# RESPeCT Summer Institute Professional Development Leader Guide (PDLG)

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| **Grade Level** | 4 | **Day** | 7 | **STeLLA Strategy** | SCSL Strategy D: Select Content Representations and Models | **Subject Matter Focus** | Energy Transfer |
| **Focus Questions** | • How do you know when a content representation is appropriate and matched to the main learning goal?<br>• How can we engage students in using content representations and models in meaningful ways?<br>• Where does energy come from? Where does it go? | | | | | | |
| **Main Learning Goals** | Participants will understand the following:<br>• Content representations can be helpful tools if they're matched to the learning goal of a lesson, are scientifically accurate, and address common student misconceptions. In addition, they must be comprehensible to students without reinforcing or introducing misconceptions and without distracting students with too many details or new terms.<br>• To ensure meaningful learning from content representations, students need to be engaged in modifying or creating the representations, in analyzing their meaning, and in critiquing them.<br>• Energy isn't created or destroyed, but it can undergo many changes (transformations).<br>• Student understandings of energy transfer can be facilitated by modeling energy as discrete objects that can be moved between containers.<br>• Heat is the end form of energy and isn't easily transformed to other forms. | | | | | | |

| **Preparation** | **Materials** | **Videos** |
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| **Daily Setup Tasks**<br>• Check that video clips are correctly linked to PowerPoint (PPT) slides.<br>• Set up PowerPoint.<br>• Make sure video clips play correctly with good sound.<br>• Arrange furniture and food.<br>• Arrange participant materials.<br>• Put up posters and charts.<br><br>**Planning and Preparation Tasks**<br>• Study the PDLG, PowerPoint slides (PPTs), video clips, and handouts. Make changes to PPTs if needed.<br>• Review the reflections from day 6 and create a summary slide (PPT 2).<br>• Watch the video clips and anticipate participant responses.<br>• Prepare charts for the day's agenda and | **Posters and Charts**<br>• STeLLA Framework and Strategies poster<br>• Day-7 Agenda (chart)<br>• Norms for Working Together (chart)<br>• Day-7 Focus Questions (chart)<br>• Strategy charts from days 1–6 (STL strategies 1–7 and SCSL strategies A, B, C, and I)<br>• Parking Lot poster<br><br>**Handouts in RESPeCT PD Binder Front Pocket**<br>• Z-fold summary chart: Science Content Storyline Lens Strategies<br><br>**Handouts in RESPeCT PD Binder, Day 7**<br>• 7.1 Analysis Guide D (5 copies: 2 for examples matched to learning goal; 2 for lesson analysis; 1 for content deepening | • Video Clip 7.1: Bernstein classroom (SCSL strategy D); 7.1_stella_et_bernstein_L3_c1<br>• Video Clip 7.2: Knight classroom (SCSL strategy D): 7.2_stella_et_knight_L3_c1 |

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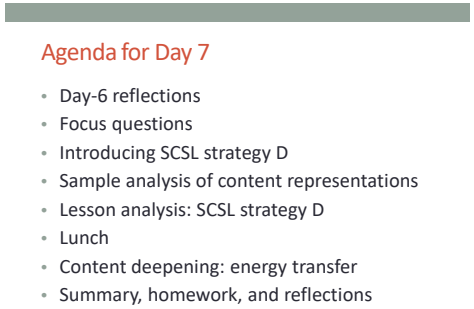
| focus questions.<br>• Review the information on energy-flow diagrams (including examples) in ET lesson 5a in the lesson plans binder.<br>• For content deepening:<br>  • Assemble materials for energy-beans investigation. | analysis)<br>• 7.2 Transcript for Video Clip 7.1<br>• 7.3 Transcript for Video Clip 7.2<br>• 7.4 Energy-Beans Worksheet<br>• 7.5 Energy-Beans Procedure<br>• 7.6 Daily Reflections—Day 7<br><br>**Handouts in RESPeCT Lesson Plans Binder**<br>• 4.2 Potential and Kinetic Energy: Energy Changing Costumes (from ET lesson 4b)<br>• 5.1 Mumford and Leroy's Big Crash, Part 4 (from ET lesson 5a)<br><br>**Supplies**<br>• Science notebooks<br>• Chart paper and markers<br>• **Optional:** Ramp-and-marble setup (from ET lesson 2a)<br>• For content deepening energy-beans investigation (per pair of participants):<br>  • Six 1-ounce plastic cups<br>  • 30 dried pinto beans<br><br>**PD Resources**<br>• STeLLA strategies booklet<br>• RESPeCT PD program binder<br>• RESPeCT lesson plans binder<br><br>**Resources in Lesson Plans Binder**<br>*Resources section:*<br>• Energy and Energy Transfer Content Background Document<br>• Common Student Ideas about Energy | |

**DAY 7 SESSION OUTLINE**

| Time | Activities | Purpose |
|---|---|---|
| 8:00–8:25<br>25 min | **Getting Started: Housekeeping, Agenda, Day-6 Reflections, Norms, Focus Questions** | • Build community by sharing participants' reflections from day 6.<br>• Set the stage for a day of learning. |
| 8:25–9:00<br>35 min | **Introducing SCSL Strategy D** | • Deepen participants' knowledge of the purpose and key features of SCSL strategy D. |
| 9:00–10:20<br>80 min<br>(Includes 10-min break) | **Sample Analysis of Content Representations** | • Develop participants' ability to analyze content representations to determine how well they match the main learning goal.<br>• Deepen participants' science-content knowledge as it emerges from analyzing content representations. |
| 10:20–12:00<br>100 min | **Lesson Analysis: SCSL Strategy D** | • Develop participants' ability to analyze content representations to determine how well engaged students are in their use.<br>• Use lesson analysis of classroom videos to better understand STeLLA strategy D.<br>• Deepen participants' science-content knowledge of energy transfer through lesson analysis. |
| 12:00–12:45<br>45 min | **LUNCH** | |
| 12:45–3:15<br>150 min<br>(Includes 10-min break) | **Content Deepening: Energy Transfer** | • Deepen participants' science-content knowledge of energy transfer by using content representations and models matched to the learning goal.<br>• Deepen participants' science-content knowledge of energy transfer by conducting an investigation from ET lesson 5a. |
| 3:15–3:30<br>15 min | **Wrap-Up: Summary, Homework, and Reflections** | • Summarize and reflect on key ideas about SCSL strategies A, B, C, D, and I and the SEC science content, lesson plans, and lesson analysis work. |

