RESPeCT Summer Institute Professional Development Leader Guide (PDLG)

Grade Level	3	Day	7	STeLLA Strategy	SCSL Strategy D: Select Content Representations and Models	Subject Matter Focus	Forces

Focus Questions	• How do you know when a content representation is appropriate and matched to the main learning goal? • How can we engage students in using content representations and models in meaningful ways? • What happens if more than one force pushes or pulls an object? • How can ideas about forces help us predict the motion of objects?
Main Learning Goals	Participants will understand the following: • 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. • 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. • *Speed* is the rate or amount of distance an object travels over time without regard to direction. • *Velocity* is the speed of an object in a particular direction. • *Acceleration* is a change in the velocity of an object in a moment of time. • Velocity and acceleration are represented using vectors. • The acceleration of an object is directly proportional to the net force acting on the object and inversely proportional to the mass of the object. • Objects with more mass experience less acceleration. • *Mass* is the amount of substance that makes up an object. • *Weight* is the force of gravity pulling an object toward the center of Earth.

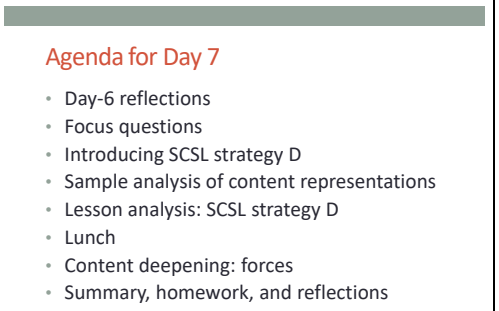
Preparation	Materials	Videos
Daily Setup Tasks • Check that video clips are correctly linked to PowerPoint (PPT) slides. • Set up PowerPoint. • Make sure video clips play correctly with good sound. • Arrange furniture and food. • Arrange participant materials. • Put up posters and charts. **Planning and Preparation Tasks** • Study the PDLG, PowerPoint slides (PPTs), video clips, and handouts. Make	**Posters and Charts** • STeLLA Framework and Strategies poster • Day-7 Agenda (chart) • Norms for Working Together (chart) • Day-7 Focus Questions (chart) • Strategy charts from days 1–6 (STL strategies 1–7 and SCSL strategies A, B, C, and I) • Parking Lot poster **Handouts in RESPeCT PD Binder Front Pocket** • Z-fold summary chart: Science Content Storyline Lens Strategies	• Video Clip 7.1: Wilde classroom (SCSL strategy D); 7.1_mspcp_gr.3.forces_wilde_L6_c3–4 • Video Clip 7.2: Wilde classroom (SCSL strategy D); 7.2_mspcp_gr.3.forces_wilde_L5_c9 **Optional clip (if time allows):** • Video Clip 7.3: Kawamura classroom (SCSL strategy D); 7.3_optional_stella2-03_kawamura_c1–c3 (6th-grade lesson on the Sun's effect on climate)

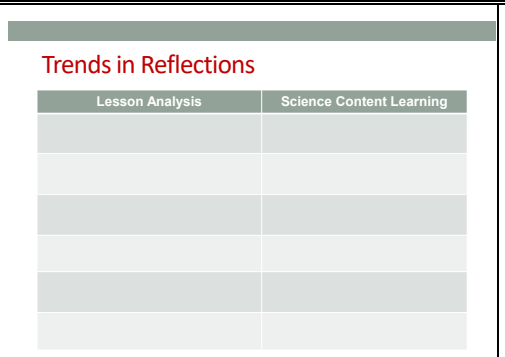
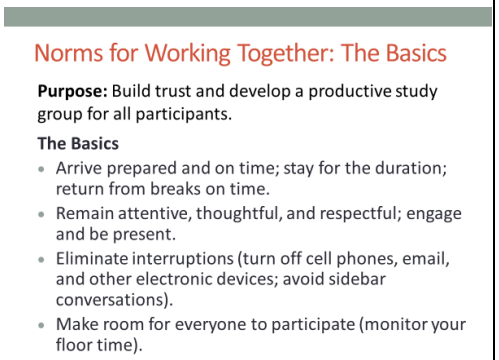
changes to PPTs if needed.
• Review the reflections from day 6 and create a summary slide.
• Watch the video clips and anticipate participant responses.
• Prepare charts for the day's agenda and focus questions.
• Review the activities for Forces lessons 5a/b and 6a in the lesson plans binder.
	Handouts in RESPeCT PD Binder, Day 7
	• 7.1 Analysis Guide D: Selecting and Using Content Representations (5 copies: 2 for sample analysis of content representations; 3 for video-based lesson analysis)
	• 7.2 Transcript for Video Clip 7.1
	• 7.3 Transcript for Video Clip 7.2
	• 7.4 Transcript for Video Clip 7.3
	• 7.5 Describe the Forces (from Forces lessons 5a/b)
	• 7.6 Velocity and Acceleration of a Baseball
	• 7.7 Baby Pushing a Soccer Ball and a Bowling Ball
	• 7.8 Shoving a Shopping Cart
	• 7.9 Daily Reflections—Day 7
	
