RESPeCT Summer Institute Professional Development Leader Guide (PDLG)

Grade Level	4	**Day**	5	**STeLLA Strategy**	Science Content Storyline Lens (SCSL) Strategy A: Identify One Main Learning Goal	**Subject Matter Focus**	Energy Transfer
Focus Questions	• What is the Science Content Storyline Lens (SCSL)? • Why is one main learning goal essential for science content storyline coherence? • How do we know whether something has energy? • What causes a moving object to have more or less motion energy?						
Main Learning Goals	Participants will understand the following: • Research from the TIMSS Video Study of Science Teaching emphasizes the importance of creating science content storylines that support students in making links between classroom activities and science ideas. • The SCS Lens and strategies empower teachers to think in new ways about planning and teaching science lessons. • Identifying and focusing on one main learning goal in a lesson is an important strategy for creating a coherent science content storyline. • Energy can change, or transform, from one form to another form. • Energy is all around us and can be detected using our senses. Seeing objects move, hearing a sound, feeling heat, and seeing light are all ways of detecting energy. • When an object moves faster, it has more energy. • Heat is a special end form of energy. Heat energy is conserved but is a less useful form.						

Preparation	**Materials**	**Videos**

Daily Setup Tasks
• Check that video clips are correctly linked to PowerPoint (PPT) slides.
• Set up PowerPoint.
• Make sure video clips play correctly with good sound.
• Arrange furniture and food.
• Arrange participant materials.
• Put up posters and charts.
 	
Planning and Preparation Tasks
• Study the PDLG, PowerPoint slides (PPTs), video clips, and handouts. Make changes to PPTs if needed.
• Review the reflections from day 4 and create a summary slide.
• Watch video clips and anticipate participant
	Posters and Charts
	• STeLLA Framework and Strategies poster
	• Day-5 Agenda (chart)
	• Norms for Working Together (chart)
	• Day-5 Focus Questions (chart)
	• Effective Science Teaching chart (from day 1)
	• Strategy charts from days 1–4 (STL strategies 1–6)
	• Parking Lot poster
	
	Handouts in RESPeCT PD Binder Front Pocket
	• Z-fold summary chart: Science Content Storyline Lens Strategies (blank)
	
	Handouts in RESPeCT PD Binder, Day 5
	• 5.1 Analysis Guide A: Identifying One Main
		• Video clips from one Energy Transfer lesson:
		  • Video Clip 5.1: Bernstein classroom (beginning of lesson); 5.1_stella_et_bernstein_L2_c1
		  • Video Clip 5.2: Bernstein classroom (during lesson); 5.2_stella_et_bernstein_L2_c2
		  • Video Clip 5.3: Bernstein classroom (end of lesson); 5.3_stella_et_bernstein_L2_c3

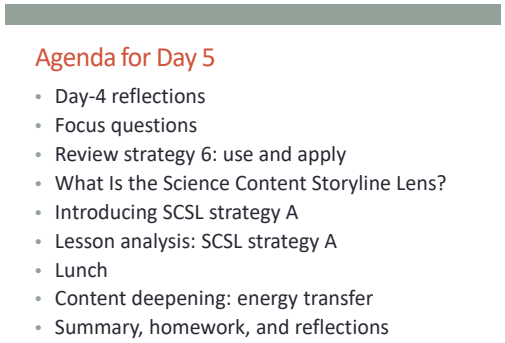
responses.
• Prepare charts for the day's agenda and focus questions.
• Review the activities for ET lessons 1b and 2a/b in the lesson plans binder. (**Note:** For this session, handout 5.7 (Ramps, Speed, and Energy from ET lesson 2a) will be completed in one investigation. In lesson 2, students completed part of the handout in lesson 2a and the rest in lesson 2b.)
• Content deepening:
  • For the marble-and-ramp investigation, Carve out a groove in the block of Styrofoam so the marble will nest in the groove when it rolls off the ramp. The marble should push the Styrofoam across the table until both come to a stop. Making the groove in the Styrofoam will produce more consistent results.
	Learning Goal (2 copies)
	• 5.2 Practice Identifying One Main Learning Goal
	• 5.3 Transcript for Video Clip 5.1
	• 5.4 Transcript for Video Clip 5.2
	• 5.5 Transcript for Video Clip 5.3
	• 5.6 Forms of Energy
	• 5.7 Ramps, Speed, and Energy (from ET lesson 2a)
	• 5.8 Extended Homework: RESPeCT Lesson Plan Analysis
	• 5.9 Daily Reflections—Day 5
	
	Handouts in RESPeCT Lesson Plans Binder
	• 2.2 High-Speed Energy Procedure (from ET lesson 2a)
	• 4.1 Map of Plate Boundaries around the World (from ECS lesson 4a)
	
	PD Leader Masters, Days 5–8
	• PD Leader Master: Practice Identifying One Main Learning Goal (Answer Key)
	
	Supplies
	• Science notebooks
	• Chart paper and markers
	• Plastic relief map of the United States (1 per group) (from ECS lesson 1a)
	• For energy-detectives investigation (1 per pair):
	  • Plastic bag containing windup toy, flashlight, and noisemaker
	• For ramp-and-marble investigation (1 setup per pair):
	  • 1 ruler (with a groove down the middle)
	  • 1 marble
	  • 1/2-inch blocks of wood or notepads (to elevate the ramps)
	  • Small block of Styrofoam (with groove cut out)
	  • 2 sheets of plain white paper
	  • Tape	

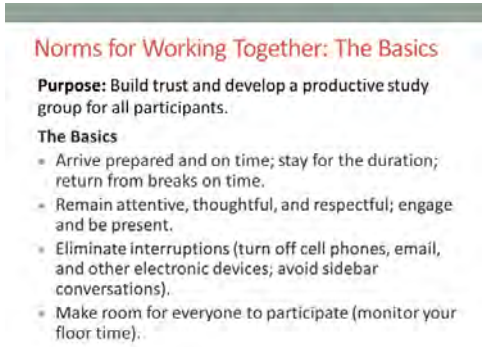
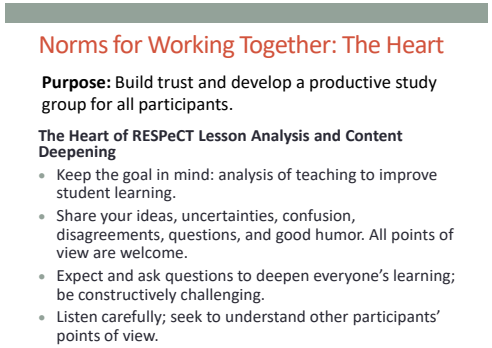
	PD Resources • STeLLA strategies booklet • RESPeCT PD program binder • RESPeCT lesson plans binder **Resources in Lesson Plans Binder** *Resources section:* • Energy and Energy Transfer Content Background Document • Common Student Ideas about Energy	

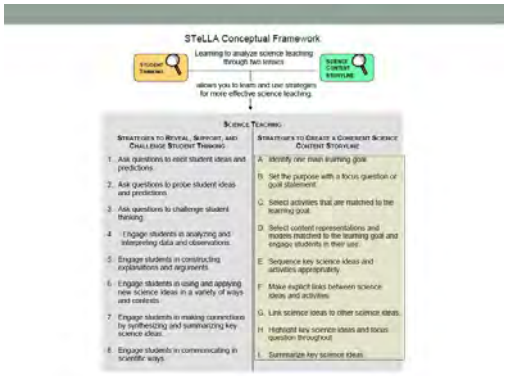
DAY 5 SESSION OUTLINE

Time	Activities	Purpose
8:00–8:25 25 min	**Getting Started: Housekeeping, Agenda, Day-4 Reflections, Norms, Focus Questions**	• Build community by sharing participants' reflections from day 4. • Set the stage for a day of learning.
8:25–8:40 15 min	**Review of Strategy 6: Use and Apply**	• Review STL strategy 6 (use and apply) and deepen participants' understandings of this strategy and the Earth's Changing Surface lesson content.
8:40–8:55 15 min	**What Is the Science Content Storyline Lens (SCSL)?**	• Help participants develop strong initial understandings of the Science Content Storyline Lens.
8:55–10:10 75 min (Includes 10-min break)	**Introducing SCSL Strategy A**	• Clarify and deepen participants' understandings of SCSL strategy A: Identify one main learning goal. • Clarify the distinctions between science ideas, student ideas, and main learning goals.
10:10–12:00 110 min	**Lesson Analysis: SCSL Strategy A**	• Use lesson analysis of classroom videos to better understand SCSL strategy A. • Deepen participants' science-content knowledge of energy transfer through lesson analysis.
12:00–12:45 45 min	**LUNCH**	
12:45–3:15 150 min (Includes 10-min break)	**Content Deepening: Energy Transfer**	• Reflect on previous learning or teaching experience related to energy. • Deepen participants' science-content knowledge of energy transfer by conducting investigations from ET lessons 1b and 2a/b.
3:15–3:30 15 min	**Wrap-Up: Summary, Homework, and Reflections**	• Summarize and reflect on key ideas from today's learning, including the Science Content Storyline Lens, STeLLA strategy A, and the Energy Transfer science content.