**DAY 7**

| PD Model: Time/Phase | Purpose, Content, and What Participants Do | Slides | Process |
|---|---|---|---|
| 8:00–8:25<br>25 min<br><br>**Getting Started**<br><br>Slides 1–7 | **Purpose**<br>• Build community by sharing participants' reflections from day 6.<br>• Set the stage for a day of learning.<br><br>**What Participants Do**<br>• Review the day's agenda.<br>• Discuss reflections from day 6.<br>• Review and discuss progress on the RESPeCT program norms.<br>• Read today's focus questions.<br><br>**Posters and Charts**<br>• STeLLA Framework and Strategies poster<br>• Day-7 Agenda (chart)<br>• Norms for Working Together (chart)<br>• Day-7 Focus Questions (chart) |  | **Display Slide 1.** RESPeCT PD Program (5 min)<br><br>a. Take care of any housekeeping issues. |
| | |  | **Display Slide 2.** Agenda for Day 7 (5 min)<br><br>a. Talk through the agenda for the day. |

| PD Model: Time/Phase | Purpose, Content, and What Participants Do | Slides | Process |
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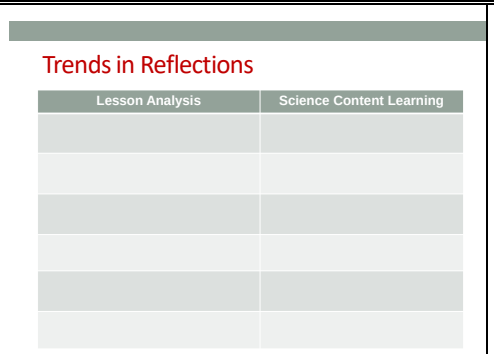
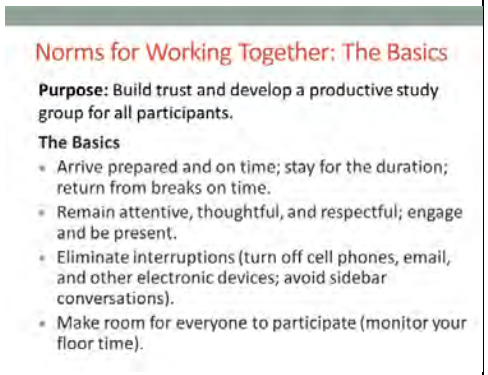
| | |  | **Display Slide 3.** Trends in Reflections (3 min)<br><br>a. Give participants time to review your feedback on their reflections from day 6 and offer reactions, comments, or follow-up questions. |
| | |  | **Display Slide 4.** Norms for Working Together: The Basics (2 min)<br><br>a. Review the norms and ask participants to think about areas where they could improve individually or as a group.<br><br>b. "How do you think we're doing individually and as a group applying these norms? Do you have any comments or suggestions about areas where we could improve?" |

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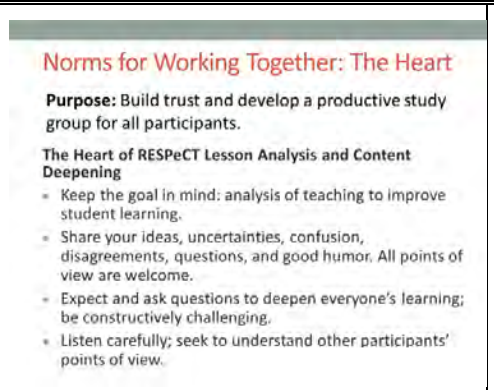
| | |  | **Display Slide 5.** Norms for Working Together: The Heart (5 min)<br><br>a. Review the norms that are at the heart of the RESPeCT program and ask participants to think about areas where they could improve individually or as a group.<br><br>b. **Emphasize:** "We're doing quite well with our norms, but as we approach the fall, I hope to see our interactions evolving so that you feel comfortable interacting less through your PD leaders as the 'teachers' and direct more of your questions and comments to one another, challenging each other, piggybacking on each other's ideas, and listening carefully to one another so that everyone is contributing to the kind of productive analysis that will help us figure out ways to strengthen our students' science learning."<br><br>c. Offer an opportunity for participants to comment on how the group is doing with these norms. Ask, "Are there any areas where we could improve? Any suggested changes?" |

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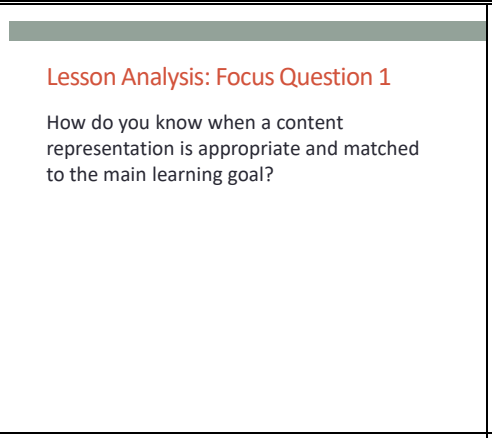
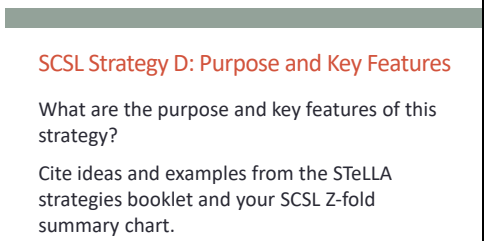
| | | Today's Focus Questions<br>1. How do you know when a content representation is appropriate and matched to the main learning goal?<br>2. How can we engage students in using content representations and models in meaningful ways?<br>3. Where does energy come from? Where does it go? | **Display Slide 6.** Today's Focus Questions (1 min)<br><br>a. Introduce the focus questions on the slide. |
| | |  | **Display Slide 7.** STeLLA Conceptual Framework (2 min)<br><br>a. "We'll be focusing on STeLLA strategy D today. Notice that this SCSL strategy has two parts. The first part—select content representations and models matched to the learning goal—sounds similar to strategy C—select activities that are matched to the learning goal. The second part focuses on *engaging* students in the use of content representations. This ensures that students aren't just *looking* at diagrams or models but are *actively engaging* with them." |

| PD Model: Time/Phase | Purpose, Content, and What Participants Do | Slides | Process |
|---|---|---|---|
| 8:25–9:00<br>35 min<br><br>**Introducing SCSL Strategy D**<br><br>Slides 8–10 | **Purpose**<br>• Deepen participants' knowledge of the purpose and key features of SCSL strategy D.<br><br>**Content**<br>• Strategy D content representations can be especially useful in helping students see how the science content storyline fits together.<br>• Content representations (such as diagrams, analogies, graphs, concept maps, models, videos, simulations, and role-plays) can make science ideas more concrete and real for students.<br>• Content representations are most meaningful when students are engaged in constructing and critiquing them.<br>• Content representations support English language learners by providing a variety of ways for them to understand science ideas that extend beyond words.<br><br>**What Participants Do**<br>• Make, share, and discuss charts summarizing the purpose and key features of SCSL strategy D.<br>• Discuss questions about strategy D.<br><br>**Supplies**<br>• Chart paper and markers |  | **Display Slide 8.** Lesson Analysis: Focus Question 1 (Less than 1 min)<br><br>a. "Now let's explore the first part of strategy D and our first focus question."<br><br>b. Read the focus question on the slide. |
| | |  | **Display Slide 9.** SCSL Strategy D: Purpose and Key Features (25 min)<br><br>a. **Small groups (12 min):** Divide participants into two groups and have each group make a chart identifying the purpose and key features of strategy D described in their SCSL Z-fold summary charts and the STeLLA strategies booklet.<br><br>b. **Whole group (8 min):** Have groups report out. Then ask, "What differences do you notice between the two charts?"<br><br>**Key ideas:**<br>• Content representations can help students envision things that are too big or too small for them to see firsthand in the classroom, or processes that take place too quickly or slowly for them to perceive.<br>• Content representations give students access to different ways of making sense of key science ideas. |

