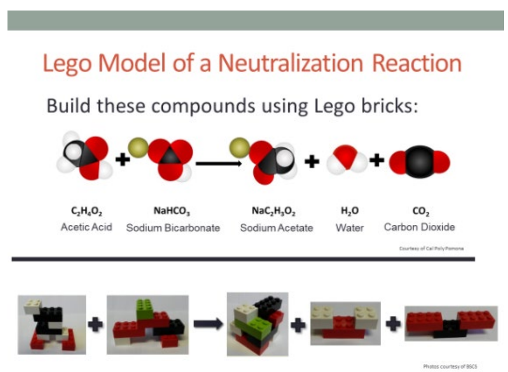
			combined?” e. Ask participants to share their predictions. If a gas is mentioned, ask, “What would be the chemical formula of the gas?” f. “Now let’s see what happens when we mix the vinegar and baking soda together.” g. Give each a pair of participants a plastic freezer bag containing 1 teaspoon of baking soda and a vial of vinegar. Caution them not to open the bags or shake them. h. “Without opening the freezer bag, carefully pop the cap off the vial and pour the vinegar into the bag so it mixes with the baking powder. Watch what happens during this reaction and record your observations in your science notebooks. Then open the bag and examine the new substance using your senses. Record these observations in your notebooks as well.” i. **Whole-group discussion:** Invite pairs to share their observations with the group.
			**Display Slide 49.** Lego Model of a Neutralization Reaction (10 min) a. Walk participants through the equation on the slide, highlighting the chemical formula of each reagent and product involved in the neutralization reaction. b. “Now I’d like you to work in pairs to make a Lego model of this reaction.” c. Distribute a set of Lego bricks to each pair of participants. **Note:** For each vinegar molecule, pairs will need four white (hydrogen) Legos, two red (oxygen)

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			Legos, and two black (carbon) Legos. For each baking-soda molecule, they'll need one lime-green (sodium) Lego, three red (oxygen) Legos, one black (carbon) Lego, and one white (hydrogen) Lego. d. "First, you'll need to build two vinegar molecules and two baking-soda molecules like the Lego molecules on the slide. After building these molecules, set aside one vinegar molecule and one baking-soda molecule to represent the reagents in the reaction. Then take apart the second pair of molecules and rearrange the atoms to form the three new substances produced in this chemical change. The sodium-acetate molecule doesn't have to look exactly like the Lego model on the slide, but the water and carbon-dioxide molecules should look like Mickey Mouse molecules. So don't get too crazy with your configurations!" e. Give pairs a few minutes to assemble their molecules. f. **Whole-group discussion:** Ask pairs to use their models to describe what happens in the actual experiment. For example: • When carbon-dioxide gas is produced, the plastic bag puffs up. • The smooth, powdery feel of the baking soda is different from the grainy feel of the new substance (sodium acetate) that formed. • The atoms are conserved in the chemical reaction. No extra Legos were needed to build the new substances, and none were left over.

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		Reflect: Content Deepening Focus Question 2 What happens when matter starts off as one thing and changes into something different?  Photo courtesy of Pixabay.com  Photo courtesy of Pixabay.com	**Display Slide 50.** Reflect: Content Deepening Focus Question 2 (6 min) a. Review the focus question on the slide. b. **Individuals:** Ask participants to answer the question in their science notebooks and use evidence from today's investigation to support their ideas. c. **Whole group:** Invite a few participants to share their responses with the group. Record key ideas on chart paper. If time allows, elicit other examples of chemical changes.
		NGSS Connections **Disciplinary core ideas (2-PS1-1; 2-PS1-4):** 1. Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties. 2. Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not. • **How did today's content deepening activities address these core ideas?** • **How would addressing these ideas in the classroom be valuable for our students?**	**Display Slide 51.** NGSS Connections (7 min) a. Read the NGSS disciplinary core ideas on the slide. Then ask participants, "How did today's content deepening activities address these core ideas? How would addressing these ideas in the classroom be valuable for our students?" b. **Individuals:** Ask participants to think about these questions and then write their ideas in their science notebooks. c. **Whole group:** Invite participants to share their responses with the group. Record key ideas on chart paper.

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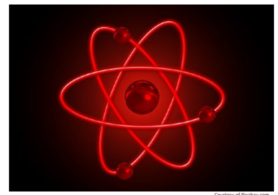
		Unit Central Questions What is matter made of? How can matter change? 	**Display Slide 52.** Central Learning Goal Review (5 min) a. Review the unit central questions on the slide and ask participants how they would answer these questions based on today's content deepening work. b. Avoid adding on to participants' responses. Simply ask probe and challenge questions to ensure that participants express their ideas about matter in scientifically accurate ways.
3:15–3:30 15 min **Wrap-Up: Summary, Homework, and Reflections** Slides 53–55	**Purpose** • Summarize and reflect on the day's learning, including progress made in understanding genetics and the relationship between lesson analysis and asking effective elicit, probe, and challenge questions. **What Participants Do** • Synthesize key ideas about the science content, questioning strategies, and lesson analysis. • Copy down the homework assignment for day 3.	Summary: Today's Focus Questions What progress have we made in addressing today's focus questions? 1. How can lesson analysis help us better understand how elicit, probe, and challenge questions can reveal and challenge student thinking? 2. When does the arrangement of water molecules change when heat is added? 3. What happens when matter starts off as one thing and changes into something different?	**Display Slide 53.** Summary: Today's Focus Questions (8 min) a. Divide participants into three groups. Have Group 1 come up with some conclusions/key ideas related to focus question 1. Have Group 2 come up with conclusions/key ideas for focus question 2, and have Group 3 do the same thing for focus question 3. b. Give each group 2 minutes to come up with ideas and conclusions. c. Allow a 2-minute share-out for each group.

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	• Write reflections on STeLLA strategies 1, 2, and 3, and the science content. **Handouts in PD Binder** • 2.4 Daily Reflections—Day 2 **Supplies** • Science notebooks	**Homework** 1. For tomorrow, read the STeLLA strategies booklet and complete the Z-fold summary chart for these two Student Thinking Lens strategies: • **Strategy 4:** Engage students in analyzing and interpreting data and observations. • **Strategy 5:** Engage students in constructing explanations and arguments. 2. Read sections 5–10 in the content background document. 3. Don't forget about the lesson-plan reading-and-reporting assignment due on day 4.	**Display Slide 54.** Homework (1 min) a. Forecast that next time, you'll tackle two new, closely interconnected Student Thinking Lens strategies. b. Go over the homework assignments on the slide and have participants copy them into their science notebooks. Encourage participants to write down any questions they still have about the science ideas they explored during today's content deepening session. c. Remind participants about their homework for Friday (becoming experts on the lesson plans assigned to them).
		Reflections on Today's Session Complete the Daily Reflections sheet (handout 2.4 in PD program binder). 1. What value do you see in analyzing student thinking and practicing questions that elicit, probe, and challenge student thinking? What concerns do you have about enacting these practices? 2. Did you identify any science ideas that you are unclear about? If so, what helped you identify this uncertainty? 3. What questions do you have about the purposes and goals of the RESPeCT PD program? 4. Which norms are we successfully implementing? Which norms need more work?	**Display Slide 55.** Reflections on Today's Session (6 min) a. Make sure participants have **at least 5 minutes** to think about the questions on the reflections sheet (handout 2.4 in the PD program binder) and write down their thoughts.