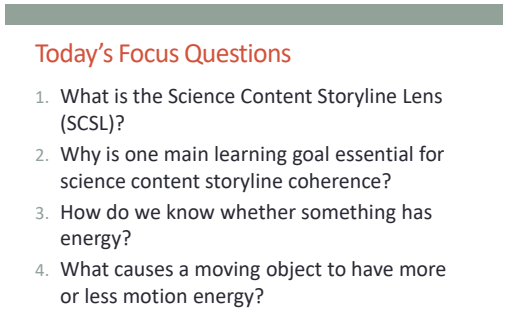
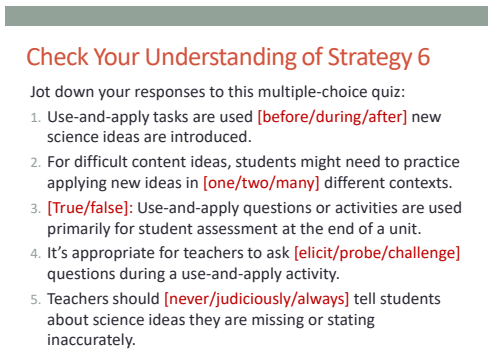
DAY 5

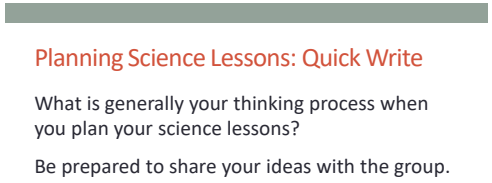
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
8:00–8:25 25 min **Getting Started** Slides 1–8	**Purpose** • Build community by sharing participants' reflections from day 4. • Set the stage for a day of learning. **What Participants Do** • Review the day's agenda. • Discuss the reflections from day 4. • Review and discuss progress on the RESPeCT program norms. • Read the focus questions for day 5. **Posters and Charts** • STeLLA Framework and Strategies poster • Day-5 Agenda (chart) • Norms for Working Together (chart) • Day-5 Focus Questions (chart)		**Display Slide 1.** RESPeCT PD Program (5 min) a. Take care of any housekeeping issues.
			**Display Slide 2.** Agenda for Day 5 (2 min) a. Talk through the agenda for the day.

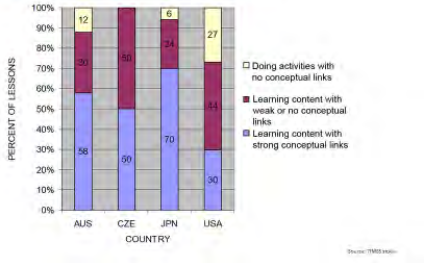
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 3.** Trends in Reflections (5 min) a. Give participants time to review your feedback on their reflections from day 4 and offer reactions, comments, or follow-up questions.
			**Display Slide 4.** Norms for Working Together: The Basics (5 min) a. Review the norms as a group. b. **Ask:** "Any comments or suggested changes? How are we doing with applying these norms?"
			**Display Slide 5.** Norms for Working Together: The Heart (5 min) a. Review these norms as a group. b. **Ask:** "Any comments or suggested changes? Which of these norms do you think we could get better at applying individually and as a group?" c. **Remind participants:** "These norms will become increasingly important during the Summer Institute and throughout the academic year as we analyze one another's classroom videos and learn

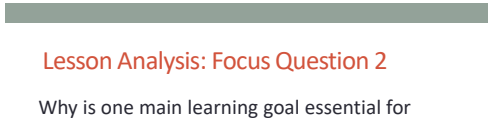
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			together."
			**Display Slide 6.** STeLLA Conceptual Framework (1 min) a. **Transition:** This slide marks the transition from the STL strategies to the Science Content Storyline Lens strategies. b. "Throughout the PD program, we'll continue learning about the Student Thinking Lens (STL) strategies, but today we'll transition to the Science Content Storyline Lens strategies." c. Highlight the SCSL strategies on the slide.

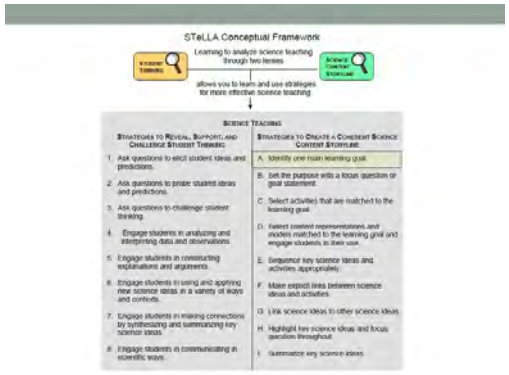
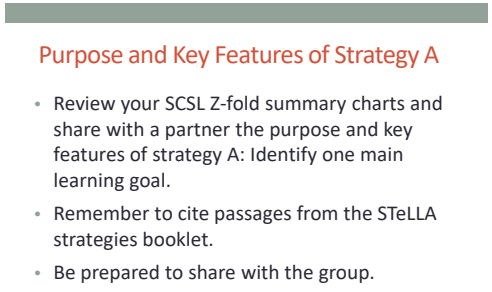
		Focus for the Week
		• Content area 2: energy transfer (ET)
		• Science Content Storyline Lens
		  • Strategies A, B, C, D, F, G, H, and I
		  • Video-based lesson analysis (Energy Transfer lessons)
		• Energy Transfer lesson plans review (last day)
		• Academic-year schedule (last day)
		  • Video recording
		  • Study-group sessions
			Display Slide 7. Focus for the Week (1 min)
			
			a. "This week we'll focus on a new content area: energy transfer. We'll also examine the Science Content Storyline Lens strategies and the Energy Transfer lessons you'll be teaching in the fall, analyze video clips of those lessons, and deepen your science-content knowledge related to the lesson plans."
			b. "On the last day of the RESPeCT PD program, we'll review the lesson plans and the schedule for the academic year."
			c. "You may notice that we skip strategy E: Sequence key science ideas and activities appropriately. This strategy will be addressed during the school year as you teach the STeLLA lesson plans and analyze how they're sequenced within each lesson and across lessons."

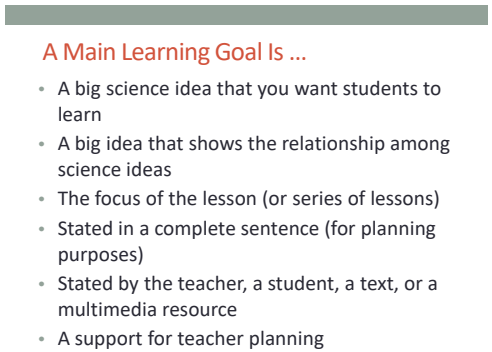
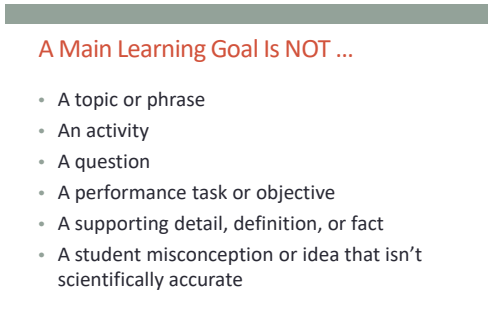
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 8.** Today's Focus Questions (1 min) a. Introduce the focus questions that will guide today's work.
8:25–8:40 15 min **Review of Strategy 6: Use and Apply** Slides 9–10	**Purpose** • Review STL strategy 6 (use and apply) and deepen participants' understandings of this strategy and the Earth's Changing Surface lesson content. **Content** • STL strategy 6 engages students in using and applying new science ideas in a variety of ways and contexts. **What Participants Do** • Take a multiple-choice quiz to check their understanding of STL strategy 6. • Work on a scenario that engages them in using and applying strategy 6 and the Earth's Changing Surface lesson content.		**Display Slide 9.** Check Your Understanding of Strategy 6 (7 min) **Note:** Display this slide only if it wasn't used on day 4. a. "To check your understanding of STL strategy 6, jot down your responses to this multiple-choice quiz in your science notebooks." b. Have participants discuss their answers either in pairs or as a group. (If time is short, just read the answers aloud.) **Answer key:** 1. After 2. Many 3. False 4. Challenge (and probe) 5. Judiciously (defined as "good or discriminating judgment; wise, sensible, or well advised")

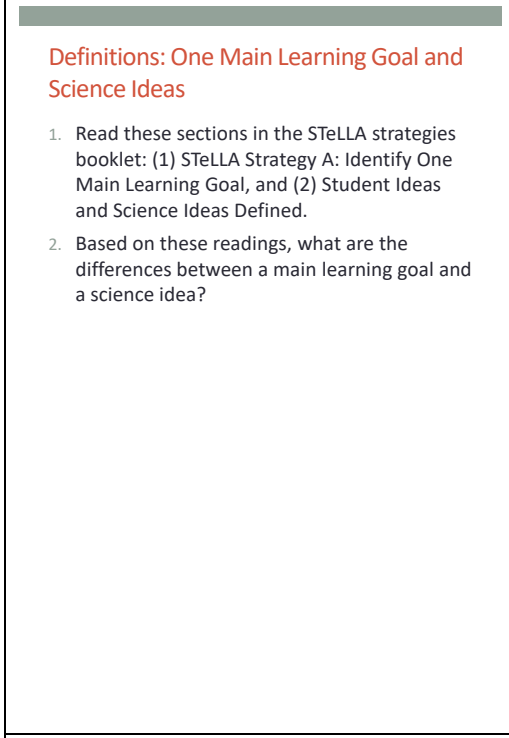
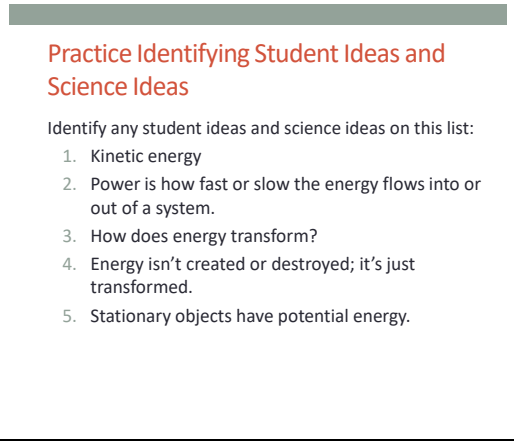
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	Supplies • Science notebooks		**Display Slide 10.** Use and Apply Your Content Deepening Knowledge (8 min) a. Have participants form small groups. b. Distribute a relief map of the United States (from ECS lesson 1a) to each group and have participants locate handout 4.1 (Map of Plate Boundaries around the World) from ECS lesson 4a in their lesson plans binders. c. **Small groups (4 min):** "Discuss the use-and-apply questions on the slide with your small group, using the relief map and plate-boundaries map to support your ideas. Be ready to share your ideas and evidence from the maps." d. **Whole-group share-out (4 min):** "What ideas and evidence do you have for answering these questions?"
8:40–8:55 15 min **What Is the Science Content Storyline Lens (SCSL)?** Slides 11–13	**Purpose** • Help participants develop strong initial understandings of the Science Content Storyline Lens. **Content** • A science content storyline brings coherence within and across science lessons. **What Participants Do** • Write about and discuss their typical process of planning science lessons. • Discuss their reading about the definition of a science content		**Display Slide 11.** Planning Science Lessons: Quick Write (6 min) **Note:** This activity is a lead-in for thinking about specific SCSL strategies. When planning science lessons, are participants thinking primarily about (1) SCSL issues, such as learning goals, (2) student misconceptions (an STL issue), which is a great start but doesn't include SCSL strategies, or (3) activities and/or classroom management and timing issues? a. **Individuals:** Direct participants to take 2–3 minutes to write down the key things they think about when planning science lessons. b. **Whole group:** Ask participants to share their reflections with the group.

