RESPeCT Summer Institute Professional Development Leader Guide (PDLG)

Grade Level	3	Day	6	STeLLA Strategy	SCSL Strategies B, C, and I STL Strategy 7	Subject Matter Focus	Forces
Focus Questions	• How can we begin and end a lesson to help students develop a coherent science content storyline? • How can selecting appropriate science activities help students develop a coherent science content storyline? • Why do moving objects slow down and eventually stop? • What force makes a moving object slow down and eventually stop?						
Main Learning Goals	Participants will understand the following: • STeLLA strategies B, I, and 7 are like bookends that mark the beginning and end of a lesson. The science ideas in the summary should match the focus question from the beginning of the lesson, and both the focus question and the summary should match the lesson's main learning goal. • Activities should be selected because they will help students engage in making sense of the main learning goal, not because they're fun, easy to do, or only topically related. Therefore, activities must be closely matched to the main learning goal. • Friction is a motion-resistant force created when the surfaces of two objects roll or slide across each other. • Friction depends on the surface composition of two objects that are sliding or rolling across each other. • Friction depends on the normal force exerted between two objects sliding or rolling across each other. • Friction slows down an object in motion.						

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 5 and create a summary slide. • Watch video clips and anticipate participant	**Posters and Charts** • STeLLA Framework and Strategies poster • Day-6 Agenda (chart) • Day-6 Focus Questions (chart) • Norms for Working Together (chart) • Strategy charts from days 1–5 (STL strategies 1–6 and SCSL strategy A) • Parking Lot poster **Handouts in RESPeCT PD Binder Front Pocket** • Participants' SCSL and STL Z-fold summary charts **Handouts in RESPeCT PD Binder, Day 6** • 6.1 Analysis Guides B and I: Setting the Purpose and Summarizing Key Science Ideas	Video clips from one Forces lesson: • Video Clip 6.1: Torres classroom (strategy B, beginning of lesson); 6.1_mspcp_gr.3.forces_torres_L1_c1–2 • Video Clip 6.2: Torres classroom (strategy I, end of lesson); 6.2_mspcp_gr.3.forces_torres_L1_c5 Video clips from another Forces lesson: • Video Clip 6.3: Torres classroom (strategy C); 6.3_mspcp_gr.3.forces_torres_L3_c1 • Video Clip 6.4: Torres classroom (strategy C); 6.4_mspcp_gr.3.forces_torres_L3_c2 • Video Clip 6.5: Torres classroom (strategy C); 6.5_mspcp_gr.3.forces_torres_L3_c3

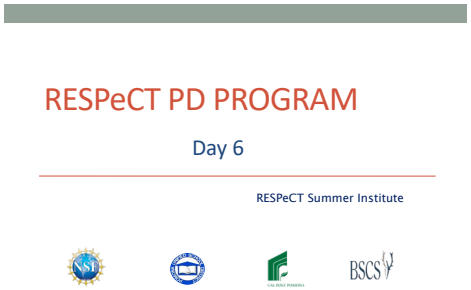
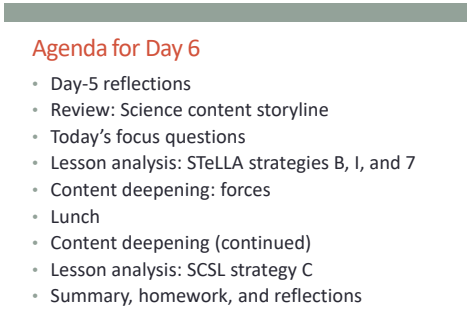
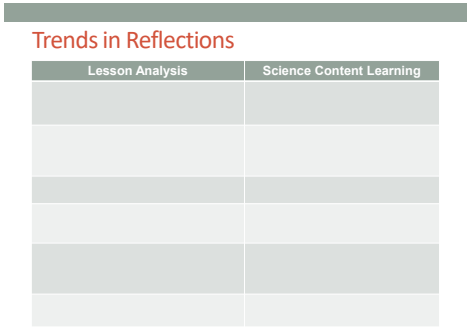
responses.
• Prepare charts for the day's agenda and focus questions.
• Review the activities for Forces lessons 3a/b, and 4a/b in the lesson plans binder.
• For content deepening:
  • Assemble the materials for the ramp investigation (see Supplies section). Glue a strip of sandpaper to the underside of the strip of tile for each team. (The setup should look like the model on PowerPoint slide 20.)
  • On chart paper, create a class data table (chart) for teams to record the middle distance the car traveled over the carpet, tile, and sandpaper. (Use the table on PowerPoint slide 22 as a model.)
  • Follow the instructions in Forces lesson 4a (overview page) for assembling the hand-strip model using handout 6.9 (Hand Strip).
	• 6.2 Transcript for Video Clip 6.1
	• 6.3 Transcript for Video Clip 6.2
	• 6.4 Analysis Guide C: Selecting Activities Matched to the Learning Goal
	• 6.5 Transcript for Video Clip 6.3
	• 6.6 Transcript for Video Clip 6.4
	• 6.7 Transcript for Video Clip 6.5
	• 6.8 Does the Surface Matter? (from Forces lessons 3a/b)
	• 6.9 Hand Strip (Teacher Master) (from Forces lesson 4a)
	• 6.10 Friction and Rolling Soccer Balls
	• 6.11 Friction and Sliding Hockey Pucks
	• 6.12 Pushing a Box against Static Friction
	• 6.13 Moving a Refrigerator
	• 6.14 Daily Reflections—Day 6
	
	Handouts in RESPeCT Lesson Plans Binder
	• 4.2 Friction (from Forces lesson 4b)
	
	PD Leader Masters, Days 5–8
	• PD Leader Master: Analysis Guide C: Selecting Activities Matched to the Learning Goal (Answer Key)
	
	Supplies
	• Science notebooks
	• Chart paper and markers
	• Black and red pens (or markers)
	• For ramp investigation from lessons 3a/b: (1 setup per team):
	  • Wood strip
	  • 1–2 wood blocks to support the ramp
	  • Toy car
	  • Strip of carpet (4 ft long)
	  • Strip of smooth tile (4 ft long)
	  • Strip of sandpaper (4 ft long; glued to underside of tile)
	  • Meter stick
	• For hand-strip investigation from lessons 4a/b:
	  • 1 ramp setup (from lessons 3a/b)	

	• Hand strip • Hand lens (magnifying glass) (1 per pair) **PD Resources** • STeLLA strategies booklet • RESPeCT PD program binder • RESPeCT lesson plans binder **Resources in Lesson Plans Binder** *Resources section:* • Forces and Motion: Content Background Document • Common Student Ideas about Forces and Motion	

DAY 6 SESSION OUTLINE

Time	Activities	Purpose
8:00–8:30 30 min	**Getting Started: Housekeeping, Agenda, Day-5 Reflections, Focus Questions**	• Build community by sharing participants' reflections from day 5. • Set the stage for a day of learning.
8:30–10:10 100 min (Includes 10-min break)	**Lesson Analysis: STeLLA Strategies, B, I, and 7**	• Use lesson analysis of classroom videos to better understand STeLLA strategies B, I, and 7. • Deepen participants' science-content knowledge of forces through lesson analysis.
10:10–12:00 110 min	**Content Deepening: Forces**	• Deepen participants' science-content knowledge of forces by conducting investigations from Forces lessons 3a/b and 4a/b. • Expand participants' science-content knowledge of frictional forces.
12:00–12:45 45 min	**LUNCH**	
12:45–1:15 30 min	**Content Deepening (Continued)**	• Expand participants' science-content knowledge of friction and frictional forces.
1:15–3:15 120 min (Includes 10-min break)	**Lesson Analysis: SCSL Strategy C**	• Use lesson analysis of classroom videos to better understand SCSL strategy C. • Deepen participants' science-content knowledge of forces through lesson analysis.
3:15–3:30 15 min	**Wrap-Up: Summary, Homework, and Reflections**	• Summarize and reflect on key ideas about STeLLA strategies B, I, 7, and C, and the Forces science content.

DAY 6

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
8:00–8:30 30 min **Getting Started** Slides 1–6	**Purpose** • Build community by sharing participants' reflections from day 5. • Set the stage for a day of learning. **What Participants Do** • Review the day's agenda. • Discuss reflections from day 5. • Review key areas of learning from day 5. • Read today's focus questions. **Posters and Charts** • STeLLA Framework and Strategies poster • Day-6 Agenda (chart) • Day-6 Focus Questions (chart) **Supplies** • Science notebooks		**Display Slide 1.** RESPeCT PD Program (5 min) a. Take care of any housekeeping issues.
			**Display Slide 2.** Agenda for Day 6 (5 min) a. Go over the agenda for the day.
			**Display Slide 3.** Trends in Reflections (7 min) a. Give participants time to review your feedback on their reflections from day 5 and offer reactions, comments, or follow-up questions.