	Supplies
	• Science notebooks
	• Chart paper and markers
	• Red and green pencils and markers (for drawing vectors)
	• For investigations from lessons 5a/b:
	  • Foam-board arrows of different lengths (2 short, 2 medium, 2 long)
	  • 2 hand strips
	• For investigation from lesson 6a:
	  • Portable fan
	  • Small cotton balls (cut large cotton balls into quarters)
	  • Foam-board arrows of different lengths (2 short, 2 medium, 2 long)
	
	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 7 SESSION OUTLINE

Time	Activities	Purpose
8:00–8:25 25 min	**Getting Started: Housekeeping, Agenda, Day-6 Reflections, Norms, Focus Questions**	• Build community by sharing participants' reflections from day 6. • Set the stage for a day of learning.
8:25–9:00 35 min	**Introducing SCSL Strategy D**	• Deepen participants' knowledge of the purpose and key features of SCSL strategy D.
9:00–10:20 80 min (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. • Deepen participants' science-content knowledge as it emerges from analyzing content representations.
10:20–12:00 100 min	**Lesson Analysis: SCSL Strategy D**	• Develop participants' ability to analyze content representations to determine how well engaged students are in their use. • Use lesson analysis of classroom videos to better understand STeLLA strategy D. • Deepen participants' science-content knowledge of forces through lesson analysis.
12:00–12:45 45 min	**LUNCH**	
12:45–3:15 150 min (Includes 10-min break)	**Content Deepening: Forces**	• Deepen participants' science-content knowledge of forces by conducting investigations from Forces lessons 5a/b and 6a. • Deepen participants' understandings of the ways scientists think about speed, velocity, and acceleration and how they relate to mass.
3:15–3:30 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 Forces 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 25 min **Getting Started** Slides 1–7	**Purpose** • Build community by sharing participants' reflections from day 6. • Set the stage for a day of learning. **What Participants Do** • Review the day's agenda. • Discuss reflections from day 6. • Review and discuss progress on the RESPeCT program norms. • Read today's focus questions. **Posters and Charts** • STeLLA Framework and Strategies poster • Day-7 Agenda (chart) • Norms for Working Together (chart) • Day-7 Focus Questions (chart)		**Display Slide 1.** RESPeCT PD Program (5 min) a. Take care of any housekeeping issues.
			**Display Slide 2.** Agenda for Day 7 (5 min) a. Talk through the agenda for the day.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 3.** Trends in Reflections (5 min) a. Give participants time to review your feedback on their reflections from day 6 and offer reactions, comments, or follow-up questions.
			**Display Slide 4.** Norms for Working Together: The Basics (2 min) a. Review the norms and ask participants to think about areas where they could improve individually or as a group. 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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		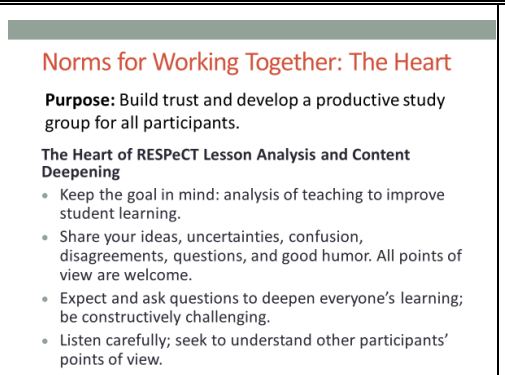	**Display Slide 5.** Norms for Working Together: The Heart (5 min) a. Review the norms that are at the heart of the RESPeCT program and ask participants to think about areas where they could improve individually or as a group. b. **Emphasize:** "We're doing quite well with our norms, but as we approach 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." 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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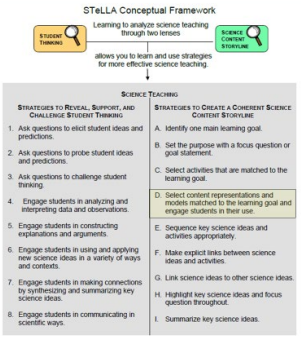
		Today's Focus Questions • How do you know when a content representation is appropriate and matched to the main learning goal? • How can we engage students in using content representations and models in meaningful ways? • What happens if more than one force pushes or pulls an object? • How can ideas about forces help us predict the motion of objects?	**Display Slide 6.** Today's Focus Questions (1 min) a. Introduce the focus questions on the slide.
			**Display Slide 7.** STeLLA Conceptual Framework (2 min) 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."