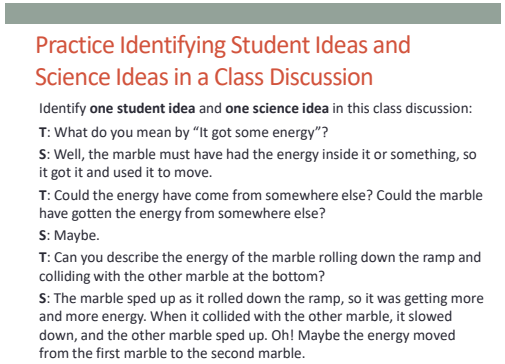
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	storyline. • Review and discuss the TIMSS (Trends in Mathematics and Science Study) research basis for the Science Content Storyline Lens. **Posters and Charts** • STeLLA Framework and Strategies poster **PD Resources** • STeLLA strategies booklet		c. **Tell participants:** "The Science Content Storyline Lens strategies should provide some new or additional ways of thinking about planning your science lessons."
		Lesson Analysis: Focus Question 1 What is the Science Content Storyline Lens (SCSL)? • What is a science content storyline, and why is it important? • What is challenging about developing a science content storyline?	**Display Slide 12.** Lesson Analysis: Focus Question 1 (7 min) a. **Small groups:** Direct half the group to focus on the first bulleted question on the slide, and the other half to focus on the second. Allow groups 2 minutes to think about their assigned questions as they review "Introduction to the Science Content Storyline Lens" in the STeLLA strategies booklet. b. **Whole group:** Have each group share their ideas and responses for these questions. c. As you listen to participants, make sure that what they're saying is consistent with the strategies booklet. If you aren't sure they're interpreting the text accurately, ask them to identify the specific text they're drawing from.
		The TIMSS Video Study Findings and the Science Content Storyline Lens  	**Display Slide 13.** The TIMSS Video Study Findings and the Science Content Storyline Lens (2 min) a. Emphasize the research basis for the Science Content Storyline Lens and its importance. Remind participants that the data on the slide was presented on day 1 of the PD program. b. **Ask:** "What does this graph reveal about US science lessons compared with higher-achieving countries?" **Ideal response:** According to the study, US science lessons didn't do as well linking science

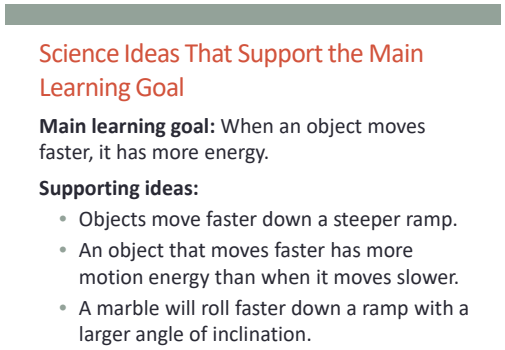
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			ideas to lesson activities; in fact, many lessons were activity focused and included significantly fewer science ideas compared to other countries. c. **Summarize:** Point to strategies F and G on the STeLLA strategies poster: Make explicit links between science ideas and activities (strategy F) and link science ideas to other science ideas (strategy G). These strategies and the idea of a Science Content Storyline Lens grew out of the TIMSS research findings. d. "Today we'll begin our study of the Science Content Storyline Lens, with a focus on strategy A: Identify one main learning goal."
8:55–10:10 75 min (Includes 10-min break) **Introducing**	**Purpose** • Clarify and deepen participants' understandings of SCSL strategy A: Identify one main learning goal. • Clarify the distinctions between science ideas, student ideas, and main learning goals. **Content** • A main learning goal is a big idea that students are expected to		**Display Slide 14.** Lesson Analysis: Focus Question 2 (1 min) a. Read the focus question on the slide.

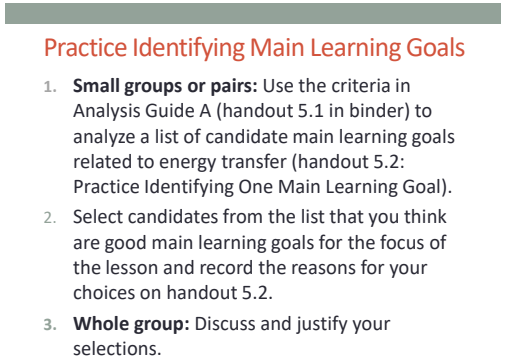
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
SCSL Strategy A Slides 14–23	learn and take away from a lesson or series of lessons. Everything in the lesson supports the development of this one main learning goal. **What Participants Do** • Make a chart highlighting the purpose and key features of SCSL strategy A. • Review the differences and relationships among student ideas, science ideas, and main learning goals. • Practice identifying student ideas and science ideas in a written list. • Practice identifying strong main learning goals using the analysis guide for strategy A. **Handouts in PD Binder** • 5.1 Analysis Guide A • 5.2 Practice Identifying One Main Learning Goal **PD Leader Masters** • PD Leader Master: Practice Identifying One Main Learning Goal (Answer Key) **Supplies** • Chart paper and markers **PD Resources**		**Display Slide 15.** STeLLA Conceptual Framework (1 min) a. "Now let's dig into SCSL strategy A!" b. "As you can see, strategy A is the first of nine Science Content Storyline Lens strategies. It appears first because it's the foundation on which all the other SCSL strategies are built. This will become clearer as we delve into the other strategies and see how important it is that each of them is matched to the lesson's main learning goal."
			**Display Slide 16.** Purpose and Key Features of Strategy A (25 min) a. **Pairs:** "Share with a partner what you wrote on your Science Content Storyline Lens Z-fold summary chart about the purpose and key features of strategy A." b. **Whole group:** Have one or two participant volunteers lead the group in creating a chart that describes the purpose and key features of strategy A. c. **Transition:** "Next, we'll review the difference between a science idea and the main learning goal of a lesson. Then you'll practice identifying and clarifying this distinction."

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	• STeLLA strategies booklet • SCSL Z-fold summary chart (blank copy in front pocket of PD binder) **Resources in Lesson Plans Binder** *Resources section:* • Content background document • Common Student Ideas		**Display Slide 17.** A Main Learning Goal Is … (1 min) a. "This slide lists some key ideas about the definition of a main learning goal." b. Read through the ideas. c. **Emphasize:** "Notice the parenthetical reference to 'lessons' in the third bullet point. Each lesson should have only one main learning goal, but you might need two or more lessons to help students accomplish a difficult goal. So it's often necessary to spend more than one lesson on a specific learning goal."
			**Display Slide 18.** A Main Learning Goal Is NOT … (1 min) a. Review what is **not** considered a main learning goal.

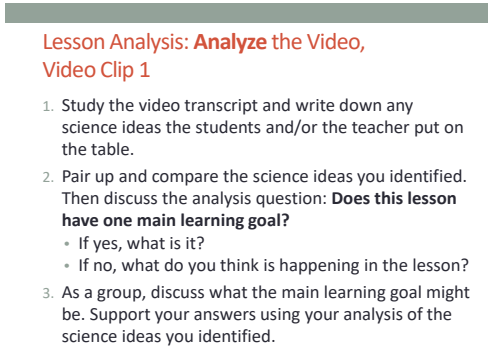
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 19.** Definitions: One Main Learning Goal and Science Ideas (10 min) a. Have participants locate these two readings in the strategies booklet: (1) STeLLA Strategy A: Identify One Main Learning Goal, and (2) Student Ideas and Science Ideas Defined. b. "After you read these sections in the strategies booklet, we'll discuss the differences between a science idea and a main learning goal." c. **Individuals (3 min):** Give participants time to read the specified sections in the strategies booklet. d. **Whole group (7 min):** Discuss the question on the slide. e. **Emphasize:** "While you might incorporate several science ideas that support the main learning goal of a lesson, be careful not to plan an 'all about' lesson with too many different science ideas that will likely come across to students as a bunch of disconnected facts to be memorized."
			**Display Slide 20.** Practice Identifying Student Ideas and Science Ideas (5 min) a. "Next, we'll practice identifying student ideas and science ideas just to make sure you understand the way we're defining these terms." **Note:** As needed, refer participants to the section in the strategies booklet where student ideas are defined (Student Ideas and Science Ideas Defined). b. **Individuals:** "First, identify examples of **science ideas** on the slide. If you need help, refer to the

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			document in your lesson plans binders titled Common Student Ideas about Energy. Then identify examples of **student ideas** on the slide." c. **Whole group:** Discuss participants' responses and the correct answers (see answer key). **Answer key:** • Science ideas: 2, 4, 5 • Student ideas: 1, 4
			**Display Slide 21.** Practice Identifying Student Ideas and Science Ideas in a Class Discussion (5 min) a. "It's a little trickier to recognize student ideas and science ideas in class discussions because students sometimes give only one- or two-word answers to teacher questions. But if you link the teacher's question with a student's response, you can sometimes find a science idea or a student idea." **Note:** In the RESPeCT PD program, we encourage students to speak in complete sentences as much as possible. b. "Let's practice linking the teacher's question with student responses in the sample discussion on the slide." c. **Pairs:** "Work with a partner to see if you can identify one student idea and one science idea in this discussion." d. **Whole-group share-out:** Have participants share the ideas they identified in the sample discussion. Then review the answers (see answer key). e. **Emphasize:** "Here's some food for thought: To make student thinking more visible, why not require students to speak in complete sentences during

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			classroom discussions about science ideas?" **Answer key:** • *Student idea:* Well, the marble must have had the energy inside it or something, so it got it and used it to move. • *Science idea:* The marble sped up as it rolled down the ramp, so it was getting more and more energy. When it collided with the other marble, it slowed down, and the other marble sped up. Oh! Maybe the energy moved from the first marble to the second marble.
			**Display Slide 22.** Science Ideas That Support the Main Learning Goal (6 min) a. Display *only* the main learning goal on the slide. b. **Pairs:** "Work with a partner to come up with two or three science ideas that might support the development of this main learning goal. Use the content background document and the Common Student Ideas chart as resources." c. **Whole group:** Have pairs share the supporting science ideas they came up with. d. Next, reveal the list of possible supporting science ideas one by one on the slide and compare them with participants' ideas. e. **Highlight:** "Some of these supporting science ideas could also be a main learning goal for a lesson."