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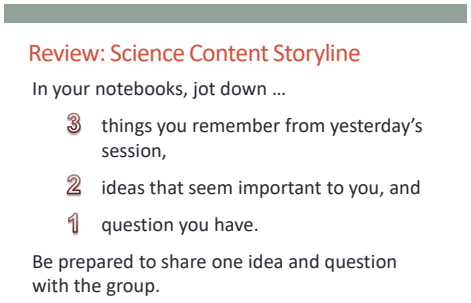
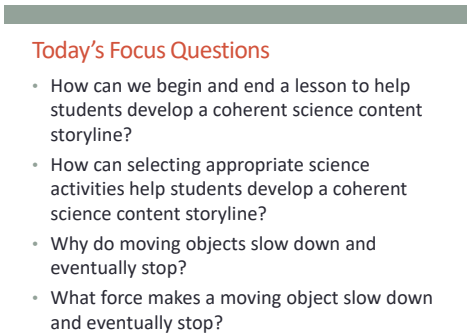
			**Display Slide 4.** Review: Science Content Storyline (10 min) a. Point out the three tasks on the slide. Allow 4–5 minutes for participants to write their responses in their science notebooks. b. Have each participant share one idea about the science content storyline that she or he thinks is really important. c. Then ask participants to share their questions. If you can answer them quickly, go ahead and do so. If a question needs a more detailed response, write it down and schedule a time to address it.
			**Display Slide 5.** Today's Focus Questions (2 min) a. Introduce today's focus questions.

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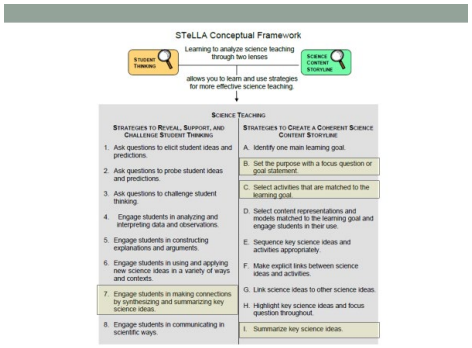
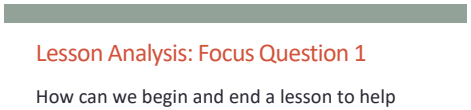
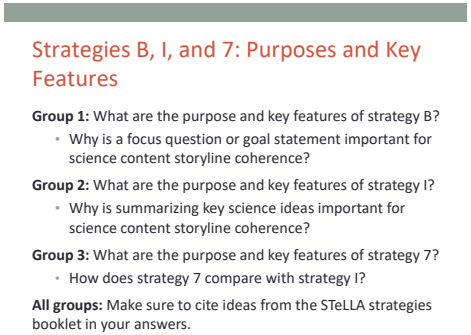
			**Display Slide 6.** STeLLA Conceptual Framework (1 min) a. "Today we'll be looking at four new STeLLA strategies. Three of them are Science Content Storyline Lens strategies, and one is a Student Thinking Lens strategy. Throughout the session, think about how these strategies are different from one another and how they are closely linked to each other."
8:30–10:10 100 min (Includes 10-min break) **Lesson Analysis: STeLLA Strategies B, I, and 7** Slides 7–14	**Purpose** • Use lesson analysis of classroom videos to better understand STeLLA strategies B, I, and 7. • Deepen participants' science-content knowledge of forces through lesson analysis. **Content** • Strategies B, I, and 7 are like bookends that mark the beginning and end of a lesson. The science ideas used in the summary should match the focus question from the beginning of the lesson, and both the focus question and the summary should match the lesson's main learning goal. • The Forces science content emerges from video-based lesson analysis. **What Participants Do**		**Display Slide 7.** Lesson Analysis: Focus Question 1 (Less than 1 min) a. "Now let's dig into our first focus question."
			**Display Slide 8.** Strategies B, I, and 7: Purposes and Key Features (25 min) a. **Pairs (3 min):** Direct participants to retrieve their Z-fold summary charts and share with a partner what they learned from their homework assignment about STeLLA strategies B, I, and 7. b. **Small groups (12 min):** Divide participants into three small groups and have them make charts that capture the purposes and key

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	• Make, share, and discuss charts summarizing the purposes and key features of strategies B, I, and 7. • Discuss questions about strategies B, I, and 7. • Analyze video clips from the beginning and end of a Forces lesson. • Study the main learning goal (MLG), focus question, and summary in a Forces lesson plan. **Videos** • Video Clip 6.1, Torres classroom (beginning of lesson) • Video Clip 6.2, Torres classroom (end of lesson) **Handouts in PD Binder** • 6.1 Analysis Guides B and I • 6.2 Transcript for Video Clip 6.1 • 6.3 Transcript for Video Clip 6.2 **Supplies** • Science notebooks • Chart paper and markers **PD Resources** • STeLLA strategies booklet • RESPeCT lesson plans binder • Participants' SCSL and STL Z-fold summary charts (front pocket of PD binder)		features of the three strategies. **Note:** Challenge participants to imagine themselves in a Teacher Leader role. Ask them, "How would you explain these strategies to the teachers you're leading?" c. **Whole group (10 min):** Have small groups share their charts in a whole-group share-out. **Key ideas:** • Make sure participants understand that a focus question is designed to do more than just get students interested in the lesson. It gets them thinking about a phenomenon or something else they've never thought about before. It also reveals important things about the knowledge and experiences they're bringing to the lesson, it conceptually situates the learning, and it's referred to throughout the lesson. • STeLLA strategies B, I, and 7 are like bookends that mark the beginning and end of a lesson. The science ideas used in the summary should match the focus question from the beginning of the lesson, and both the focus question and the summary should match the lesson's main learning goal.

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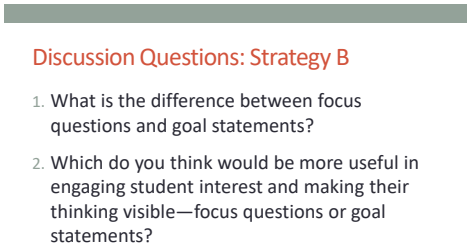
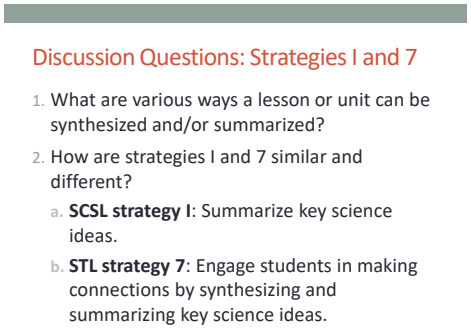
			**Display Slide 9.** Discussion Questions: Strategy B (7 min) a. **Whole group:** Discuss the questions on the slide as a group. **Key ideas:** • A focus question is designed to be answered using the lesson's main learning goal and supporting science ideas. A goal statement describes the main science idea to be learned. • Focus questions are always used in RESPeCT lesson plans because they're useful in engaging student interest, making their thinking visible, and eliciting initial ideas at the beginning of a lesson. When posed at the end of a lesson, focus questions challenge students to use new ideas developed during the lesson.
			**Display Slide 10.** Discussion Questions: Strategies I and 7 (7 min) a. **Whole group:** Discuss the first question on the slide. Participants can refer to the information on strategy 7 in the STeLLA strategies booklet to identify a variety of ways in which key science ideas in a lesson can be synthesized. b. **Emphasize:** "Toward the end of a unit, an entire lesson may be devoted to strategy 7, which engages students in synthesizing and summarizing science ideas across several lessons." c. Discuss the second question on the slide. **Key ideas:** • In strategy I, the *teacher* creates a summary of

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			key science ideas in the lesson. Strategy 7, however, engages *students* in synthesizing and summarizing key science ideas in the lesson. When *students themselves* perform this work, it makes their thinking visible, engages them in active sensemaking, and reveals to the teacher any misunderstandings or gaps in knowledge. Using both strategies brings coherence to a science lesson and is a powerful way to end it. • In strategy 7, summarizing involves making connections between key science ideas, which helps students *synthesize* the main learning goal or big idea in a lesson. • Summaries should focus on key science ideas, not activities; that is, focusing on "what we *learned*" versus "what we *did*." • For a variety of reasons, a lesson sometimes ends before the main learning goal has been fully developed. However, summarizing work should still take place. For example, the teacher might say, "Our focus question today was *How do plants get their food?* What have we found out so far?" After students respond, the teacher could reply, "Yes, so far we've discovered that water and soil aren't food for plants. But we still haven't figured out what *is* food for plants. We'll continue working on this question next time."