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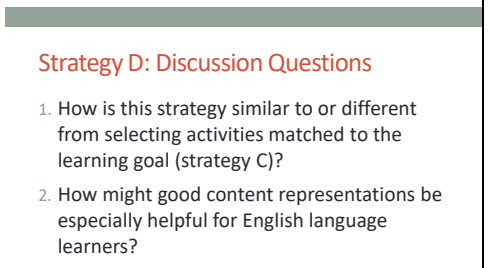
| | **PD Resources**<br>• STeLLA strategies booklet<br>• SCSL Z-fold summary chart (front pocket of PD binder) | | • If content representations or models are closely matched to the main learning goal, they can be especially useful in helping students see how the science content storyline fits together.<br>• There are many different types of content representations (analogies, metaphors, and visual representations, such as diagrams, charts, graphs, concept maps, models, and role-plays).<br>• Content representations can reveal and challenge student thinking if students are involved in creating, modifying, and analyzing the representations (instead of just listening to the teacher explain them). |
| | |  | **Display Slide 10.** Strategy D: Discussion Questions (10 min)<br><br>a. **Whole group:** Discuss the questions on the slide.<br><br>**Key ideas:**<br>• **Slide question 1:** Both strategy C and strategy D emphasize that all activities must be matched to the main learning goal. Strategy D, however, emphasizes a very important kind of activity: content representations. It also emphasizes that teachers should actively engage students in creating, modifying, and using content representations.<br>• **Slide question 2:** Good content representations can benefit all students, but they especially benefit ELL students because they present science ideas in pictures, images, and other visual formats |

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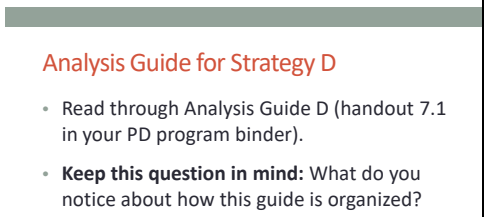
| | | | in addition to words. |
| 9:00–10:20<br>80 min<br>(Includes 10-min break)<br><br>**Sample Analysis of Content Representations**<br><br>Slides 11–17 | **Purpose**<br>• Develop participants' ability to analyze content representations to determine how well they match the main learning goal.<br>• Deepen participants' science-content knowledge as it emerges from analyzing content representations.<br><br>**Content**<br>• Six criteria are used in analyzing and selecting a content representation that is matched to the main learning goal.<br><br>**What Participants Do**<br>• Study how Analysis Guide D is organized.<br>• Use the analysis guide to analyze three examples of energy-transfer content representations (drawn from content deepening or Energy Transfer lessons).<br><br>**Handouts in PD Binder**<br>• 7.1 Analysis Guide D (two copies)<br><br>**Handouts in Lesson Plans Binder**<br>• 4.2 Potential and Kinetic Energy: Energy Changing Costumes (from ET lesson 4b) |  | **Display Slide 11.** Analysis Guide for Strategy D (10 min)<br><br>a. Have participants locate Analysis Guide D in their PD program binders (handout 7.1).<br><br>c. **Individuals:** "As you read the analysis guide, keep in mind the discussion question on the slide."<br><br>d. **Whole group:** Discuss the question on the slide.<br><br>**Key ideas:**<br>• This analysis guide focuses on the main learning goal by having participants write that down first.<br>• The guide is divided into three parts. Part 1 focuses on how well matched the content representation is to the main learning goal. Part 2 focuses on how well engaged students are in using the content representation.<br>• The guide ends with identifying ways to improve the content representation and its use in a lesson (part 3). |

| PD Model: Time/Phase | Purpose, Content, and What Participants Do | Slides | Process |
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| | **Supplies**<br>• **Optional:** Ramp-and-marble setup (from ET lesson 2a)<br>**PD Resources**<br>• STeLLA strategies booklet<br>• RESPeCT lesson plans binder | Content Representation 1: Ramp-and-Marble Model<br>Read the main learning goal and the description of the content representation in **Analysis Guide D1** (page 1 of handout 7.1).<br>**Main learning goal:** Energy can move or transfer from object to object.<br>**Description of content representation:** Students use a ramp-and-marble model (a ruler-ramp of varying heights, a marble, and a block of Styrofoam) to simulate the transfer of kinetic energy from one object to another. | **Display Slide 12.** Content Representation 1: Ramp-and-Marble Model (5 min)<br>a. **Set the context:** "Now we're going to analyze a content representation to see how well it's matched to the learning goal stated on the slide."<br>b. Have participants read the main learning goal and the description of the content representation in **Analysis Guide D1** (page 1 of handout 7.1). |
| | | Content Representation 1: Ramp-and-Marble Model<br>  <br>Photo courtesy of Cal Poly Pomona | **Display Slide 13.** Content Representation 1: Ramp-and-Marble Model (15 min)<br>a. **Individuals:** Have participants work independently on part 1 of Analysis Guide D1.<br>b. **Pairs:** "Now pair up and discuss your answers to the analysis questions." |

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| | | Does Content Representation 1 Match the Main Learning Goal?<br>How did you answer these questions from part 1 of **Analysis Guide D1**?<br>1. Is the content representation scientifically accurate?<br>2. Is it closely matched to the main learning goal?<br>3. Does it present science ideas to students in comprehensible ways?<br>4. Does it reinforce/introduce any misconceptions?<br>5. Does it address common misconceptions?<br>6. Does it contain distracting details? | **Display Slide 14.** Does Content Representation 1 Match the Main Learning Goal? (15 min)<br><br>a. **Whole group:** Discuss participants' responses to the questions in part 1 of Analysis Guide D1. (See ideal responses below.)<br><br>b. **Ask:** "How might this content representation be improved? Would you use it with your students?"<br><br>**Key ideas:**<br>• Students roll a marble down a ruler-ramp, and it collides with a Styrofoam block at the bottom of the ramp. The marble pushes the Styrofoam across the table.<br>• The height of the ramp affects the amount of potential and kinetic energy in the system.<br>• The model shows a transfer of energy from the marble to the Styrofoam block when they collide.<br>• The Styrofoam block moves farther when the marble rolls down a higher, steeper ramp than when it rolls down a lower, less-steep ramp.<br>• The marble on the steeper ramp is moving faster and therefore has more energy than the marble on the lower ramp.<br><br>**Ideal responses:**<br>1. Yes.<br>2. Yes, this model closely matches the learning goal (energy can transfer from object to object). |