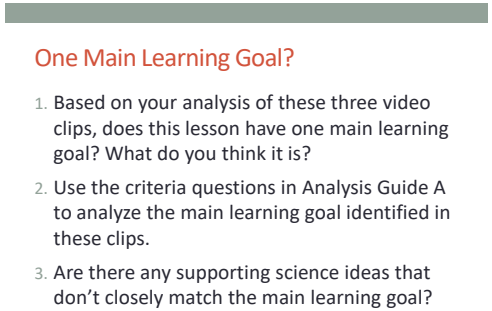
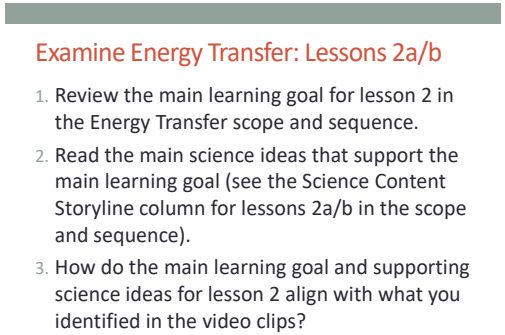
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 23.** Practice Identifying Main Learning Goals (10 min) a. Direct participants to locate handout 5.1 (Analysis Guide A: Identifying One Main Learning Goal) and handout 5.2 (Practice Identifying One Main Learning Goal) in their PD program binders. b. **Small groups/pairs:** Have participants form small groups or pairs and use the criteria from Analysis Guide A to analyze the list of possible learning goals on handout 5.2. c. Direct participants to write yes or no on the handout to indicate whether the statement is or is not a good candidate for a lesson's main learning goal. Then have them state the reason for each assessment using criteria from the analysis guide. d. **Whole-group share-out:** Have participants share and discuss their selections. e. Be sure to highlight what distinguishes a main learning goal from supporting science ideas, topics, phrases, activities, or questions. f. Also use this discussion to clarify science content. **Answer key:** See PD Leader Master: Practice Identifying One Main Learning Goal (Answer Key).
10:00–10:10 10 min	**BREAK**		

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
10:10–12:00 110 min **Lesson Analysis: SCSL Strategy A** Slides 24–32	**Purpose** • Use lesson analysis of classroom videos to better understand SCSL strategy A. • Deepen participants' science-content knowledge of energy transfer through lesson analysis. **Content** • Using one main learning goal brings coherence within and across lessons. • A main learning goal is a big idea that students are expected to learn and take away from a lesson or series of lessons. Everything in the lesson supports the development of this one main learning goal. **What Participants Do** • Watch a sequence of three video clips from one lesson. Analyze the science ideas in each clip and determine whether they're organized to support one main learning goal. • Use the criteria in Analysis Guide A to determine the quality of the main learning goal identified for this lesson. • Examine an Energy Transfer lesson plan to see how the main learning goal and supporting	Lesson Analysis: Strategy A Next, we'll watch a sequence of three video clips from a single lesson about energy and energy transfer. **Analysis question for all three clips:** Does this lesson have one main learning goal? **Follow-up questions:** • If yes, what is it? • If no, what do you think is happening in the lesson?	**Display Slide 24.** Lesson Analysis: Strategy A (1 min) a. Make sure participants understand that they will be viewing a sequence of three video clips from the same Energy Transfer lesson. b. "For all three clips, we'll answer the analysis question, Does this lesson have one main learning goal?" c. "If the answer is yes, what is the learning goal? If no, why do you think that's the case? What do you think is happening in the lesson?"
		Lesson Analysis: **Review** Lesson Context, Video Clip 1 1. Read the lesson context on the video transcript (handout 5.3 in PD program binder). 2. As you watch the clip, keep the analysis question in mind: **Does this lesson have one main learning goal?** • If yes, what is it? • If no, what do you think is happening in the lesson? Link to video clip 1: 5.1_stella_et_bernstein L2 c1	**Display Slide 25.** Lesson Analysis: Review Lesson Context, Video Clip 1 (5 min) a. Have participants read the lesson context at the top of the video transcript (handout 5.3 in PD program binder). (Less than 1 min) b. Read the information on the slide. (Less than 1 min) c. Show the video clip. (4 min)

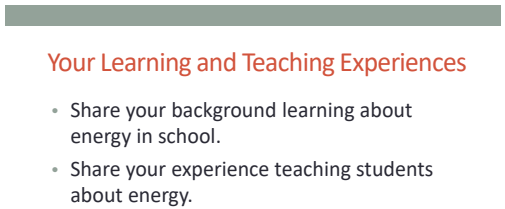
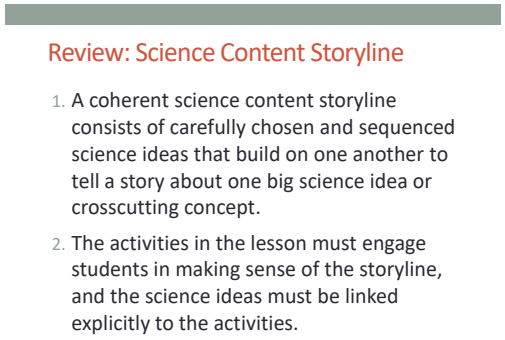
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	science ideas are identified. **Videos** • Video Clip 5.1, Bernstein classroom (beginning of lesson) • Video Clip 5.2, Bernstein classroom (during the lesson) • Video Clip 5.3, Bernstein classroom (end of lesson) **Handouts in PD Binder** • 5.1 Analysis Guide A • 5.3 Transcript for Video Clip 5.1 • 5.4 Transcript for Video Clip 5.2 • 5.5 Transcript for Video Clip 5.3 **Supplies** • Science notebooks • Chart paper and markers **PD Resources** • RESPeCT lesson plans binder		**Display Slide 26.** Lesson Analysis: Analyze the Video, Video Clip 1 (25 min) a. Before participants analyze the video transcript, remind them of these key points: (1 min) • A science idea is a full-sentence idea that students could take away as something they learned during the lesson. • Science ideas are sometimes identified by linking the teacher's question with the student's response. b. **Individuals (8 min):** "Study the video transcript and write in your notebooks any science ideas you identify in the discussion." c. **Pairs (5 min):** "Pair up and compare the science ideas you identified in the transcript. Then discuss the questions on the slide." d. **Whole group (11 min):** Have participants share what they think might be the main learning goal of this lesson, using their analyses of the science ideas they identified to support their suggestions. e. List the possible learning goals on chart paper. f. Let participants know they'll revisit this list of possible main learning goals for the lesson after they watch the remaining video clips.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Lesson Analysis: **Review** Lesson Context, Video Clip 2 1. Read the lesson context on the video transcript (handout 5.4 in PD binder). 2. As you watch the clip, keep the analysis question in mind: **Does this lesson have one main learning goal?** • If yes, what is it? • If no, what do you think is happening in the lesson? Link to video clip 2: 5.2_stella_et_bernstein_L2_c2	**Display Slide 27.** Lesson Analysis: Review Lesson Context, Video Clip 2 (5 min) a. Have participants read the lesson context at the top of the video transcript (handout 5.4 in PD binder). (Less than 1 min) b. Review the instructions on the slide. (Less than 1 min) c. Show the video clip. (4 min)
		Lesson Analysis: **Analyze** the Video, Video Clip 2 1. Study the video transcript and write down any **student ideas** and **science ideas** you identify. 2. Pair up and compare the student ideas and science ideas you identified. Then discuss this question: **Are these ideas consistent with the possible main learning goal you identified for video clip 1?** 3. As a group, discuss the possible main learning goal for this lesson. Make sure to support your answers using your analysis of the science ideas you identified.	**Display Slide 28.** Lesson Analysis: Analyze the Video, Video Clip 2 (25 Min) a. Review the definitions of a science idea and a student idea. Remind participants that students can express correct science ideas and inaccurate student ideas at the same time. (1 min) b. **Individuals (8 min):** "Study the video transcript and write in your notebooks any student ideas and science ideas you identify." c. **Pairs (5 min):** "Pair up and compare the student ideas and science ideas you identified in the transcript. Then discuss the question on the slide." d. **Whole group (11 min):** Have participants share what they think might be the main learning goal of this lesson, using their analyses of the science ideas they identified to support their suggestions. e. List the possible learning goals on chart paper. f. Let participants know they'll revisit this list of possible main learning goals for the lesson after