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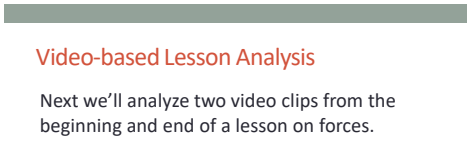
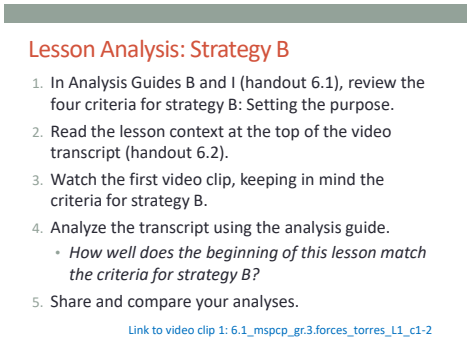
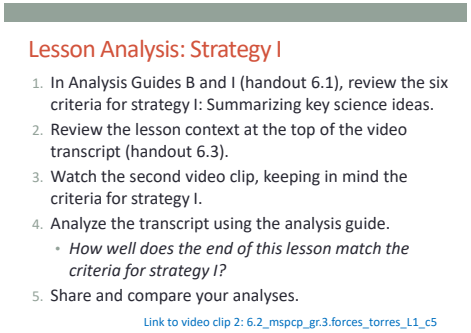
			**Display Slide 11.** Video-based Lesson Analysis (Less than 1 min) a. **Transition:** This slide marks the transition to video-based lesson analysis.
			**Display Slide 12.** Lesson Analysis: Strategy B (20 min) a. Have participants locate Analysis Guides B and I (handout 6.1 in PD program binder) and spend 1 or 2 minutes reading the criteria for strategy B: Setting the purpose. b. **Ask:** "Do you have any questions about these criteria?" c. **Emphasize:** "Keep the criteria for strategy B in mind as you watch the first video clip from the beginning of a lesson on forces." d. **Individuals:** Give participants a couple of minutes to read and think about the lesson context at the top of the video transcript (handout 6.2). e. Show the video clip. f. **Whole group:** "How well does the beginning of

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			this lesson match the criteria for strategy B?" **Note:** During the discussion, be on the lookout for opportunities to clarify science-content ideas. **Ideal responses for questions from Analysis Guide B:** 1. **Implied main learning goal:** Forces (pushes, pulls) cause things to move. 2. **Uses everyday language:** Yes, the focus question uses everyday language ("What might cause something to move?"). 3. **Scientifically accurate:** The focus question is presented in a scientifically accurate way. 4. **Goal statement:** Not applicable.
			**Display Slide 13.** Lesson Analysis: Strategy I (20 min) a. Allow participants 1 or 2 minutes to read the six criteria in the analysis guide for strategy I: Summarizing key science ideas. b. **Ask:** "Do you have any questions about these criteria?" c. **Emphasize:** "Keep the criteria for strategy I in mind as you watch the next video clip from the end of the same Forces lesson." d. **Individuals:** Give participants a couple of minutes to review the lesson context at the top of the video transcript (handout 6.3). e. Show the second video clip. f. **Whole group:** "How well does the end of this lesson match the criteria for strategy I? How well does the summary statement match the beginning of the lesson?"

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			Note: During the discussion, be on the lookout for opportunities to clarify science-content ideas. **Ideal responses for questions from Analysis Guide I:** 1. **Summary statement/activity:** Yes, the teacher engages students in summarizing key ideas from the activity (video segment 00:03–02:18). Then students write what they learned about the focus question, which is another summarizing activity. 2. **Conceptual understanding:** Yes, the summary discussion focuses on using the conceptual idea of forces to explain how things move. 3. **Matched to the MLG and FQ:** Yes, the summary is matched to the focus question. In fact, in the final summary activity, students write an answer to the focus question. 4. **Scientifically accurate:** The summary discussion is scientifically accurate; however, from segments 00:35–00:37, the teacher pushed (or led) the student to be more accurate by saying that a pushing force, not a hand, caused the block to move. 5. **Sensemaking:** Yes, students are engaged in making sense of the summary both during the discussion and in the writing/drawing task. 6. **Improvements:** After affirming students' use of the words *push* and *force* (segments 00:37–01:13), the teacher could have included examples of pulling forces. 7. **A missed opportunity:** When a student refers to gravity (segment 02:09), the teacher could have asked students whether gravity is a push or a pull. That would link this unexpected response to the day's learning goal, since gravity isn't a focus in this lesson.

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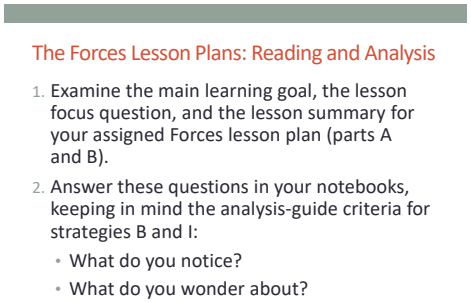
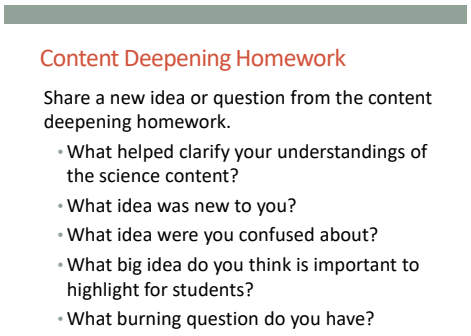
			**Display Slide 14.** The Forces Lesson Plans: Reading and Analysis (10 min) **Note:** This slide can be abridged or skipped if time is running short. a. Read the instructions on the slide and assign a two-part lesson plan (parts A and B) to each participant. b. Ask participants if they have any questions about the assignment. c. **Individual reading-and-analysis time (5 min):** "Answer the slide questions in your notebooks, keeping in mind the analysis-guide criteria." d. **Whole-group discussion (5 min):** Briefly discuss participants' observations and questions for their assigned lesson plans. **Note:** Participants should see a close match between the main learning goal, the lesson focus question, and the summary. However, also welcome critiques and suggestions for improvement. Just make sure critiques are based on good understandings of the strategies involved.
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 **Content Deepening: Forces** Slides 15–50	**Purpose** • Deepen participants' science-content knowledge of forces by conducting investigations from Forces lessons 3a/b and 4a/b. • Expand participants' science-content knowledge of frictional forces. **Content** • Friction is a motion-resistant force created when the surfaces of two objects roll or slide across each other. • Friction depends on the surface composition of two objects that are sliding or rolling across each other. • Friction depends on the normal force exerted between two objects sliding or rolling across each other. • Friction slows down an object in motion. **What Participants Do** • Investigate whether differences in surface textures affect the distance a toy car travels before it stops. • Compare the hand-strip model with the carpet, tile, and		**Display Slide 15.** Content Deepening: Forces (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 Forces and Motion.
			**Display Slide 16.** Content Deepening Homework (3 min) a. Invite participants to briefly share a new idea or question related to the content deepening homework from the previous session. b. Quickly address any misunderstandings or confusion, but don't spend time discussing ideas that will be presented during today's session (e.g., forces in outer space).

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	sandpaper surfaces and identify similarities and differences. • Describe different types of frictional forces in a variety of scenarios. **Handouts in PD Binder** • 6.8 Does the Surface Matter? (from Forces lessons 3a/b) • 6.9 Hand Strip (Teacher Master) (from Forces lesson 4a) • 6.10 Friction and Rolling Soccer Balls • 6.11 Friction and Sliding Hockey Pucks • 6.12 Pushing a Box against Static Friction **Handouts in Lesson Plans Binder** • 4.2 Friction (from Forces lesson 4b) **Supplies** • Science notebooks • Chart paper and markers • Black and red pens (or markers) **PD Resources** • RESPeCT lesson plans binder **Resources in Lesson Plans Binder** *Resources section:* • Content background document • Common Student Ideas	Unit Central Questions What makes something start to move? What makes something stop moving or change direction?	**Display Slide 17.** Unit Central Questions (Less than 1 min) a. Review the unit central questions on the slide. b. Remind participants that these questions will guide student thinking throughout the Forces unit."
		Content Deepening: Focus Question 1 Why do moving objects slow down and eventually stop?	**Display Slide 18.** Content Deepening: Focus Question 1 (Less than 1 min) a. Read the focus question on the slide. b. "To help us answer this question, we'll explore science ideas from Forces lessons 3a and 3b." c. Have participants write the question in their science notebooks and draw a box around it. Make sure they leave space below the question to write a response later.
		Investigation 1: Does the Surface Matter? **Think about this scenario:** Students rolled a soccer ball over three different surfaces: • Grass • Blacktop on the playground • Tile flooring in the school hallway The students tried to use the same force each time. Then they measured how far the ball rolled. **Question:** Do you think the ball traveled the same distance on all three surfaces? Why or why not?	**Display Slide 19.** Investigation 1: Does the Surface Matter? (2 min) a. Introduce the scenario on the slide; then ask, "Do you think the ball traveled the same distance on all three surfaces? Why or why not?" b. Invite participants to share their ideas and reasoning.