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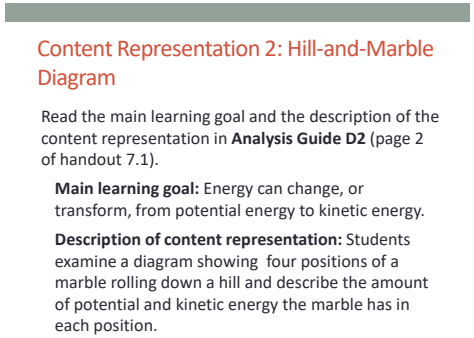
| | | | 3. Yes.<br>4. No.<br>5. Yes.<br>6. No, it doesn't distract students with too many details. No really difficult vocabulary terms.<br><br>**Take-home message:** Trying to address all six criteria in the analysis guide is a balancing act or trade-off. To make complex science ideas meaningful and comprehensible to students, the content representation needs to be simplified, but simplifications can sometimes be misleading in terms of scientific accuracy. The important thing is for teachers to be aware of such problems so they can be addressed. |
| | |  | **Display Slide 15.** Content Representation 2: Hill-and-Marble Diagram (5 min)<br><br>a. Set the context for analyzing another content representation.<br><br>b. Have participants turn to **Analysis Guide D2** (page 2 of handout 7.1) and read the main learning goal and description of the content representation.<br><br>c. Direct participants to locate handout 4.2 (Potential and Kinetic Energy: Energy Changing Costumes) in their lesson plans binders and review the activity in ET lesson 4b. |

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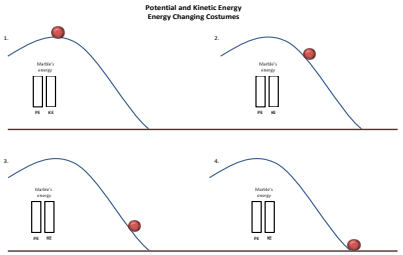
| | | Content Representation 2: Hill-and-Marble Diagram<br>  <br> | **Display Slide 16.** Content Representation 2: Hill-and-Marble Model (10 min)<br><br>a. **Individuals:** Have participants work independently on part 1 of Analysis Guide D2.<br><br>**Note:** If time is short, just do partner work.<br><br>b. **Pairs:** "Now pair up and discuss your answers to the analysis questions." |
| | | Does Content Representation 2 Match the Main Learning Goal?<br>How did you answer these questions from part 1 of **Analysis Guide D2**?<br>1. Is the content representation scientifically accurate?<br>2. Is it closely matched to the main learning goal?<br>3. Does it present science ideas to students in comprehensible ways?<br>4. Does it reinforce/introduce any misconceptions?<br>5. Does it address common misconceptions?<br>6. Does it contain distracting details? | **Display Slide 17.** Does Content Representation 2 Match the Main Learning Goal? (10 min)<br><br>a. **Whole group:** Discuss participants' responses to the questions in part 1 of Analysis Guide D2. (See ideal responses below.)<br><br>b. **Ask:** "How might this content representation be improved? Would you use it with your students?"<br><br>**Key ideas:**<br>• Energy moves from place to place and can transfer from object to object in a collision.<br>• Some energy, such as potential energy, can't be detected in the same way kinetic energy can.<br>• Objects above the ground have potential energy. This form of energy is stored.<br>• Energy isn't created; it comes from somewhere.<br>• Potential energy can transform into kinetic |

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| | | | energy as an object moves from a higher place to a lower place.<br><br>**Ideal responses:**<br>1. Yes.<br>2. Yes, this content representation is matched to the learning goal.<br>3. Yes.<br>4. No.<br>5. Yes.<br>6. No.<br><br>**Take-home message:** Trying to address all six criteria in the analysis guide is a balancing act or trade-off. To make complex science ideas meaningful and comprehensible to students, the content representation needs to be simplified, but simplifications can sometimes be misleading in terms of scientific accuracy. The important thing is for teachers to be aware of such problems so they can be addressed. |
| 10:10–10:20<br>10 min | **BREAK** | | |

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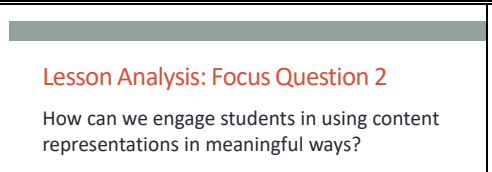
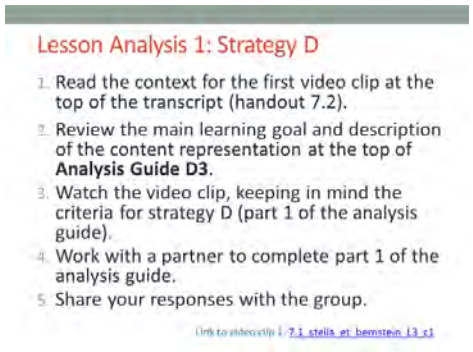
| 10:20–12:00<br>100 min<br><br>**Lesson Analysis: SCSL Strategy D**<br><br>Slides 18–23 | **Purpose**<br>• Develop participants' ability to analyze content representations to determine how well engaged students are in their use.<br>• Use lesson analysis of classroom videos to better understand STeLLA strategy D.<br>• Deepen participants' science-content knowledge of energy transfer through lesson analysis.<br><br>**Content**<br>• Six criteria are used in analyzing and selecting a content representation that is well matched to the main learning goal.<br>• Three criteria are used in analyzing how well teachers engage students in using content representations.<br><br>**What Participants Do**<br>• Use Analysis Guide D to analyze student engagement with a content representation in two classroom video clips and determine how well it matches the main learning goal.<br>• Identify key ideas participants have learned about strategy D and the science content from the lesson analysis work.<br><br>**Videos**<br>• Video Clip 7.1, Bernstein |  | **Display Slide 18.** Lesson Analysis: Focus Question 2 (Less than 1 min)<br><br>a. **Transition slide:** "Next we'll watch two video clips of strategy D in use in an Energy Transfer lesson. In addition to completing part 1 of Analysis Guide D3, we'll focus on parts 2 and 3: *How well engaged are students in using the content representation? And what suggestions do you have for improving the content representation and its use with students?"* |
| | |  | **Display Slide 19.** Lesson Analysis 1: Strategy D (25 min)<br><br>a. Orient participants to **Analysis Guide D3** and the transcript for video clip 1 (handout 7.2 in PD binder).<br><br>b. Have participants read the main learning goal and description of the content representation at the top of the analysis guide.<br><br>c. Show the video clip.<br><br>d. **Pairs:** Have participants pair up and complete part 1 of the analysis guide.<br><br>e. **Whole group:** Discuss participants' responses to the questions in part 1 of the guide. (See ideal response below.)<br><br>**Key ideas:**<br>• The height of the ramp affects the amount of energy in the system. |