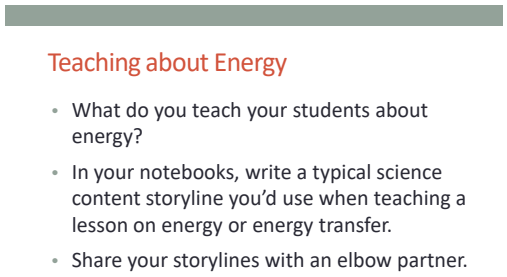
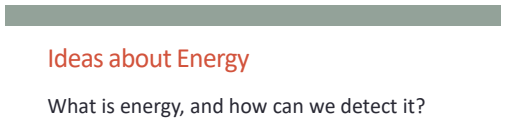
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			they watch one more video clip.
		Lesson Analysis: **Review** Lesson Context, Video Clip 3 1. Read the lesson context on the video transcript (handout 5.5 in PD binder). 2. As you watch the clip, keep the analysis question in mind: **Does this lesson have one main learning goal?** • If yes, what is it? • If no, what do you think is happening in the lesson? Link to video clip 3: 5.3_stella_et_bernstein_L2_c3	**Display Slide 29.** Lesson Analysis: Review Lesson Context, Video Clip 3 (5 min) a. Have participants read the lesson context at the top of the video transcript (handout 5.5 in PD binder). (Less than 1 min) b. Review the instructions on the slide. (Less than 1 min) c. Show the video clip. (4 min)
		Lesson Analysis: **Analyze** the Video, Video Clip 3 1. Study the video transcript and write down any **student ideas** and **science ideas** you identify. 2. Pair up and compare the student ideas and science ideas you identified. Then discuss this question: **Are these ideas consistent with the possible main learning goal you identified for clips 1 and 2?** 3. As a group, discuss the possible main learning goal for this lesson. Make sure to support your answers using your analysis of the science ideas you identified.	**Display Slide 30.** Lesson Analysis: Analyze the Video, Video Clip 3 (24 min) a. **Individuals (8 min):** "Study the video transcript and write in your notebooks any student ideas and science ideas you identify." b. **Pairs (5 min):** "Pair up and compare the student ideas and science ideas you identified on the transcript. Then discuss the questions on the slide." c. **Whole group (11 min):** Have participants share what they think might be the main learning goal of this lesson, using their analyses of the science ideas they identified to support their suggestions. d. List the science ideas and possible learning goals on chart paper. e. **Ask:** "Did the three video clips develop coherence across the lesson or include too many ideas that didn't support the main learning goal?"

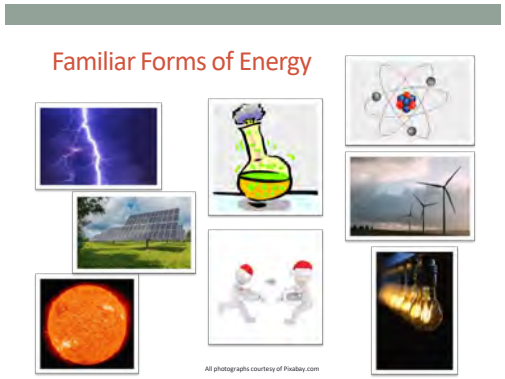
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 31.** One Main Learning Goal? (15 min) a. **Whole group:** Discuss the first question on the slide and reach a consensus on the main learning goal for the lesson. **Ideal response:** *The height of the ramp affects the amount of energy the marble possesses.* b. **Pairs:** Have participants work in pairs to answer the criteria questions in Analysis Guide A for the main learning goal they agreed upon for this lesson. Also have them identify any supporting science ideas that don't closely match the main learning goal. c. **Whole group:** Discuss participants' responses to the questions in Analysis Guide A and the final question on the slide.
			**Display Slide 32.** Examine Energy Transfer: Lesson 2 (5 min) **Note:** This slide is **optional** if time is running short. It's designed to help participants see how the lesson plans are written to highlight the main learning goal and science ideas that support the main learning goal. a. Have participants locate the scope and sequence for the Energy Transfer lessons in their lesson plans binders. b. Direct participants to compare the main learning goal for lessons 2a/b with the goal they came up with in their analyses of the video clips. It should be a pretty close match.

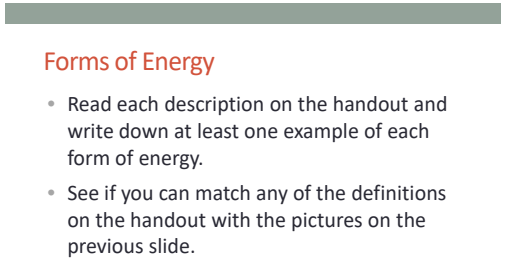
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			c. Then have participants review the ideas in the Science Content Storyline column of the scope and sequence for lessons 2a/b. All of these ideas should support the main learning goal. d. Pose the question on the slide and elicit participants' ideas and observations.
12:00-12:45 45 min	**LUNCH**		
12:45–3:15 150 min (Includes 10-min break) **Content Deepening: Energy Transfer**	**Purpose** • Reflect on previous learning or teaching experience related to energy. • Deepen participants' science-content knowledge of energy transfer by conducting investigations from ET lessons 1b and 2a/b. **Content** • Energy is the ability to do work or move something against a force. • Energy is all around us, and we can detect it with our senses. • Energy exists in several forms and		**Display Slide 33.** Content Deepening: Energy Transfer (Less than 1 min) a. **Transition:** This slide marks the transition to the content deepening work. **Note:** Throughout this content deepening phase, refer as needed to the content background document and Common Student Ideas about Energy.

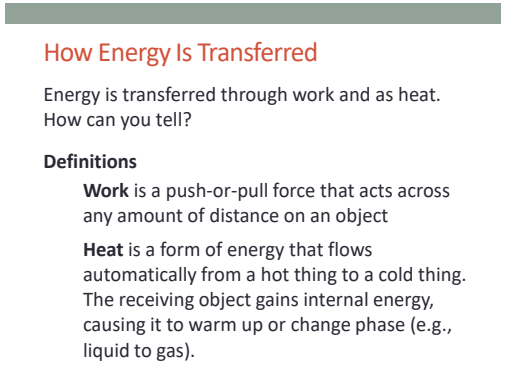
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
Slides 33–60	can change or transform from one type of energy to another. Energy can also transfer or move from one object to another. • Energy is transferred through work and as heat. Work is a push-or-pull force that acts on an object. Heat is energy that flows automatically from a hot thing to a cold thing. • Motion energy is called *kinetic energy*. • Some forms of energy, such as potential energy, can't be detected using our senses, but the changes it causes or has the potential to cause can often be perceived or measured. • Energy can move and change forms, but it can't be created, used up, or destroyed. The total amount of energy in a system remains constant. • In any interaction, some energy transforms to heat. Ultimately, all energy changes to heat, which spreads out into the atmosphere and either leaves Earth's system or is reflected back to Earth. **What Participants Do** • Reflect on their learning background and/or teaching experiences related to energy. • *For those with experience teaching energy lessons:* Share		**Display Slide 34.** Your Learning and Teaching Experiences (3 min) a. Go around the room and have participants share their background learning about energy formally in school and/or their experience teaching students about energy.
			**Display Slide 35.** Review: Science Content Storyline (Less than 1 min) a. Briefly review the characteristics of a coherent science content storyline.

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

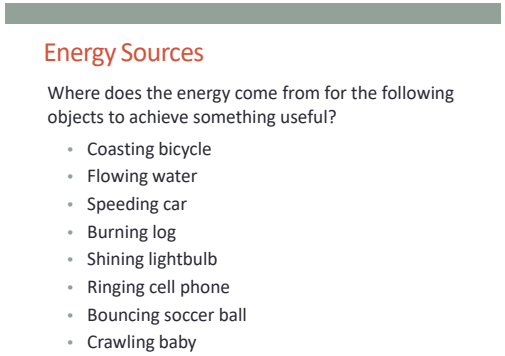
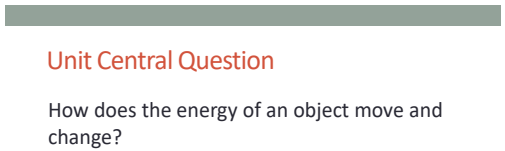
	the science content storylines they use when teaching students about energy.
	
	Handouts in PD Binder
	• 5.6 Forms of Energy
	• 5.7 Ramps, Speed, and Energy (from ET lesson 2a)
	
	Handouts in Lesson Plans Binder
	• 2.2 High-Speed Energy Procedure (from ET lesson 2a)
	
	Supplies
	• Science notebooks
	• Chart paper and markers
	• Plastic bag containing windup toy, flashlight, and noisemaker (1 bag per pair)
	• For ramp-and-marble investigation (1 setup per pair):
	  • 1 grooved ruler
	  • 1 marble
	  • 1/2-inch blocks of wood or notepads (to elevate the ramps)
	  • Small block of Styrofoam (with groove cut out)
	  • 2 sheets of plain white paper
	  • Tape
	
	Resources in Lesson Plans Binder
	Resources section:
	• Content background document
	• Common Student Ideas
		
		 
			Display Slide 36. Teaching about Energy (7 min)
			
			a. **Individuals (3 min):** "What do you teach your students about energy? In your science notebooks, write a typical science content storyline you'd use when teaching a lesson on energy transfer."
			b. **Pairs (4 min):** Have participants share their science content storylines with an elbow partner.
			
			Display Slide 37. Ideas about Energy (7 min)
			
			a. Read the question on the slide and invite participants to share their ideas about energy.
			b. As participants share their ideas, record them on chart paper.
			c. Highlight the following ideas if they aren't mentioned during the share-out:
			  • Energy is the ability to do work or move something against a force.
			  • We can often detect energy with our senses. Seeing motion, feeling heat, hearing a sound, and seeing light tells us that energy is present.
			  • We can't always perceive or detect energy using our senses, but we can often perceive the changes it causes or has the potential to cause, such as the transfer of motion energy from one object to another. Motion energy is also called *kinetic energy*.
			  • Energy exists in several forms and can change or transform from one type of energy to another.
			  • According to the law of conservation of energy,