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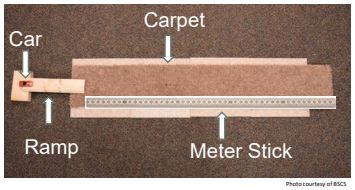
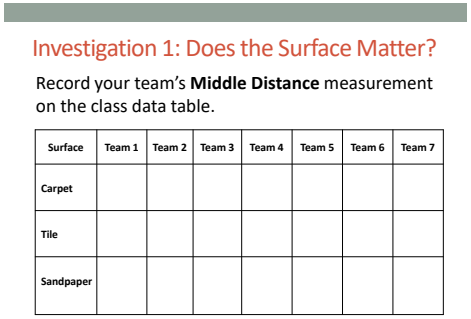
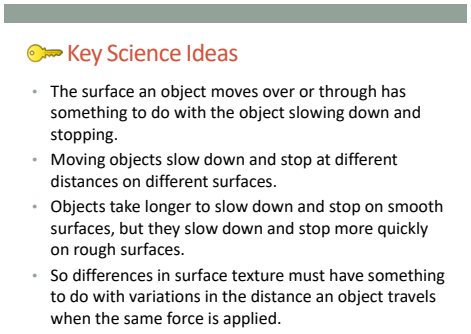
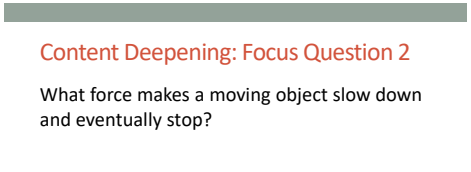
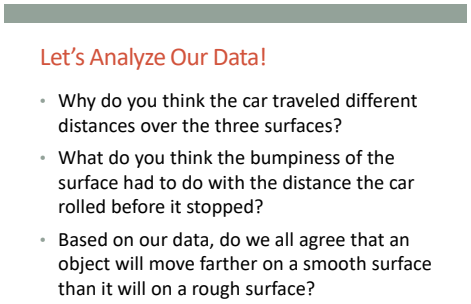
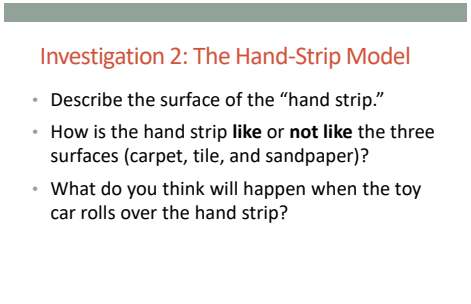
		Investigation 1: Does the Surface Matter?  	**Display Slide 20.** Investigation 1: Does the Surface Matter? (5 min) a. In this investigation, we'll explore whether the surface a toy car rolls over has anything to do with making it slow down and eventually stop. We'll also consider whether differences in surface textures affect the distance the car travels before it stops. b. "Before we break up into teams to conduct the investigation, I'd like you to predict what you think will happen." c. Distribute handout 6.8 (Does the Surface Matter?) and read the overview aloud. d. **Individuals:** Direct participants to answer the questions on page 1 of the handout. e. **Whole group:** Invite a few participants to share their predictions and reasoning with the group. Record predictions on chart paper.
		Investigation 1: Does the Surface Matter? Record your distance measurements on this data table in the handout. Surface | Distance Trial 1 | Distance Trial 2 | Distance Trial 3 | Middle Distance Carpet Tile Sandpaper	**Display Slide 21.** Investigation 1: Does the Surface Matter? (10 min) a. Divide participants into teams and distribute the supplies for the ramp setup. b. Walk participants through the instructions on page 2 of handout 6.8 (Does the Surface Matter?). Encourage them to ask clarification questions as needed. c. Go over the data table on the handout (and

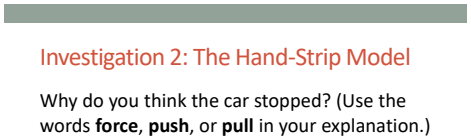
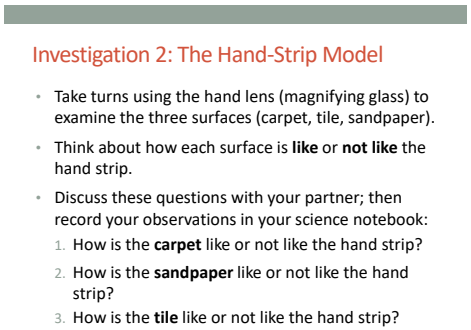
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			slide). Make sure participants understand how to record their measurements for each trial and compute the middle distance. Note that following the activity, each team will add data from their tables to the "class" data table. d. Remind participants not to exert any force on the car at the top of the ramp. They should place it gently on the ramp, let it go, and allow gravity to take over. Also emphasize that they should leave the meter stick in place during the investigation and not pick it up to take measurements. e. Have teams begin the investigation. Circulate among the teams as they work and be available to answer questions or provide support.
			**Display Slide 22.** Investigation 1: Does the Surface Matter? (5 min) a. After teams have finished recording their trial measurements on the handout and computing the middle distances, have them complete step 3 on the handout and add their team's data to the class data table (step 4).

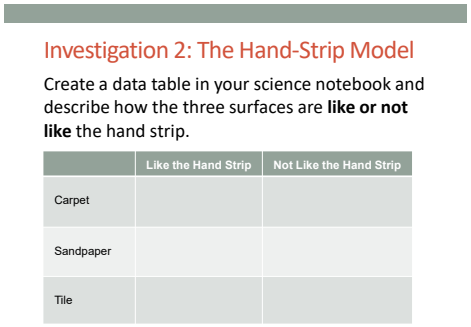
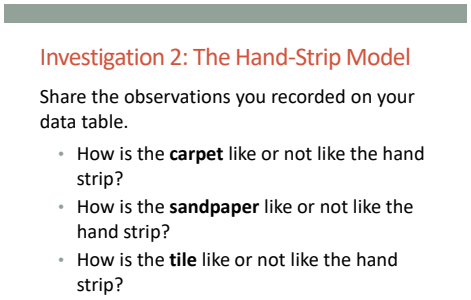
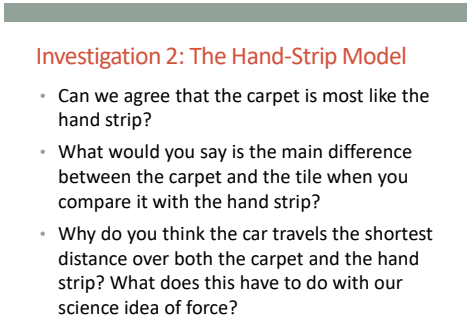
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Investigation 1: Does the Surface Matter? • What patterns do you see in the "class" data? • Do these results match your predictions?	**Display Slide 23.** Investigation 1: Does the Surface Matter? (1 min) a. Briefly discuss the questions on the slide.
		Investigation 1: Does the Surface Matter? **Question 1:** *Why do you think the car traveled different distances over the three surfaces?* • Write your explanation on the handout. • Make sure to support your ideas with evidence from the data table and our investigation.	**Display Slide 24.** Investigation 1: Does the Surface Matter? (3 min) a. Read the first handout question and the tasks on the slide. b. **Individuals:** Ask participants to write their explanations on the handout, making sure to include evidence from the data table and investigation. c. **Whole group:** Invite a few participants to share their explanations and evidence with the group.