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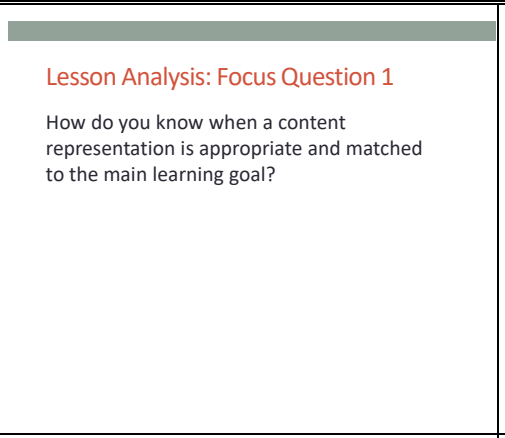
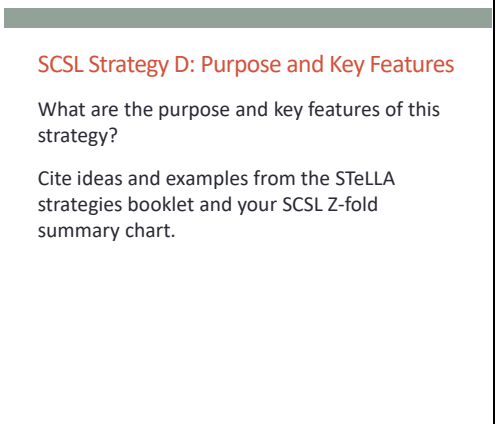
8:25–9:00 35 min **Introducing SCSL Strategy D** Slides 8–10	**Purpose** • Deepen participants' knowledge of the purpose and key features of SCSL strategy D. **Content** • Strategy D content representations can be especially useful in helping students see how the science content storyline fits together. 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. • Content representations are most meaningful when students are engaged in constructing and critiquing them. • Content representations support English language learners by providing a variety of ways for them to understand science ideas that extend beyond words. **What Participants Do** • Make, share, and discuss charts summarizing the purpose and key features of SCSL strategy D. • Discuss questions about strategy D. **Supplies** • Chart paper and markers		**Display Slide 8.** Lesson Analysis: Focus Question 1 (Less than 1 min) a. "Now let's explore the first part of strategy D and our first focus question." b. Read the focus question on the slide.
			**Display Slide 9.** SCSL Strategy D: Purpose and Key Features (25 min) a. **Small groups (13 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. b. **Whole group (12 min):** Have groups report out. Then ask, "What differences do you notice between the two charts?" **Key ideas:** • 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. • Content representations give students access to different ways of making sense of key science ideas. • If content representations or models are