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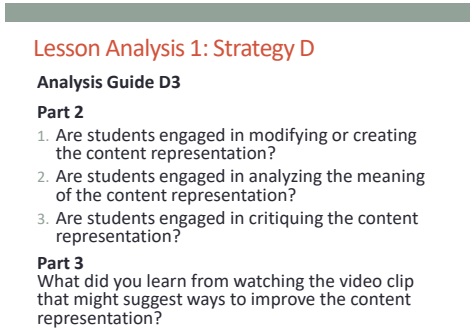
| | classroom<br>• Video Clip 7.2, Knight classroom<br><br>**Handouts in PD Binder**<br>• 7.1 Analysis Guide D<br>• 7.2 Transcript for Video Clip 7.1<br>• 7.3 Transcript for Video Clip 7.2<br><br>**PD Resources**<br>• STeLLA strategies booklet<br>• RESPeCT lesson plans binder<br>• SCSL Z-fold summary chart (front pocket of PD binder)<br><br>**Resources in Lesson Plans Binder**<br>*Resources section:*<br>• Content background document | | • The speed of the marble increases as the ramp height is increased.<br><br>**Ideal responses:**<br>1. Yes.<br>2. Yes, this content representation is matched to the learning goal.<br>3. Yes.<br>4. No.<br>5. Yes.<br>6. No. |
| | |  | **Display Slide 20.** Lesson Analysis 1: Strategy D (25 min)<br><br>a. "Now we're going to turn our attention to part 2 of strategy D, which engages students in using content representations. We'll also consider ways the content representation could be improved."<br><br>b. **Individuals:** "Study the video transcript again and think about parts 2 and 3 of **Analysis Guide D3**. Be ready to share evidence that supports your conclusions."<br><br>c. **Pairs:** "Compare your conclusions about student engagement with the content representation."<br><br>d. **Whole group:** Review participants' responses to parts 2 and 3 of the analysis guide. Challenge participants to support their answers with evidence from the video transcript.<br><br>e. If it didn't already come up in the discussion, ask participants, "How might the teacher have engaged these students in |

| PD Model: Time/Phase | Purpose, Content, and What Participants Do | Slides | Process |
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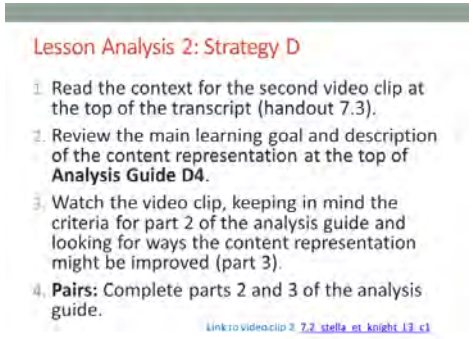
| | | | analyzing or critiquing the representation?" |
| | |  | **Display Slide 21.** Lesson Analysis 2: Strategy D (25 min)<br><br>a. "Next, we'll focus only on parts 2 and 3 of the analysis guide: *How well engaged are students in using the content representation? And what suggestions do you have for improving the content representation and its use with students?"*<br>b. Orient participants to **Analysis Guide D4** and the transcript for the second video clip (handout 7.3 in PD binder).<br>c. Have participants read the main learning goal and description of the content representation at the top of the analysis guide.<br>d. "For this analysis, we're going to look at a new classroom video and examine how students are (or are not) engaged in using the content representation."<br>e. Show the video clip.<br>f. **Pairs:** Have participants pair up and complete parts 2 and 3 of the analysis guide. |

| PD Model: Time/Phase | Purpose, Content, and What Participants Do | Slides | Process |
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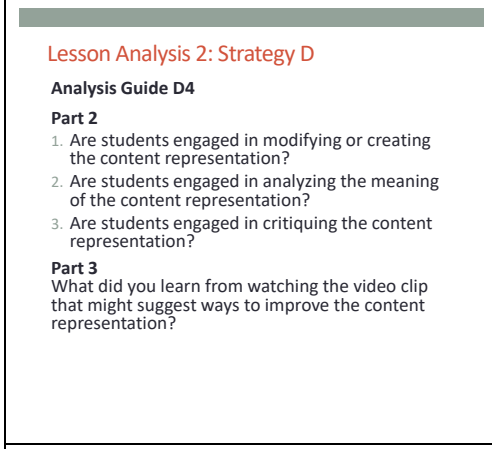
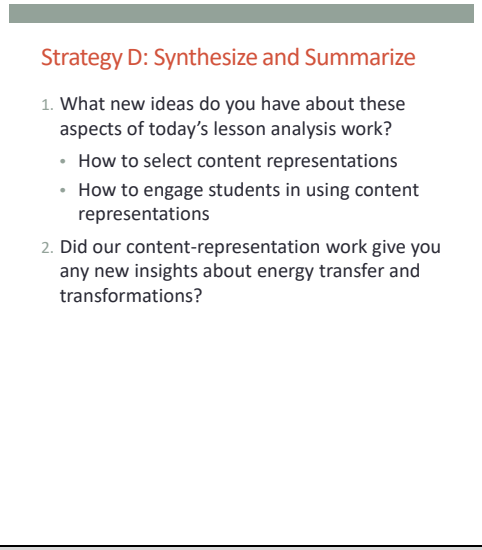
| | |  | **Display Slide 22.** Lesson Analysis 2: Strategy D (15 min)<br><br>a. **Whole group:** Discuss participants' responses to parts 2 and 3 of **Analysis Guide D4**. Challenge participants to support their answers with evidence from the video transcript.<br>b. If it didn't already come up in the discussion, ask participants, "How might the teacher have engaged these students in analyzing or critiquing the representation?" |
| | |  | **Display Slide 23.** Strategy D: Synthesize and Summarize (10 min)<br><br>a. **Individuals (5 min):** Have participants work on the slide questions. Encourage them to use their resources (e.g., the strategies booklet, their Z-fold summary charts, the content background document, notes they've taken).<br>b. **Whole group (5 min):** Have participants share their new ideas for each question in a round-robin format, if time allows. Otherwise, have a couple of volunteers share their ideas for each question. |
| 12:00–12:45<br>45 min | **LUNCH** | | |

| PD Model: Time/Phase | Purpose, Content, and What Participants Do | Slides | Process |
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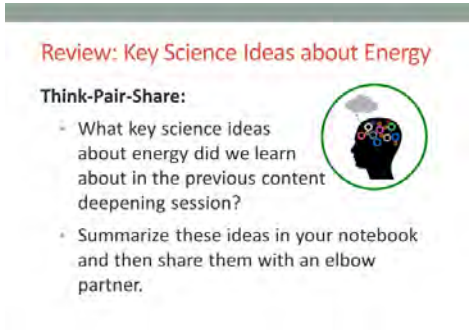
| 12:45–3:15<br>150 min<br>(Includes 10-min break)<br><br>**Content Deepening: Energy Transfer**<br><br>Slides 24–42 | **Purpose**<br>• Deepen participants' science-content knowledge of energy transfer by conducting investigations using content representations and models matched to the learning goal.<br>**Content**<br>• Energy can't be created or destroyed, but it can transfer from object to object and transform from one form to another.<br>**What Participants Do**<br>• Review and summarize key ideas about energy.<br>• Use a content representation to investigate energy transfers and transformations in a system.<br>• Read the conclusion of the story about Mumford and Leroy's big crash.<br>• Create an energy-flow diagram to model the energy transfers and transformations that occurred in Mumford and Leroy's collision.<br>**Handouts in PD Binder**<br>• 7.4 Energy-Beans Worksheet<br>• 7.5 Energy-Beans Procedure<br>**Handouts in Lesson Plans Binder**<br>• 5.1 Mumford and Leroy's Big Crash, Part 4 (from ET lesson 5a) |  | **Display Slide 24.** Content Deepening: Energy Transfer (Less than 1 min)<br>a. **Transition:** This slide marks the transition to the content deepening work.<br>**Note:** Throughout this content deepening phase, refer as needed to the content background document and Common Student Ideas about Energy. |
| | |  | **Display Slide 25.** Review: Key Science Ideas about Energy (8 min)<br>a. **Think-Pair-Share (5 min):** "What key science ideas about energy did we learn about in the previous content deepening session? Summarize these ideas in your notebooks and then share them with an elbow partner."<br>**Note:** If participants need a refresher on the definition and characteristics of science ideas, have them reread the information in the STeLLA strategies booklet (Student Ideas and Science Ideas Defined).<br>b. **Whole group (3 min):** Invite participants to share their ideas with the group.<br>c. During this share-out, record key ideas on chart paper. Combine similar ideas into one statement on the chart. |