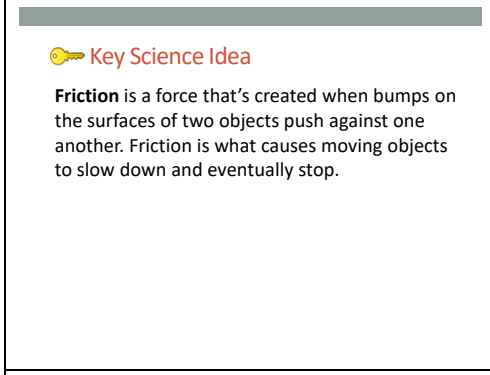
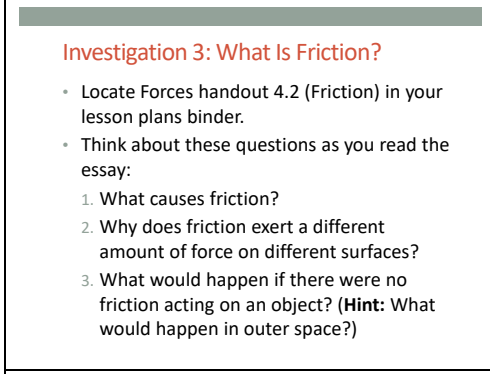
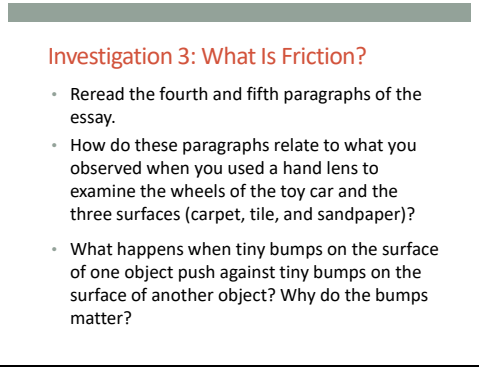
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Investigation 1: Does the Surface Matter? **Question 2:** *If forces make an object start to move, do they also have something to do with making an object stop moving?* Think about this question. Then complete the sentence on the handout: *I think forces [do/do not] have something to do with making an object stop moving because* _____. Use evidence from your investigation to explain your answer.	**Display Slide 25.** Investigation 1: Does the Surface Matter? (4 min) a. Review the second handout question and the tasks on the slide. b. **Individuals:** Ask participants to complete the sentence on the handout, using evidence from the data table and investigation to support their explanations. c. **Whole group:** Invite a few participants to share their explanations and evidence with the group.
		Reflect: Content Deepening Focus Question 1 Why do moving objects slow down and eventually stop?	**Display Slide 26.** Reflect: Content Deepening Focus Question 1 (4 min) a. Revisit the first content deepening focus question. b. **Individuals:** Have participants write a concise answer in their science notebooks using evidence from the ramp investigation. c. **Whole group:** "Do you have any new ideas for answering this question based on our investigation?" d. As participants share, record key ideas on chart paper.

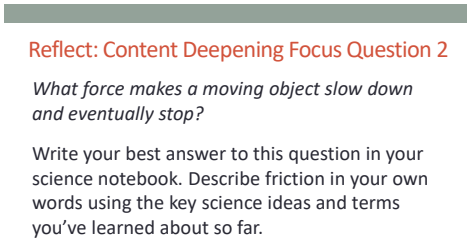
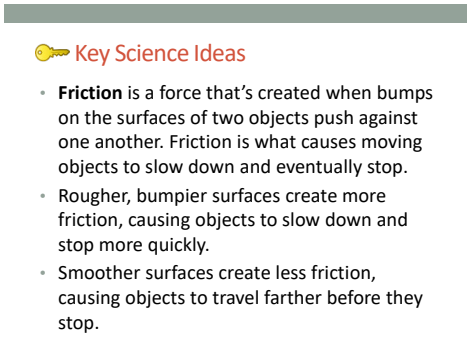
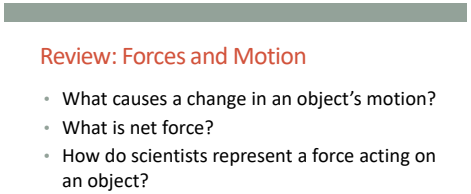
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 27.** Key Science Ideas (Less than 1 min) a. Highlight the key science ideas on the slide. b. **Ask:** "Does everyone agree with these ideas? Would you like to add or revise anything?"
			**Display Slide 28.** Content Deepening: Focus Question 2 (Less than 1 min) a. Read the focus question on the slide. b. Have participants write the question in their science notebooks and draw a box around it. Make sure they leave space below the question to write a response later. c. Emphasize that this focus question will guide student learning throughout Forces lessons 4a and 4b.

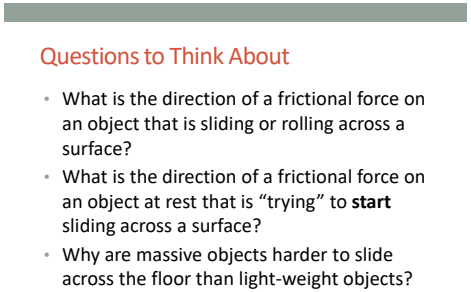
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 29.** Let's Analyze Our Data! (3 min) **Note:** Make sure the "class" data chart is displayed where everyone can see it. a. Briefly review the results on the data chart. b. Ask participants, "What pattern did we identify in the data from our ramp investigation?" **Answer:** The car traveled a greater distance over a smooth surface and a shorter distance over a rough surface. c. Discuss the questions on the slide.
			**Display Slide 30.** Investigation 2: The Hand-Strip Model (5 min) a. "Next, we'll investigate a different kind of surface and see what happens when the toy car rolls over it." b. Introduce the hand-strip model you assembled from handout 6.9 (Hand Strip). c. Ask participants to describe the surface of the hand strip and compare it with the carpet, tile, and sandpaper, noting similarities and differences. d. Ask, "What do you predict will happen when the toy car rolls over this hand strip?" e. Elicit a variety of predictions and record them on chart paper.

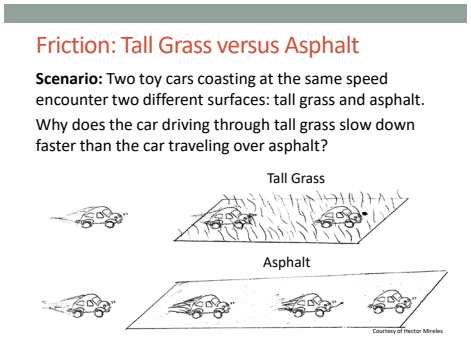
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 31.** Investigation 2: The Hand-Strip Model (4 min) a. Have participants gather around the ramp setup. Make sure the hand strip and meter stick are correctly positioned at the bottom of the ramp. b. Let the toy car run down the ramp and over the hand strip at least two times so participants can see that it travels about the same distance each time before stopping. c. Ask, "Why do you think the car stopped?" d. As participants share their ideas, record them on chart paper.
			**Display Slide 32.** Investigation 2: The Hand-Strip Model (5 min) a. "Let's revisit our ideas about the similarities and differences between the hand strip and the carpet, tile, and sandpaper." b. Have participants pair up with an elbow partner; then give each pair a hand lens (magnifying glass). c. **Pairs:** "Take turns examining the three surfaces with the magnifying glass and think about how each surface is like or not like the hand-strip model. Then discuss the questions on the slide with your partner."

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 33.** Investigation 2: The Hand-Strip Model (2 min) a. "Now I'd like you to create a data table in your science notebooks like the one on this slide." b. "Think about the surfaces you examined with a magnifying glass and record how each surface is like or not like the hand-strip model."
			**Display Slide 34.** Investigation 2: The Hand-Strip Model (2 min) a. Invite participants to share the observations they recorded on their data tables. b. Record key similarities and differences on chart paper as participants share their observations.
			**Display Slide 35.** Investigation 2: The Hand-Strip Model (3 min) a. Discuss the questions on the slide.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 36.** Key Science Idea (Less than 1 min) a. Introduce the key science idea on the slide and ask participants to copy it into their science notebooks.
			**Display Slide 37.** Investigation 3: What Is Friction? (2 min) a. Have participants locate Forces handout 4.2 (Friction) in their lesson plans binders. b. "As you read this essay about friction from Forces lesson 4b, think about the questions on the slide."
			**Display Slide 38.** Investigation 3: What Is Friction? (4 min) a. Reread the fourth and fifth paragraphs of the essay as a group (starting with "When you let go of the toy car" and ending with "That pushing force is the friction that makes a moving object slow down and eventually stop"). b. Discuss the questions on the slide.