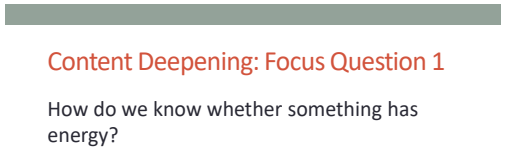
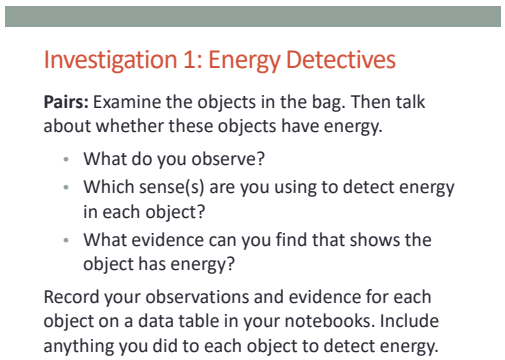
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			energy can't be created or destroyed. The total amount of energy in a system remains constant
			**Display Slide 38.** Familiar Forms of Energy (8 min) a. Hide the images on the slide and ask participants to name some of the different forms of energy they encounter every day. b. Then reveal the images and ask participants the following questions: • What are some ways in which energy reveals itself to us? • How would you describe the transfer of energy in the examples on the slide? • What form of energy do any of these objects illustrate? How would you describe this energy? **Key ideas in slide images:** • A lightning bolt radiates light from a region of air that is superheated and conducts heat into the air surrounding it. • Solar panels receive heat from the Sun in the form of radiation. • The Sun is an illuminated gas that releases heat to its cold environment in the form of radiation (much of the heat released is visible light). • Chemical potential energy in the molecular form of volatile chemicals is released to its environment as heat. • The nucleus of an atom is held together with a strong binding energy that remains dormant until the atom splits (as in a nuclear bomb or reactor). • Wind is the result of large masses of air moving from hot places on the planet to cold places (convective heat). This air can be captured and

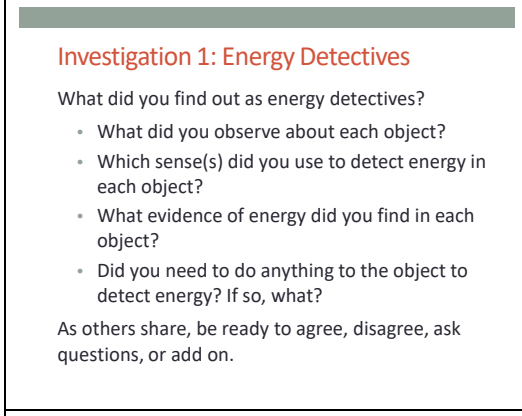
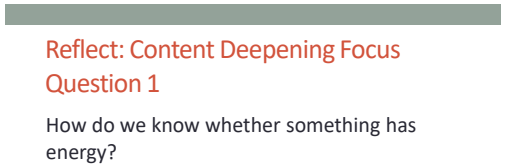
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			converted to rotational kinetic energy in a windmill. • Magnets have a strong attraction to one another, and prying them apart requires working against this magnetic force. Since work requires motion, working against this force succeeds only if the magnets actually move apart. • Electrical current is a form of work that sets charges in motion inside an electric conductor. This work is converted to light that we receive in the form of heat because it radiates away from an object (e.g., the fluorescent gas of CFL bulbs on the slide).
			**Display Slide 39.** Forms of Energy (10 min) a. Distribute handout 5.6 (Forms of Energy) and read through the definitions. b. **Individuals:** Ask participants to write down an example of each form of energy on their handouts. Then ask participants to see if they can match any of the definitions on the handout with the pictures on the previous slide. **Note:** Return to previous slide to complete the handout. Try to elicit anything participants may remember from past courses in physics. c. Emphasize that these are energy forms, not energy transfers. Some of these forms aren't easy to detect with the senses. d. **Whole-group share-out:** Invite participants to share their examples of various forms of energy. Then ask if they were able to match and energy definitions with the slide photos. **Examples of energy forms:** 1. **Kinetic energy:** a moving bicycle 2. **Chemical energy:** gasoline, wood, coal, food

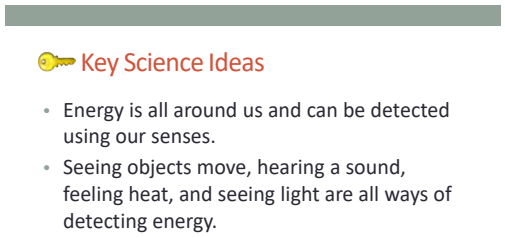
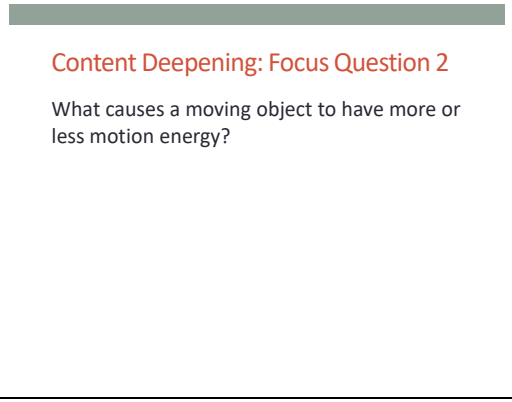
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			3. **Internal energy:** the random motion and arrangement of atoms in a glass of water at room temperature 4. **Gravitational potential energy:** the pull of gravity causes water at the top of a mountain to flow downhill rather than uphill 5. **Mechanical waves:** sound, water, earthquakes 6. **Electrical energy:** turning on an electrical circuit connected to a battery 7. **Radiant energy:** heat from the Sun 8. **Nuclear energy:** the source of heat inside the Sun; atoms splitting to create fuel in submarines, power plants, and bombs 9. **Elastic energy:** a stretched rubber band 10. **Mass energy:** energy released in nuclear reactions and inside the Sun
			**Display Slide 40.** How Energy Is Transferred (2 min) a. "Energy transfers aren't forms of energy but ways in which energy moves from one object to another. We can detect most energy transfers with our senses." b. "Energy can transfer from object to object or from place to place as a result of work or as heat. Scientists make strict distinctions between work and heat." c. Review these definitions: 1. *Work:* A push-or-pull force that acts across any amount of distance on an object. 2. *Heat:* Energy that flows automatically from a hot thing to a cold thing. The receiving object gains internal energy, causing it to warm up or change phase (e.g., from a solid to a liquid as ice melts, or from a liquid to gas as water

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			boils). d. Ask participants, "How can you tell that energy is being transferred?" Elicit some ideas and examples.
		How Energy Is Transferred through Work **Work** • Accomplished when moving an object against a frictional force • Performed by gravity when something falls to the ground • Accomplished when lifting an object against the force of gravity • Required to squeeze an object against elastic forces • Causes an object to accelerate to a new speed • Required for charging a battery to use later	**Display Slide 41.** How Energy Is Transferred through Work (Less than 1 min) a. Read through the information on the slide.
		How Energy Is Transferred as Heat **Heat** • Radiated by the brightness of a fire • Reaches Earth from the Sun • Rises with the hot air from a heating duct • Causes warm air to rise • Felt when holding a sleeping baby • Melts ice in your hand • Transfers from a hot iron to your hand when you burn it • Causes a kettle of water to change temperature	**Display Slide 42.** How Energy Is Transferred as Heat (Less than 1 min) a. Read through the information on the slide.

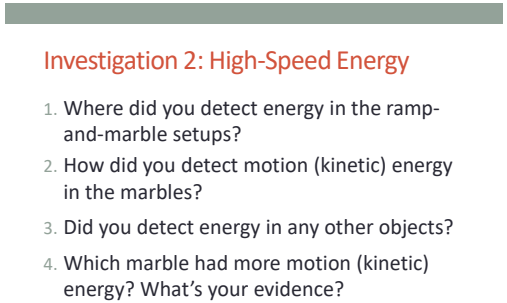
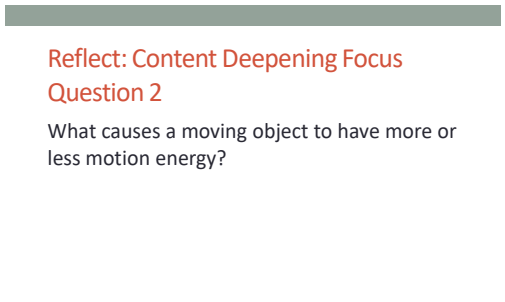
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 43.** Energy Sources (4 min) a. Read the question on the slide. b. **Whole group:** Elicit ideas from participants; then quickly review the answers from the answer key. **Answer key:** • Coasting bicycle: Kinetic energy generated from motion • Flowing water: Gravitational potential energy from height • Speeding car: Kinetic energy from gasoline powering the engine • Burning log: Chemical energy from the chemical bonds in the wood • Shining lightbulb: Electrical energy from a power-generating plant • Ringing cell phone: Stored electrical energy from a battery • Bouncing soccer ball: Kinetic energy in the ball • Crawling baby: Kinetic energy from food
			**Display Slide 44.** Unit Central Question (Less than 1 min) a. Read the unit central question on the slide. b. Emphasize that this question will guide student learning throughout the entire series of Energy Transfer lessons. c. Tell participants that the information they gather during the content deepening investigations this week will help them answer this question. d. Have participants write the focus question in their science notebooks and draw a double-lined box around it. This practice reinforces the process

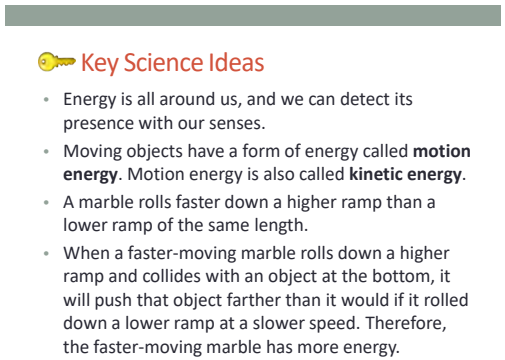
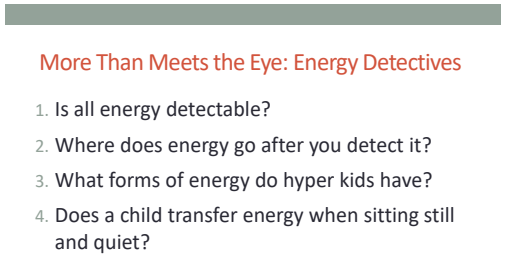
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			they'll follow with students in the lessons.
			**Display Slide 45.** Content Deepening: Focus Question 1 (Less than 1 min) a. Read the focus question on the slide. b. Emphasize that this question will guide student learning throughout ET lesson 1b. c. Ask participants to write the focus question in their notebooks and draw a box around it.
			**Display Slide 46.** Investigation 1: Energy Detectives (10 min) a. "For this investigation, you'll become energy detectives and see if you can detect the presence of energy in some different objects." b. Have participants pair up with their elbow partners. Then give each pair a plastic bag containing a windup toy, a flashlight, and a noisemaker. c. Walk participants through the directions on the slide. d. "As you observe and handle these objects, keep in mind that you may have to do something to them to detect energy." e. Direct participants to record their observations and evidence of energy for each object on a data table in their science notebooks. The table should have two columns with the headings "Object" and "Evidence of Energy." **Note:** You may want to display the sample data