| PD Model: Time/Phase | Purpose, Content, and What Participants Do | Slides | Process |
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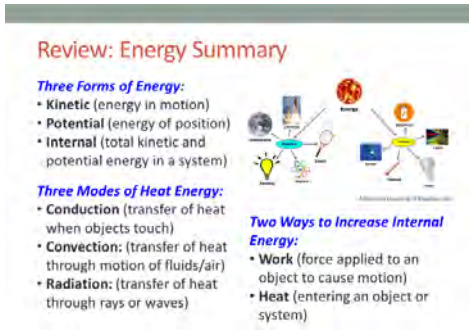
| | **Supplies**<br>• For energy-beans investigation (per pair of participants):<br>  • Six 1-ounce plastic cups<br>  • 30 dried pinto beans<br>**PD Resources**<br>• Science notebooks<br>• RESPeCT lesson plans binder<br>**Resources in Lesson Plans Binder**<br>*Resources section:*<br>• Content background document<br>• Common Student Ideas |  | **Display Slide 26.** Review: Energy Summary (10 min)<br>a. Summarize the key concepts on the slide from the previous content deepening session.<br>b. Have participants locate the content background document in their lesson plans binders.<br>c. **Individuals:** Ask participants to scan the document and identify key concepts about energy that reflect their content deepening work from the past two sessions. Make sure they note the relevant sections in the content background document.<br>d. **Whole group:** Invite participants to share their findings with the group and cite the relevant sections in the content background document that match concepts discussed in content deepening sessions.<br>e. As participants share their findings, record them on chart paper. |

| PD Model: Time/Phase | Purpose, Content, and What Participants Do | Slides | Process |
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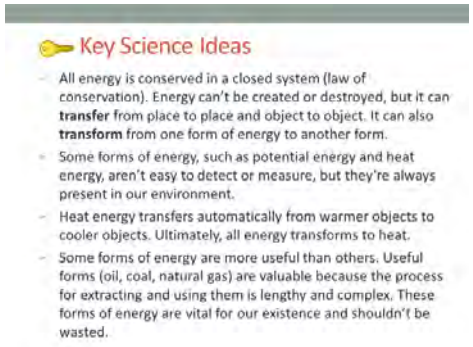
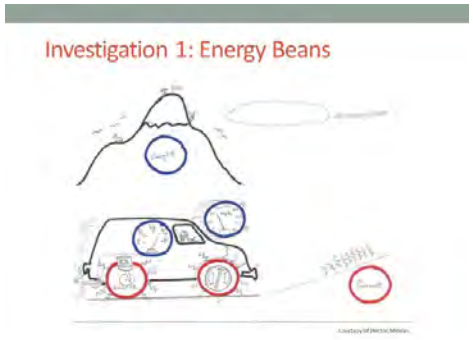
| | |  | **Display Slide 27.** Key Science Ideas (8 min)<br><br>a. Read the key science ideas on the slide.<br>b. **Whole-group discussion:** "Does everyone agree with these ideas based on our energy review? Would you like to add or revise anything?<br>c. Have participants copy these ideas into their science notebooks.<br>d. Ask participants, "How might we represent these concepts for our students as we teach the Energy Transfer unit?"<br>e. During this discussion, copy participants' ideas on chart paper. Probe participants' responses and differing views.<br>f. "Next, we'll explore how we can facilitate student understandings of energy transfer using content representations and models." |
| | |  | **Display Slide 28.** Investigation 1: Energy Beans (10 min)<br><br>a. Distribute handouts 7.4 (Energy-Beans Worksheet) and 7.5 (Energy-Beans Procedure).<br>b. Walk participants through the information on handout 7.5.<br>c. Emphasize that in this investigation, participants will explore energy transfers and transformations in a system. The system is a gas-powered car driving up a |

| PD Model: Time/Phase | Purpose, Content, and What Participants Do | Slides | Process |
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| | | | hill, the beans represent energy, and the cups represent four possible forms of energy: chemical energy, kinetic energy, gravitational potential energy, and internal energy. Energy transfers can take place in the system through work or heat. Energy transfers out of the system when beans are moved out of a cup and placed in the atmosphere. Energy transformations take place when beans are moved from cup to cup, signifying that energy has changed from one form to another.<br>d. Ask participants to study the diagram on handout 7.4. Highlight the form of energy each object represents:<br>• Mountain = gravitational potential energy<br>• Speedometer = kinetic energy<br>• Fuel-tank meter = chemical energy<br>• Engine piston (red rear wheel) = internal energy (performs work on wheels to give the car kinetic energy)<br>• Brakes (red front wheel) = internal energy (converts to heat energy when brakes are applied, which reduces car's kinetic energy)<br>• Pavement (red circle) = internal energy (converts to heat energy from wheels' rolling friction and braking)<br>• Atmosphere = heat energy (end destination of any heat that transfers away from the red objects) |

| PD Model: Time/Phase | Purpose, Content, and What Participants Do | Slides | Process |
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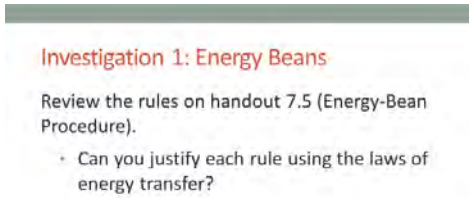
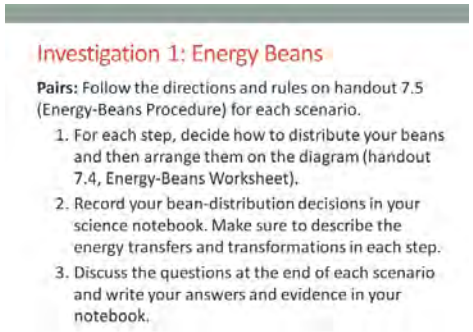
| | |  | **Display Slide 29.** Investigation 1: Energy Beans (5 min)<br><br>a. Highlight the rules on handout 7.5 (Energy-Beans Procedure).<br>b. Ask participants, "Can you justify each rule using the laws of energy transfer?" |
| | |  | **Display Slide 30.** Investigation 1: Energy Beans (25 min)<br><br>a. Have participants pair up; then distribute 30 beans and six plastic or paper cups to each pair.<br>b. Review the directions on the slide.<br>c. **Pairs:** Direct pairs to work through each scenario on the handout, deciding how to distribute their beans for each step and arranging them on the worksheet (handout 7.4) to reflect their decisions. Have participants record their bean-distribution decisions in their science notebooks and describe the energy transfers and transformations that take place in each step. Then have pairs discuss the questions at the end of each scenario and write their answers and evidence in their notebooks.<br><br>**Note:** A specific quantity of beans should be moved from object to object or place to place in each step of the scenario (e.g., from the |