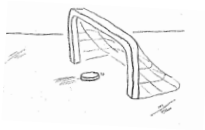
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 39.** Reflect: Content Deepening Focus Question 2 (3 min) a. Review the focus question on the slide. b. Ask participants to write their best answer to the question in their notebooks, describing friction in their own words using the key science ideas and terms they've learned about so far.
			**Display Slide 40.** Key Science Ideas (Less than 1 min) a. Highlight the key science ideas on the slide. b. **Ask:** "Does everyone agree with these ideas? Would you like to add or revise anything?"
			**Display Slide 41.** Review: Forces and Motion (3 min) a. "Before we explore friction in more detail, let's review some key science ideas from our previous content deepening session." b. Briefly discuss the questions on the slide. **Answers:** • **Question 1:** An object's motion changes when a force is exerted on the object. *Forces* are pushes or pulls that occur in an interaction

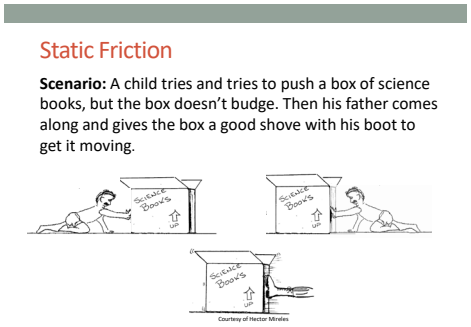
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			between two objects. These pushes or pulls make an object start moving, change speed or direction, or stop moving. In most cases, physical contact is required between two objects for a force to be exerted. *Gravity* is one kind of force that can be exerted without physical contact between two objects. • **Question 2:** *Net force* is the sum of all of the forces acting on an object. Forces acting on an object in the same direction increase the net force. Forces acting on an object in opposite directions can result in a net force of zero. If the net force is zero, there is no change in motion. An object's speed increases when the net force is in the direction of an object's motion and decreases when the net force is in the opposite direction of motion. • **Question 3:** Scientists use arrows or vectors to represent the forces acting on an object. The direction of an arrow indicates the direction of the force, and the length of the arrow represents the strength of the force. The longer the arrow, the stronger the force exerted on an object.
			**Display Slide 42.** Questions to Think About (Less than 1 min) a. Read the questions on the slide. b. "These questions will guide our content deepening work for the rest of the session."

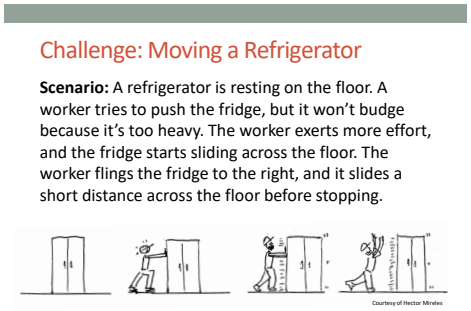
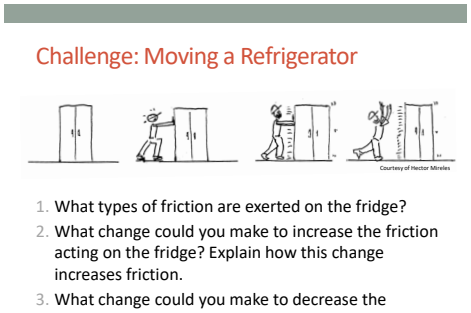
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 43.** Friction: Tall Grass versus Asphalt (3 min) **Note:** This scenario is similar to the soccer-ball scenario in Forces lesson 3a. a. Describe the scenario on the slide. Emphasize that both cars are initially coasting at the same speed. When they encounter different surfaces, they begin slowing down at different rates. The car driving on the asphalt travels farther before stopping than the car driving through tall grass. b. Ask, "Why does the car driving through tall grass slow down faster than the car traveling over asphalt?" c. Invite participants to share their explanations and reasoning. **Key ideas:** • Friction opposes the motion of one object rolling or sliding across another object. The car driving through the tall grass slows down more quickly than the car traveling over asphalt because the grass surface is rougher than the asphalt and creates greater friction against the car tires.

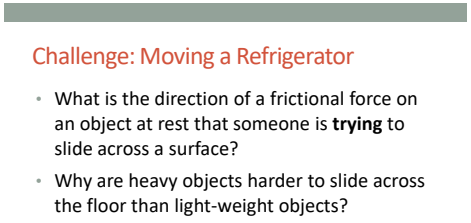
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Types of Friction • **Rolling friction:** A force that resists or opposes motion when an object rolls over a surface. • **Sliding (dynamic) friction:** A force that resists or opposes motion when an object slides across a surface. • **Static friction:** A force that opposes the initial push on an object to get it moving. The force of friction equals the force of the push, so the object doesn't move. • **Fluid friction (draft force):** The force that resists the movement of an object through water or air.	**Display Slide 44.** Types of Friction (3 min) a. "So from the essay we read earlier, we know that friction causes all moving objects on Earth to slow down and eventually stop. But are all frictional forces the same?" b. "The content background document mentions four key types of friction: rolling friction, sliding friction, static friction, and fluid friction. We'll focus on the first three." c. Walk participants through the definitions of each type of friction on the slide. d. **Emphasize:** "Static friction acts in the opposite direction of the intended motion of an object. Since the force of friction equals the force of the push, the object doesn't move. All other types of friction act in the opposite direction of the motion of an already-moving object." e. "First, we'll investigate rolling friction."
		Rolling Friction **Scenario:** Two identical soccer balls are rolling over different surfaces. One ball is rolling over a concrete surface, and the other ball is rolling over a grassy surface. Draw all of the forces acting on the soccer balls.  	**Display Slide 45.** Rolling Friction (8 min) a. Distribute handout 6.10 (Friction and Rolling Soccer Balls) and introduce the scenario. b. **Individuals:** Ask participants to draw the forces acting on each of the soccer balls and answer the questions on the handout. c. **Whole group:** Discuss participants' diagrams and responses to the handout questions. **Note:**

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			• Participants should draw a downward-pointing arrow representing weight (the downward pull of gravity) and an upward-pointing arrow representing normal force. Other arrows should represent the direction the balls are rolling across each surface, as well as the opposing force of friction.
		Rolling Friction *A force that resists or opposes an object's motion when it rolls over a surface.* Where might you encounter rolling friction in everyday life? **Examples:** • Coasting in your car after it runs out of gas • Pushing a shopping cart down a grocery aisle	**Display Slide 46.** Rolling Friction (2 min) a. Review the definition of rolling friction on the slide. b. Ask participants to share examples of rolling friction in their everyday lives. Record their ideas on chart paper.
		Sliding Friction *A force that resists or opposes an object's motion when it slides across a surface.* The strength of the frictional force depends on the following: 1. The surface composition of both objects 2. The normal force the surface exerts on the object moving over it. **Questions:** Which frictional force is greater? Why? 1. Tires skidding on dry pavement OR wet pavement 2. An empty box OR a full box of books sliding across the floor	**Display Slide 47.** Sliding Friction (3 min) a. Review the definition of sliding friction on the slide and discuss the key points about the strength of a frictional force. b. Present the alternatives on the slide and elicit participants' ideas and reasoning. **Key ideas:** • The liquid on wet pavement reduces friction between the tires and the ground, so tires skidding on dry pavement create a greater frictional force. • A box full of books generates a greater frictional force because the weight of the box causes the surface bumps on the box and the

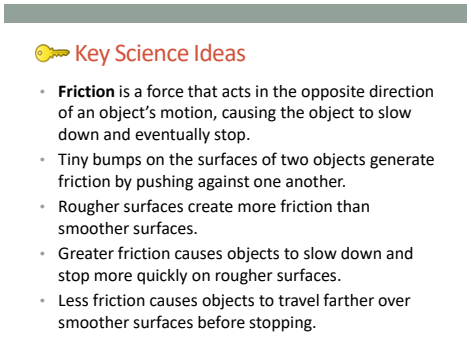
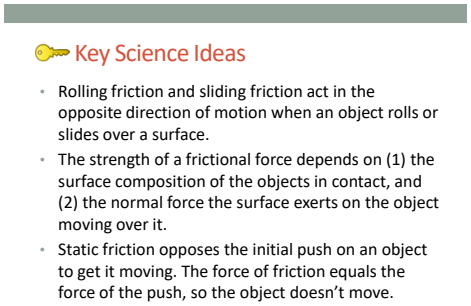
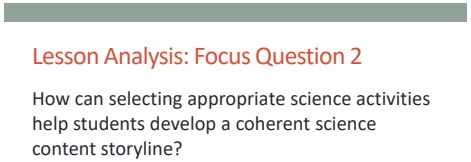
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			floor to push together more closely.
		Sliding Friction **Scenario:** Two identical hockey pucks glide over different surfaces: smooth ice and playground asphalt. Draw all of the forces acting on the hockey pucks. Smooth Ice  Playground Asphalt 	**Display Slide 48.** Sliding Friction (7 min) a. Distribute handout 6.11 (Friction and Sliding Hockey Pucks) and introduce the scenario. b. **Individuals:** Ask participants to draw the forces acting on each of the hockey pucks and answer the questions on the handout. c. **Whole group:** Discuss participants' diagrams and responses to the handout questions. **Note:** • Participants should draw a downward-pointing arrow representing weight/gravity and an upward-pointing arrow representing normal force. Other arrows should represent the direction the pucks are gliding across each surface, as well as the opposing force of friction.
		Static Friction *A force that opposes the initial push on an object to get it moving.* **Key ideas:** • Static friction acts in the opposite direction of the *intended* motion of an object. • The force of friction equals the force of the push, so the object doesn't move. • The strength of the frictional force is just enough to resist the opposing force pushing on the object. • Maximum strength can be reached by applying a larger force.	**Display Slide 49.** Static Friction (2 min) a. Review the definition of static friction on the slide and highlight the key ideas. b. Encourage participants to ask questions and offer observations. Make sure they understand that static friction acts on an object that isn't moving yet.