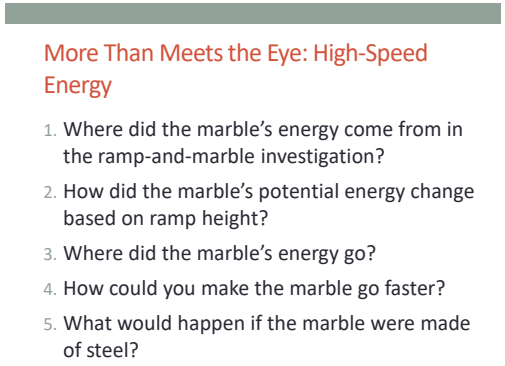
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			table from ET lesson 1a on a document reader. f. During this investigation, circulate around the room, listening to participants' ideas and observations and asking elicit and probe questions.
			**Display Slide 47.** Investigation 1: Energy Detectives (5 min) a. **Whole-group discussion:** Have pairs share the observations and evidence they recorded on their data tables for each object. Make sure they include which senses they used to detect the presence of energy in an object and whether they needed to do anything to the object to detect energy. b. During this discussion, encourage participants to agree, disagree, ask questions, or add on.
			**Display Slide 48.** Reflect: Content Deepening Focus Question 1 (4 min) a. Review the focus question on the slide. b. Invite participants to share their ideas for answering the question, using observations and evidence from the previous investigation. c. Encourage participants to agree, disagree, ask questions, or add to the ideas others share. d. During this discussion, record key ideas on chart paper.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 49.** Key Science Ideas (3 min) a. Review the key science ideas on the slide that answer the focus question. Emphasize that participants' observations helped shape these responses. b. Point out that detecting motion, sound, heat, and light in objects is actually evidence of energy transfer rather than energy, but this distinction isn't necessary for students to be aware of at this point. c. **Whole-group discussion:** "Does everyone agree with these ideas? Would you like to add or revise anything?" d. Have participants copy these science ideas into their science notebooks under the focus question.
	10-MINUTE BREAK		
			**Display Slide 50.** Content Deepening: Focus Question 2 (Less than 1 min) a. Read the focus question on the slide. b. Emphasize that this question will guide student learning throughout ET lessons 2a/b. c. Ask participants to write the focus question in their notebooks and draw a box around it.

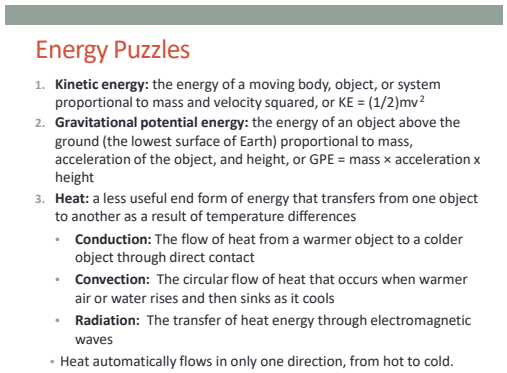
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Investigation 2: High-Speed Energy • Locate ET lesson handout 2.2 (High-Speed Energy Procedure) in your lesson plans binder. • Follow the directions carefully as you set up your ramps and conduct the investigation. • Make sure to record your data on handout 5.7 (Ramps, Speed, and Energy).  Photo courtesy of BSCS  Photo courtesy of BSCS	**Display Slide 51.** Investigation 2: High-Speed Energy (15 min) a. Have participants locate ET handout 2.2 (High-Speed Energy Procedure) in their lesson plans binders. Then distribute handout 5.7 (Ramps, Speed, and Energy) to each participant. b. "For this investigation, you'll pair up with your elbow partners again and explore the speed and energy of a marble as it rolls down ramps of different heights and moves a piece of Styrofoam." c. Hand out the necessary materials to each pair of participants. d. Demonstrate the setup for participants, including how to mark the sheet of paper to indicate where the Styrofoam block stops moving (step 4) and how to measure the distance from the middle mark to the edge of the paper (step 7). e. Inform pairs that they may have to perform several practice runs to get the marble to land in the Styrofoam groove correctly. f. Emphasize that participants should finish steps 1–9 for Ramp 1 before setting up Ramp 2. g. Answer any questions before directing pairs to begin their investigations. Circulate around the room during the activity to assist as needed. **Note:** Make sure participants complete the entire handout during this investigation. In the actual activity, students gather data in one lesson and analyze it in the following lesson.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 52.** Investigation 2: High-Speed Energy (5 min) a. Read the questions on the slide. b. **Whole-group share-out:** Invite pairs to share their observations and evidence from the investigation. Probe participants' responses and elicit differing points of view. c. During this discussion, record participants' observations and ideas on chart paper. d. Try to reach a group consensus regarding question 4. Then have participants write the answers to each question in their science notebooks.
			**Display Slide 53.** Reflect: Content Deepening Focus Question 2 (4 min) a. Review the focus question on the slide. b. Invite participants to share their ideas for answering the question, using observations and evidence from the ramp-and-marble investigation. c. Encourage participants to agree, disagree, ask questions, or add to the ideas others share. d. During this discussion, record key ideas on chart paper.

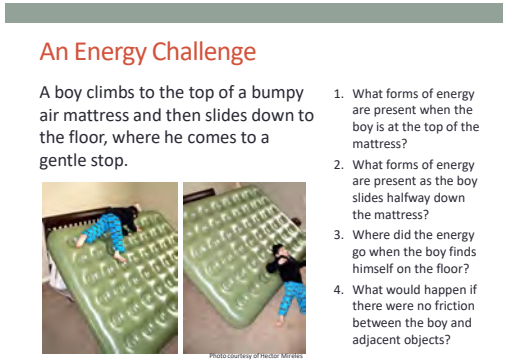
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 54.** Key Science Ideas (3 min) a. Review the key science ideas on the slide that answer the focus question. Emphasize that participants' observations and evidence from the ramp-and-marble investigation helped shape these responses. b. **Whole-group discussion:** "Does everyone agree with these ideas? Would you like to add or revise anything?" c. Have participants copy these science ideas into their science notebooks under the focus question.
			**Display Slide 55.** More Than Meets the Eye: Energy Detectives (8 min) a. **Think-Pair-Share (4 min):** Ask participants to think about the questions on the slide that relate to today's energy-detectives investigation. Then have them pair up and discuss their ideas with an elbow partner. b. **Whole-group discussion (4 min):** Invite participants to share their ideas with the group. Probe participants' responses and elicit differing points of view. c. Following the discussion, highlight these answers: • **Question 1:** Some forms of energy can't be detected with our senses. The chemical potential energy of a match and the gravitational potential energy of an object at the top of a hill are two examples. • **Question 2:** The energy we detect in an object can transfer as heat to the environment. As a bouncing ball hits the ground, its energy is

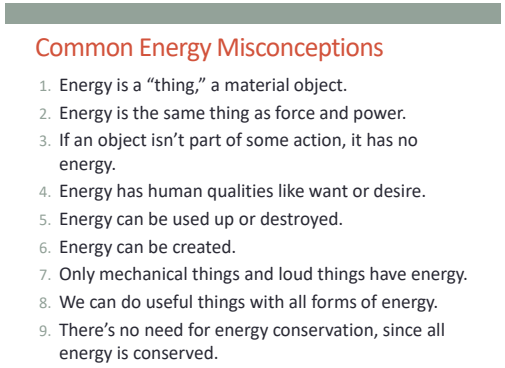
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			gradually lost as heat to the environment until it has no more energy. • **Question 3:** Hyper kids have kinetic energy from food (i.e., sugar from breakfast), but their energy also transfers to the environment in the form of heat (conduction), sound waves, and working against the ground's friction as they walk and run (which leads to heat conduction). The energy of hyper kids is like the internal energy of molecules inside an object that gains heat. • **Question 4:** Even when perfectly still, all humans radiate heat like little space heaters and consume heat through their bodily functions.
			**Display Slide 56.** More Than Meets the Eye: High-Speed Energy (8 min) a. **Think-Pair-Share (4 min):** Ask participants to think about the questions on the slide that relate to today's high-speed energy investigation. Then have them pair up and discuss their ideas with an elbow partner. b. **Whole-group discussion (4 min):** Invite participants to share their ideas with the group. Probe participants' responses and elicit differing points of view. c. Following the discussion, highlight these answers: • **Question 1:** The energy the marble had to roll down the ramp came entirely from its gravitational potential energy at the top of the ramp. Frictional force works on the moving marble, causing it to slow down and eventually stop. That work is proportional to distance: W = fd (f = frictional force; d = distance traveled). That work converts entirely into heat by slightly

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			raising the temperature of the floor and the foam. Eventually, that heat radiates or conducts into other adjacent objects and is released into the air. So energy isn't lost; it's just transferred into heat. And heat isn't detectable in this case. • **Question 2:** The marble's total energy at the top of the ramp is in the form of gravitational potential energy, which is proportional to the ramp height and independent of steepness. • **Question 3:** As the marble rolls down the ramp, it loses potential energy and gains kinetic energy. As kinetic energy decreases, frictional force increases, slowing the marble down. Ultimately, energy turns to heat once the marble has reached a complete stop. • **Question 4:** The marble's speed could be increased with a longer or higher ramp, but not both. The amount of potential energy and, thus, the marble's final kinetic energy come from the height of the ramp. • **Question 5:** If the marble were made of steel, it would be heavier and have more mass. The kinetic energy of a heavier marble moving at the same speed as a lighter marble would depend on that mass: $KE = (1/2)mv^2$. So the heavier marble moving at the same speed as the lighter marble would have more kinetic energy because it has more mass. The heavier marble, therefore, would push the Styrofoam farther.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 57.** Energy Puzzles (8 min) a. Highlight the information about kinetic energy, gravitational potential energy, and heat on the slide. b. With these ideas in mind, discuss the following questions with participants: • Which object has more kinetic energy at 55 miles per hour: a Hummer or a Mini Cooper? • Which of two identical cars has higher kinetic energy if one is moving faster? • How does a skier gain potential energy? • Which of two skiers at the top of a mountain has more potential energy: a fat one or a skinny one? Why? • Heat is an inescapable transfer of energy that can't be ignored in our examples. Rub your hands together and feel your work turn into heat. But can you reverse this transfer from hot to cold? • Imagine coffee getting cold in a room. Where does heat go? Can it return to the coffee mug by itself? • Scattered heat isn't as useful as localized heat. Would you rather have a lot of heat in your car's pistons or heat coming out of the tailpipe and escaping into the atmosphere? The pistons' heat is far more useful that the heat escaping from the tailpipe!