| PD Model: Time/Phase | Purpose, Content, and What Participants Do | Slides | Process |
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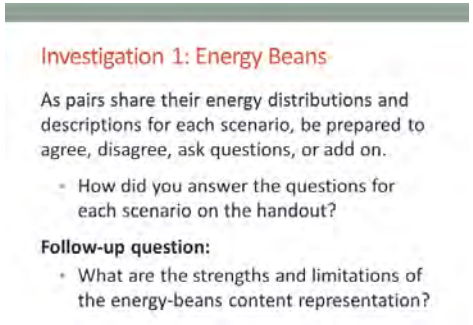
| | | | gas tank to the engine to the atmosphere). Example from scenario 2:<br>• *Idling:* One energy bean goes from the gas tank to the engine and out of the exhaust pipe into the atmosphere.<br>• *Accelerating:* Two or three energy beans work to accelerate the car to a constant speed.<br>• *Cruising:* One energy bean per minute is the cost to sustain a constant speed. The only work performed is against the friction between the tires and the road.<br>• *Climbing:* The engine must now work against gravity, which costs two energy beans per minute. |
| | |  | **Display Slide 31.** Investigation 1: Energy Beans (10 min)<br>a. **Whole-group discussion:** Invite one or two pairs to share their energy distributions and descriptions for each scenario, as well as their answers to the questions on the handout. Probe participants' decisions and reasoning. Encourage others to agree, disagree, ask questions, or add on.<br>b. During this discussion, record key ideas on chart paper.<br>c. At the end of the discussion, ask participants to evaluate the strengths and limitations of the energy-beans content representation. |

| PD Model: Time/Phase | Purpose, Content, and What Participants Do | Slides | Process |
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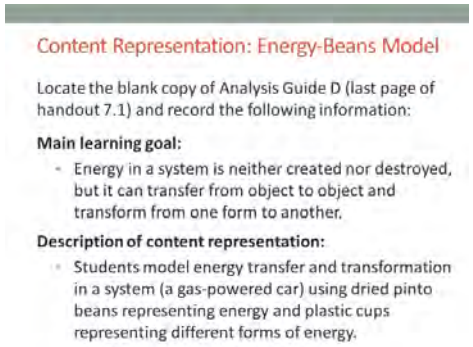
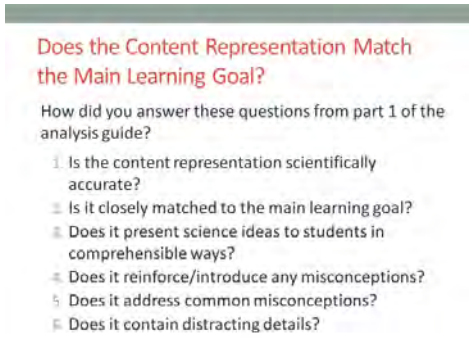
| | |  | **Display Slide 32.** Content Representation: Energy-Beans Model (10 min)<br><br>**Note:** If time is running short, work as a group on part 1 of Analysis Guide D.<br><br>a. Have participants locate the blank copy of Analysis Guide D on page 5 of handout 7.1 and copy the learning goal and description from the slide onto the handout.<br><br>b. **Pairs:** Direct participants to work with their partners to complete part 1 of the guide. |
| | |  | **Display Slide 33.** Does the Content Representation Match the Main Learning Goal? (5 min)<br><br>a. Discuss participants' responses to the questions in part 1 of the analysis guide. |
| | **10-MINUTE BREAK** | | |

| PD Model: Time/Phase | Purpose, Content, and What Participants Do | Slides | Process |
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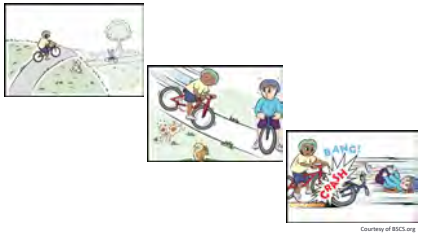
| | | Content Deepening: Focus Question<br>Where does energy come from? Where does it go? | **Display Slide 34.** Content Deepening: Focus Question (Less than 1 min)<br>a. Read the focus questions on the slide.<br>b. Emphasize that these questions will guide student learning throughout ET lesson 5a.<br>c. Ask participants to write the focus questions in their science notebooks and draw a box around them. |
| | | Mumford and Leroy's Big Crash!<br>  | **Display Slide 35.** Investigation 2: Mumford and Leroy's Big Crash (10 min)<br>a. Have participants locate handout 5.1 (Mumford and Leroy's Big Crash, Part 4) in their lesson plans binders.<br>b. Read the first page of the handout aloud and pose the questions at the bottom of the page.<br>c. **Pairs:** Have participants discuss these questions with their partners from the previous investigation and write their answers in their science notebooks.<br>d. **Whole group:** Finish reading the handout aloud as participants highlight key energy words and sentences in their handouts. |

| PD Model: Time/Phase | Purpose, Content, and What Participants Do | Slides | Process |
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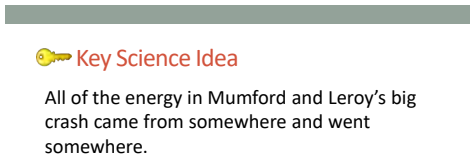
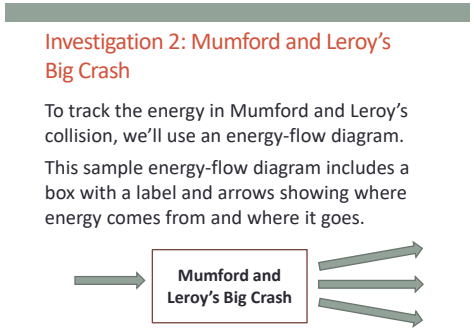
| | |  | **Display Slide 36.** Key Science Idea (Less than 1 min)<br><br>a. Highlight the key science idea on the slide. |
| | |  | **Display Slide 37.** Investigation 2: Mumford and Leroy's Big Crash (2 min)<br><br>a. "Next, we'll track the energy transfers and transformations in the story using an energy-flow diagram."<br><br>b. "The sample diagram on the slide includes a box with a label and arrows indicating where energy comes from and where it goes." |