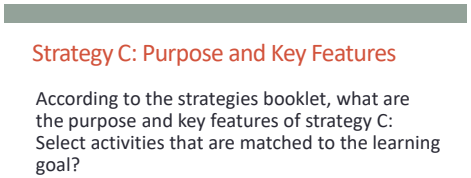
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 50.** Static Friction (8 min) a. Distribute handout 6.12 (Pushing a Box against Static Friction) and introduce the scenario. b. **Individuals:** Ask participants to draw the forces and change in motion in each instance and then answer the questions on the handout. c. **Whole group:** Discuss participants' diagrams and responses to the handout questions. **Key ideas:** • When the child tries to push the box in either direction, it doesn't budge, so the opposing frictional force is equal to the force the child exerts on it. • For box to move, a larger force is necessary than the child is able to exert. The force the father exerts when he shoves the box with his boot is greater than the static friction, and the box begins to move. • Static friction grows to match the force the child exerts on the box. As long as the box isn't moving, the net force is zero, and so is the acceleration.
12:00–12:45 45 min	**LUNCH**		

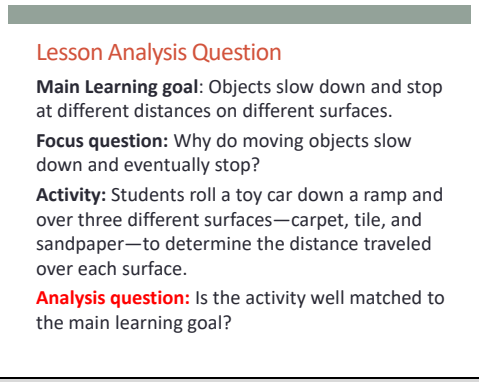
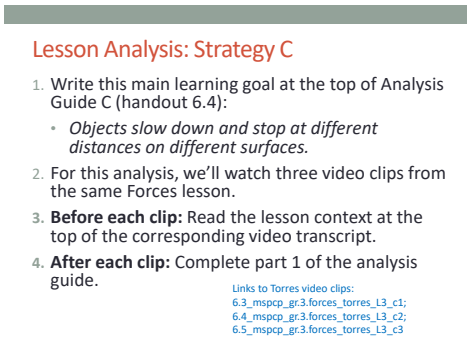
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
12:45–1:15 30 min **Content Deepening (Continued)** Slides 51–56	**Purpose** • Expand participants' science-content knowledge of frictional forces. **Content** • *Friction* is a force that acts in the opposite direction of an object's motion, causing the object to slow down and eventually stop. • Rolling friction and sliding friction act in the opposite direction of motion when an object rolls or slides over a surface. • The strength of a frictional force depends on (1) the surface composition of the objects in contact, and (2) the normal force the surface exerts on the object moving over it. • Static friction opposes the initial push on an object to get it moving. The force of friction equals the force of the push, so the object doesn't move. **What Participants Do** • Engage in a challenge that involves determining the frictional forces acting on a refrigerator. • Revise their answers to the focus question, *Why do moving objects slow down and eventually stop?* **Handouts in PD Binder** • 6.13 Moving a Refrigerator		**Display Slide 51.** Challenge: Moving a Refrigerator (8 min) a. "Are you ready to show what you know about friction? Our next challenge involves moving a refrigerator." b. Distribute handout 6.13 (Moving a Refrigerator) and introduce the scenario. Then read through the instructions on the handout. c. **Individuals:** Have participants complete the first page of the handout, using black ink to show the forces acting on the fridge and red ink to show the change in motion. Then have them answer the challenge questions on page 2.
			**Display Slide 52.** Challenge: Moving a Refrigerator (7 min) **Note:** Display page 1 of the handout on a document reader or overhead projector to mark up during this discussion. a. Invite participants to share their diagrams from the handout. As participants share their ideas, mark up a copy of the diagram showing the forces acting on the fridge, the net force, and the change in motion/acceleration. **Note:** Alternatively, you could display a participant's completed diagram or have participants copy their diagrams onto chart paper or a Smart Board.

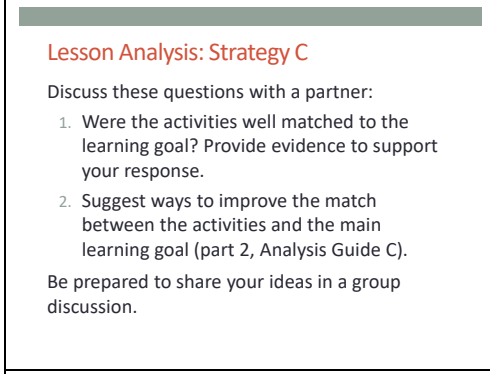
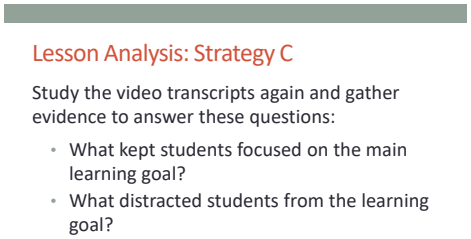
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	Supplies • Science notebooks • Chart paper and markers • Black and red pens (or markers)		b. Discuss the challenge questions on page 2 of the handout. During this discussion, encourage participants to agree or disagree with the ideas others share, add other ideas, and ask questions. **Ideal responses:** • **Question 1:** Static friction and sliding friction are acting on the fridge. • **Question 2:** To increase the friction, we could increase the weight of the fridge. More weight will cause the bumps on the surfaces of the fridge and the floor to press together more closely, which will generate greater friction. • **Question 3:** To decrease the friction, we could put some oil on the ground. The layer of oil will separate the surfaces so they aren't pressing together as closely, which will reduce friction between the fridge and the floor.
			**Display Slide 53.** Challenge: Moving a Refrigerator (5 min) a. Read the questions on the slide. b. "Based on everything you've learned about friction so far, how would you answer these questions?" c. During this discussion, encourage participants to agree or disagree with others' ideas, add on, and ask questions.

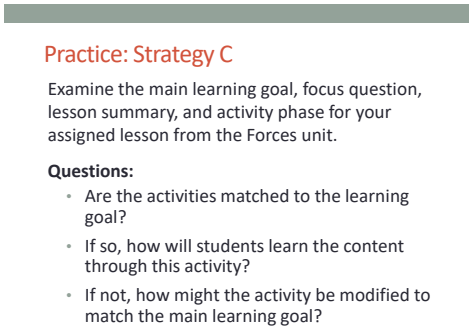
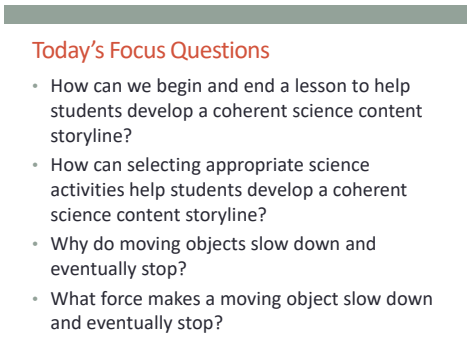
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		 Reflect: Content Deepening Focus Question 1 Why do moving objects slow down and eventually stop?	**Display Slide 54.** Reflect: Content Deepening Focus Question 1 (6 min) a. Revisit the content deepening focus question on the slide. b. "How would you revise your answers to this focus question based on our content deepening work today? Do you have any new ideas to add or other changes you'd like to make?" c. **Individuals:** Ask participants to spend a few minutes reviewing and revising the answers they wrote in their notebooks earlier. Remind them to include evidence from today's investigations. d. **Whole group:** Invite a few participants to share their revised answers with the group, using science ideas about friction and evidence from the content deepening investigations. e. As participants share their responses, record key ideas on chart paper. During this share-out, encourage participants to agree or disagree, add on, or ask questions.