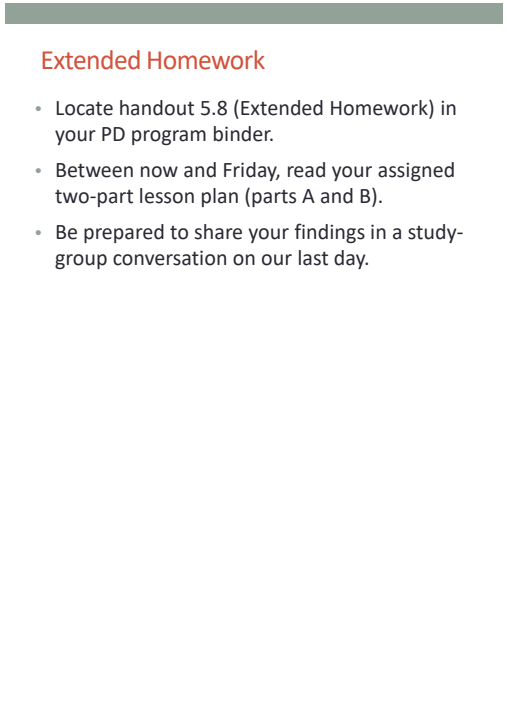
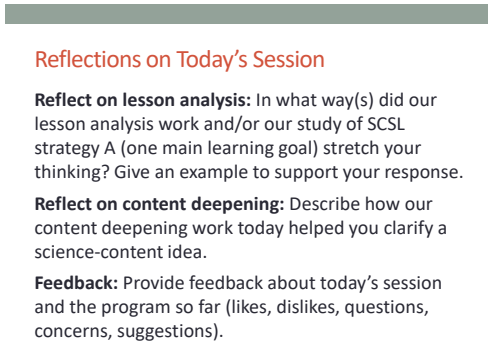
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Playing Energy Detectives  Photo courtesy of Pixabay.com **Scenario 1:** A jet engine climbs into the air at a high velocity, taking happy passengers to a far-away destination  Photo courtesy of Pixabay.com **Scenario 2:** Tasty sausages are cooking on a wood-burning grill.	**Display Slide 58.** Playing Energy Detectives (8 min) a. "As energy detectives, let's investigate the scenarios on this slide." b. Introduce each scenario and ask participants the following questions: 1. Which forms of detectable energy are present in each scenario? 2. What transfers of energy are taking place in each scenario? 3. How does kinetic energy change in the airplane? 4. How does potential energy change in the airplane? 5. What restrictions apply to the flow of heat in these scenarios (i.e., in what directions can heat flow)? **Answer key:** • **Question 1:** kinetic energy and light energy • **Question 2:** Chemical energy in the aircraft fuel is converted to kinetic energy, gravitational potential energy, heat (exhaust), and the roaring sound of the engine. • **Question 3:** The plane's kinetic energy increases because the engine is working to keep the plane climbing into the air. • **Question 4:** The plane's potential energy also increases because the engine is working against Earth's gravitational pull. • **Question 5:** Heat can flow in only one direction, from hot to cold.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 59.** An Energy Challenge (8 min) a. Read the scenario and questions on the slide. b. **Individuals:** Direct participants to answer the questions in their science notebooks, using evidence and reasoning to support their ideas. **Note:** The challenge highlights the transfer of kinetic energy to heat energy through friction in everyday experiences. c. **Whole group:** Call on a few participants to share their answers and reasoning. Probe participants' responses and elicit differing points of view. **Note:** If time is limited, skip the group share-out and just read through the answer key. d. Quickly highlight the correct answers (see answer key). **Answer key:** • **Question 1:** Potential energy is present at the top of the mattress. • **Question 2:** Potential energy, kinetic energy, and frictional heat are all present when the boy is halfway down the mattress. • **Question 3:** All of the energy converted to heat. • **Question 4:** All of the boy's initial potential energy would transfer to kinetic energy once he reached the bottom of the mattress.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 60.** Common Energy Misconceptions (8 min) a. Read through the common energy misconceptions on the slide. b. Ask volunteers to contribute a scientifically accurate statement that replaces each misconception. c. Probe participants' responses and elicit differing points of view. Highlight ideas in the answer key as needed. **Answer key:** • **Question 1:** Energy isn't a concrete thing. Objects themselves aren't energy; they *possess* energy in various forms. • **Question 2:** Force transfers energy when it acts on an object over a certain distance. Power is the rate at which energy is transferred. • **Question 3:** Action isn't necessary for energy to be present. Potential energy is stored energy quietly waiting to be released (e.g., a fuel tank, matches, a boulder at the top of a hill, a squeezed spring). • **Question 4:** It's common to use everyday language to explain scientific phenomena. Students might say, "Heat *wants* to move from hot to cold," or "The marble *likes* being at the bottom of the ramp," or "The packing peanut *needs* to stop." Inanimate objects don't have human qualities associated with volition or emotion. Qualities such as love, hate, want, need, intention, and desire don't affect the laws of nature. • **Questions 5 and 6:** Energy is always conserved. It may change from one form (maybe a visible form) to another form (maybe an invisible form), but it can never be created, used up, or destroyed.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			• **Question 7:** The Sun is the source of most of our energy, and it isn't mechanical or loud. • **Question 8:** Heat energy that escapes into the atmosphere or outer space isn't useful and can't be recaptured even though it's still energy. • **Question 9:** Useful forms of energy, such as different types of fuel and localized heat sources, are hard to access, extract, and refine. When we use them, they turn into heat energy and spread out into the atmosphere, which isn't useful.
3:15–3:30 15 min **Wrap-Up: Summary, Homework, and Reflections** Slides 61–66	**Purpose** • Summarize and reflect on key ideas from today's learning, including the Science Content Storyline Lens, STeLLA strategy A, and the Energy Transfer science content. **What Participants Do** • Review today's focus questions. • Share key ideas from today's lesson analysis (SCSL strategy A) and content deepening work. • Copy down the homework assignment for day 6. • Discuss expectations for the extended homework assignment (Energy Transfer lesson plan review). • Write reflections on today's learning. **Posters and Charts** • Effective Science Teaching chart	Today's Focus Questions 1. What is the Science Content Storyline Lens (SCSL)? 2. Why is one main learning goal essential for science content storyline coherence? 3. How do we know whether something has energy? 4. What causes a moving object to have more or less motion energy?	**Display Slide 61.** Forms of Energy (10 min) Today's Focus Questions (Less than 1 min) a. Review the focus questions addressed during today's session.
		Summary: Today's Lesson Analysis Work Reflect on today's session: • STL strategy 6: use and apply • The Science Content Storyline Lens (SCSL) • Science ideas and student ideas • SCSL strategy A: identify one main learning goal Based on our work today, do you have any suggestions for modifying our image of effective science teaching?	**Display Slide 62.** Summary: Today's Lesson Analysis Work (3 min) a. **Individual think time (1 min):** Ask participants to reflect on the work they accomplished during today's lesson analysis and think about the question on the slide. b. **Whole-group share-out (2 min):** Invite participants to share their ideas for modifying the image of effective science teaching based on today's work. Revise the chart as needed.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	Handouts in PD Binder • 5.8 Extended Homework • 5.9 Daily Reflections—Day 5 **Supplies** • Science notebooks	Summary: Today's Content Deepening Work Name one main learning goal for today's content deepening work. OR Name one supporting science idea you learned about energy transfer and/or transformation today. OR Name one common student idea (misconception) about energy and energy transfer.	**Display Slide 63.** Summary: Today's Content Deepening Work (3 min) a. **Individual think time (1 min):** Present the options on the slide and give participants 1 minute to come up with a statement that summarizes today's content deepening work in one of these areas. b. **Whole-group round-robin (2 min):** Go quickly around the room and have each participant share one summarizing statement. **Push for complete sentences!**
		Homework 1. Read in the STeLLA strategies booklet: • SCSL strategy B: Set the purpose with a focus question or goal statement • SCSL strategy C: Select activities that are matched to the learning goal • SCSL strategy I: Summarize key science ideas • STL strategy 7: Engage students in making connections by synthesizing and summarizing key science ideas 2. Fill in the appropriate columns on your SCSL Z-fold summary charts.	**Display Slide 64.** Homework (2 min) a. Review the homework assignment on the slide and have participants write it in their notebooks. b. Make sure participants are clear about the reading and writing tasks.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 65.** Extended Homework (2 min) a. Go over the information on the slide. b. Have participants review the Extended Homework assignment sheet (handout 5.8), which provides further details about the assignment. c. Remind participants that like the extended homework on the Earth's Changing Surface lessons that they were assigned during week 1, participants are responsible for reading parts A and B of their assigned lesson plan. d. Assign a two-part lesson plan to each participant. e. Ask if there are any questions about the assignment. f. **Emphasize:** The group share-out on the last day of the PD program (day 8) should focus on the assignment-sheet questions (section 2). Participants won't have time to share all the details of each lesson plan.
			**Display Slide 66.** Reflections on Today's Session (5 min) a. Ask participants to think about today's session and write their reflections and feedback on the Daily Reflections sheet (handout 5.9 in PD program binder).