| PD Model: Time/Phase | Purpose, Content, and What Participants Do | Slides | Process |
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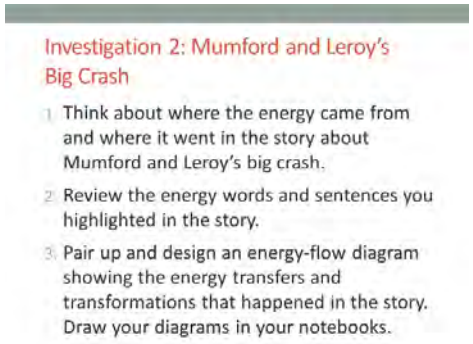
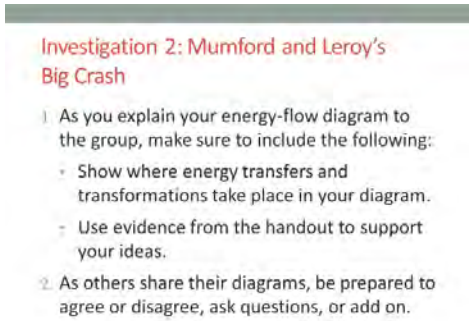
| | |  | **Display Slide 38.** Investigation 2: Mumford and Leroy's Big Crash (10 min)<br><br>a. Read the instructions on the slide.<br>b. Circulate around the room as pairs work on their energy-flow diagrams. Answer questions and probe participants' thinking as needed. |
| | |  | **Display Slide 39.** Investigation 2: Mumford and Leroy's Big Crash (10 min)<br><br>a. Invite pairs to share their energy-flow diagrams with the group, describing where energy transfers and transformations happened in the story.<br>b. "As others present their energy-flow diagrams, listen carefully and be prepared to agree or disagree, ask questions, or add on."<br>c. During this discussion, encourage participants to use evidence (words, phrases, or sentences) from the story to support their ideas and comments. |

| PD Model: Time/Phase | Purpose, Content, and What Participants Do | Slides | Process |
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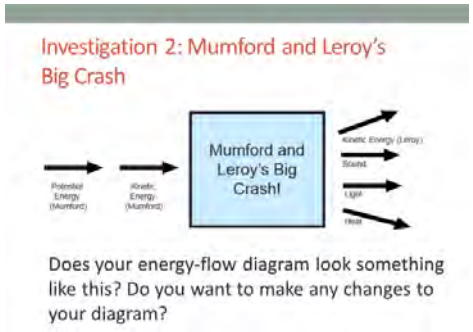
| | |  | **Display Slide 40.** Investigation 2: Mumford and Leroy's Big Crash (5 min)<br><br>a. Highlight the energy-flow diagram on the slide.<br>b. Ask participants, "Does your energy-flow diagram look something like this? In what ways is your diagram similar to or different from this diagram?"<br>c. Give participants an opportunity to revise their energy-flow diagrams based on this discussion. |
| | |  | **Display Slide 41.** Reflect: Content Deepening Focus Question (5 min)<br><br>a. Review the focus question on the slide.<br>b. Invite participants to share their ideas for answering the question, using science ideas about energy and evidence from the story about Mumford and Leroy's collision and their energy-flow diagrams.<br>c. Encourage participants to agree, disagree, ask questions, or add to the ideas others share. |

| PD Model: Time/Phase | Purpose, Content, and What Participants Do | Slides | Process |
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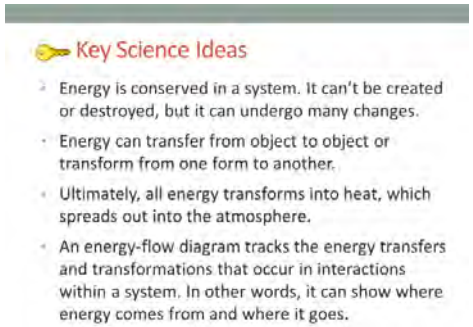
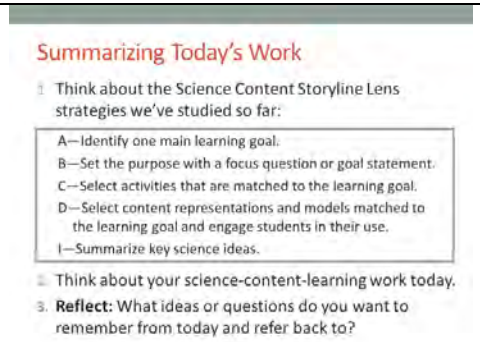
| | |  | **Display Slide 42.** Key Science Ideas (5 min)<br><br>a. Review the key science ideas on the slide that answer the focus question. Emphasize that participants' observations and evidence from the investigations helped shape these responses.<br>b. **Whole-group discussion:** "Does everyone agree with these ideas? Would you like to add or revise anything?"<br>c. Have participants copy these science ideas into their science notebooks under the focus question. |
| 3:15–3:30<br>15 min<br><br>**Wrap-Up: Summary, Homework, and Reflections**<br><br>Slides 43–45 | **Purpose**<br>• Summarize and reflect on key ideas about SCSL strategies A, B, C, D, and I and the Energy Transfer science content, lesson plans, and lesson analysis work.<br>**What Participants Do**<br>• Write about and share key ideas from SCSL strategies A, B, C, D, and I.<br>• Write about and share key ideas about today's content deepening |  | **Display Slide 43.** Summarizing Today's Work (6 min)<br><br>a. **Individuals (4 min):** Ask participants to think about the first two tasks on the slide and respond to the reflection question in their notebooks.<br>b. **Whole group (2 min):** Ask for volunteers to share an idea or question from their responses to the reflection question. |

| PD Model: Time/Phase | Purpose, Content, and What Participants Do | Slides | Process |
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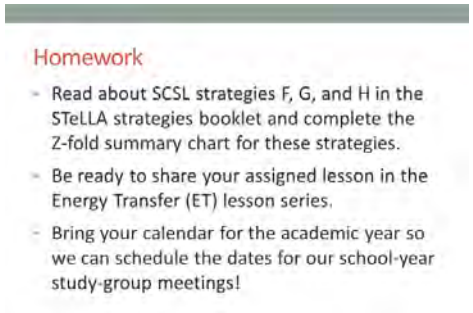
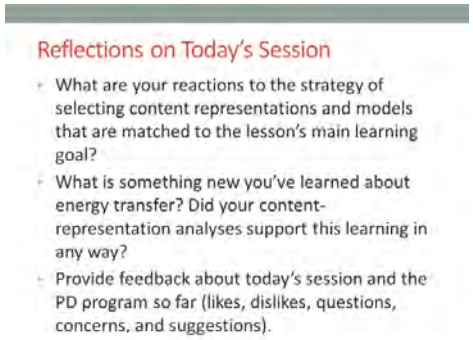
| | work.<br>• Copy down the homework assignment for day 8.<br>• Write reflections on today's learning.<br><br>**Handouts in PD Binder**<br>• 7.6 Daily Reflections—Day 7<br><br>**Supplies**<br>• Science notebooks |  | **Display Slide 44.** Homework (3 min)<br><br>a. Review the homework assignment and have participants write it in their notebooks.<br>b. Make sure participants understand the assignment.<br>c. "We won't address strategy E about sequencing science ideas and activities until the school year, since you'll learn a lot about sequencing from teaching the RESPeCT lesson plans." |
| | |  | **Display Slide 45.** Reflections on Today's Session (6 min)<br><br>a. Allow **at least 5 minutes** for participants to think about today's session and write their reflections and feedback on the Daily Reflections sheet (handout 7.6 in PD program binder). |