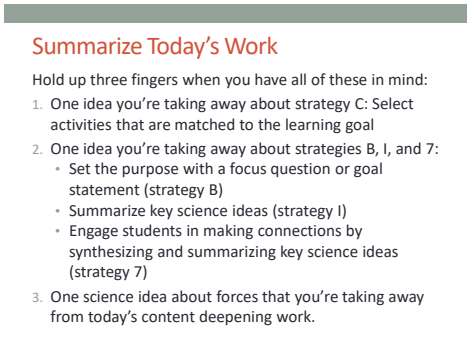
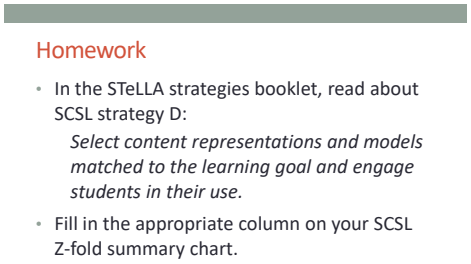
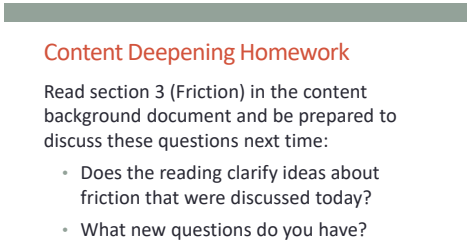
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 55.** Key Science Ideas (2 min) a. Review the key science ideas on the slide. b. Ask participants, "Do you agree with these key ideas? Would you like to revise anything?"
			**Display Slide 56.** Key Science Ideas (2 min) a. Review the key science ideas on the slide. b. Ask participants, "Do you agree with these key ideas? Would you like to revise anything?"
1:15–3:15 120 min (Includes 10-min break) **Lesson Analysis: SCSL Strategy C**	**Purpose** • Use lesson analysis of classroom videos to better understand SCSL strategy C. • Deepen participants' science-content knowledge of forces through lesson analysis. **Content** • To reflect the purpose and key features of strategy C, activities		**Display Slide 57.** Lesson Analysis: Focus Question 2 (1 min) a. Read the focus question on the slide. b. "To help us answer this question, we're going to explore STeLLA strategy C: Select activities that are matched to the learning goal."

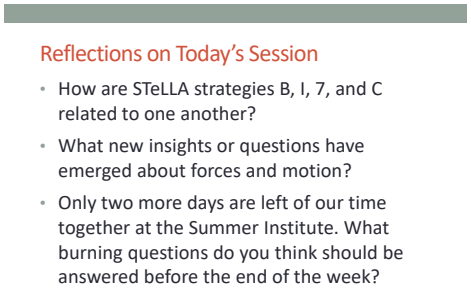
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
Slides 57–63	should be selected that can help students engage in making sense of the main learning goal, not because they're fun, easy to do, or only topically related. **What Participants Do** • Make and discuss a chart summarizing the purpose and key features of strategy C. • Use the criteria in Analysis Guide C to analyze video clips from an SEC lesson (before, during, and after an activity). • Identify activities that are *not* matched to the lesson's main learning goal. **Videos** • Video Clip 6.3, Torres classroom • Video Clip 6.4, Torres classroom • Video Clip 6.5, Torres classroom **Handouts in PD Binder** • 6.4 Analysis Guide C • 6.5 Transcript for Video Clip 6.3 • 6.6 Transcript for Video Clip 6.4 • 6.7 Transcript for Video Clip 6.5 **Supplies** • Chart paper and markers **PD Resources** • STeLLA strategies booklet **Resources in Lesson Plans Binder** *Resources section:*		**Display Slide 58.** Strategy C: Purpose and Key Features (25 min) a. Ask participants to locate the section on strategy C in the STeLLA strategies booklet. b. Have one participant lead the group in creating a chart that summarizes the purpose and key features of strategy C: Select activities that are matched to the learning goal. c. **Ask:** "What does the strategies booklet say about science activities that are fun and engaging for students? **Ideal responses:** • Activities should be selected because they can support students in understanding the main learning goal, *not* because they're fun or easy to do. • Avoid activities that are only topically related (e.g., something about forces); instead, activities should focus on a specific science idea that is closely linked to the main learning goal (e.g., Arrows can be used to represent the strength and direction of a force). • Activities should not just be interesting supplements to the science content storyline; they should help develop it. d. **Follow-up:** "Think back on science-lab activities in high school or college. Did these activities play a key role in helping you better understand the science concepts presented in textbooks or lectures? Or were they more like add-on activities that were only loosely related to the science concepts being taught?"

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	• Content background document		
			**Display Slide 59.** Lesson Analysis Question (2 min) a. For this lesson analysis, participants will view a set of three video clips from one Forces lesson. b. Review the main learning goal, focus question, and activity on the slide. Then introduce the analysis question: *Is the activity well matched to the main learning goal and focus question?*
	10-MINUTE BREAK		
			**Display Slide 60.** Lesson Analysis: Strategy C (60 min) **Note:** Refer to the content background document as needed throughout this lesson analysis. a. Have participants locate Analysis Guide C (handout 6.4) in their PD binders and write the main learning goal for the selected Forces lesson at the top. Then orient them to part 1 of the analysis guide. b. **Before each video clip:** Have participants read the lesson context at the top of the corresponding video transcript (handout 6.5 for clip 3, handout 6.6 for clip 4, and handout 6.7 for clip 5). c. Show each video clip. d. **After each clip (individuals or pairs):** Allow

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			time for participants to review the analysis guide, write down science ideas revealed in the activity, and assess how well matched these ideas are to the main learning goal. **Note:** For sample responses for the analysis-guide tasks, see PD Leader Master: Analysis Guide C: Selecting Activities Matched to the Learning Goal (Answer Key).
			**Display Slide 61.** Lesson Analysis: Strategy C (10 min) a. **Pairs:** "Discuss the questions on the slide and be ready to share your ideas with the group." b. **Whole group:** Assess how well the activities in the video clips matched the main learning goal and ask participants to offer suggestions for improving the match.
			**Display Slide 62.** Lesson Analysis: Strategy C (5 min) a. Read the questions on the slide. b. **Individuals:** Direct participants to look for evidence in the video transcripts that will help them answer these questions. c. **Whole group:** Ask one or two participants to share their ideas and evidence in response to the questions.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 63.** Practice: Strategy C (7 min) **Note:** This activity may be skipped if time is running short. a. Assign each participant one of the Forces lessons. Direct participants to quickly examine the main learning goal, focus question, lesson summary, and activity phase for their assigned lessons. b. **Individuals (2–3 min):** "Think about how well the activities in your assigned lesson are matched to the main learning goal. Be prepared to give a rationale for your choices." c. **Whole group:** Invite participants to share their ideas and reasoning with the group.
3:15–3:30 15 min **Wrap-Up: Summary, Homework, and Reflections**	**Purpose** • Summarize and reflect on key ideas about Strategies B, I, 7, and C, and the Forces science content. **What Participants Do** • Review today's focus questions. • Share key ideas about strategies B, I, 7, and C from the lesson analysis and content deepening		**Display Slide 64.** Today's Focus Questions (Less than 1 min) a. Remind participants of today's focus questions.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
Slides 64–68	work. • Copy down the homework assignment for day 7. • Write reflections on today's learning. **Handouts in PD Binder** • 6.14 Daily Reflections—Day 6 **Supplies** • Science notebooks		**Display Slide 65.** Summarize Today's Work (7 min) a. **Individuals:** Read the instructions on the slide and give participants enough time to come up with three ideas to summarize today's work. b. **Whole group:** In a round-robin, invite participants to share a key idea for each category on the slide. (Allow participants to pass if they wish.)
			**Display Slide 66.** Lesson Analysis Homework (Less than 1 min) a. Go over the lesson analysis homework assignment and have participants write it in their notebooks. b. Make sure participants understand each part of the assignment.
			**Display Slide 67.** Content Deepening Homework (Less than 1 min) a. Go over the content deepening homework assignment and have participants write it in their notebooks. b. Make sure participants are clear about this reading assignment.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 68.** Reflections on Today's Session (7 min) a. Allow participants **at least 5 minutes** to think about today's session and write their reflections and feedback on the Daily Reflections sheet (handout 6.14 in PD program binder).