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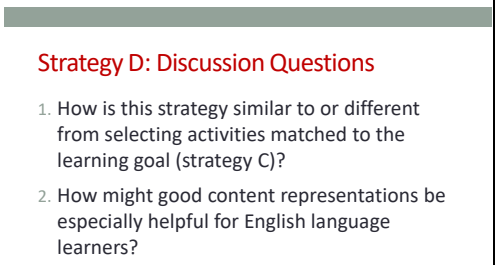
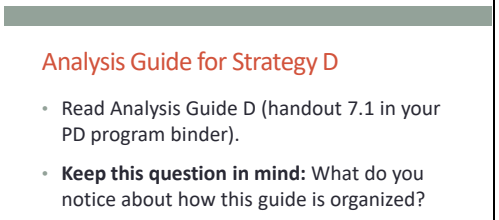
	PD Resources • STeLLA strategies booklet • SCSL Z-fold summary chart (front pocket of PD binder)		closely matched to the main learning goal, they can be especially useful in helping students see how the science content storyline fits together. • There are many different types of content representations (analogies, metaphors, and visual representations, such as diagrams, charts, graphs, concept maps, models, and role-plays). • 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) a. **Whole group:** Discuss the questions on the slide. **Key ideas:** • **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. • **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

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			in addition to words.
9:00–10:20 80 min (Includes 10-min break) **Sample Analysis of Content Representations** Slides 11–17	**Purpose** • Develop participants' ability to analyze content representations to determine how well they match the main learning goal. • Deepen participants' science-content knowledge as it emerges from analyzing content representations. **Content** • Six criteria are used in analyzing and selecting a content representation that is matched to the main learning goal. **What Participants Do** • Study how Analysis Guide D is organized. • Use the analysis guide to analyze two examples of Forces content representations (drawn from the Forces lessons). **Handouts in PD Binder** • 7.1 Analysis Guide D (2 copies) **PD Resources** • STeLLA strategies booklet • RESPeCT lesson plans binder		**Display Slide 11.** Analysis Guide for Strategy D (10 min) a. Have participants locate Analysis Guide D in their PD program binders (handout 7.1). b. **Individuals:** "As you read the analysis guide, keep in mind the discussion question on the slide." c. **Whole group:** Discuss the question on the slide. **Key ideas:** • This analysis guide focuses on the main learning goal by having participants write that down first. • 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. • The guide ends with identifying ways to improve the content representation and its use in a lesson (part 3).

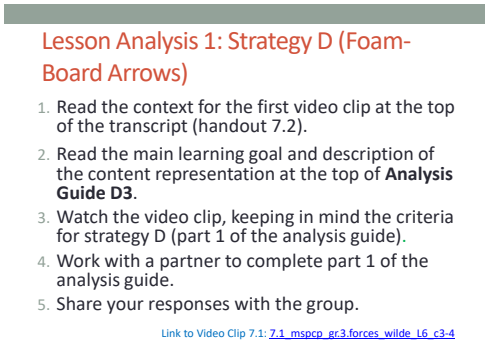
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Content Representation 1: Arrows Model Read the main learning goal and description of the content representation in **Analysis Guide D1** (page 1 of handout 7.1).	**Display Slide 12.** Content Representation 1: Arrows Model (3 min) a. **Set the context:** "Now we're going to analyze a content representation to see how well it's matched to the stated learning goal." b. Have participants read the main learning goal and description of the content representation in **Analysis Guide D1** (page 1 of handout 7.1).
		Content Representation 1: Arrows Model 	**Display Slide 13.** Content Representation 1: Arrows Model (12 min) a. **Individuals:** Have participants work independently on part 1 of Analysis Guide D1. b. **Pairs:** "Now pair up and discuss your answers to the analysis questions." c. Emphasize that the content representation participants are analyzing is *not just the arrows* but the *entire activity*.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Does Content Representation 1 Match the Main Learning Goal? How did you answer these questions from part 1 of the analysis guide? 1. Is the content representation scientifically accurate? 2. Is it closely matched to the main learning goal? 3. Does it present science ideas to students in comprehensible ways? 4. Does it reinforce/introduce any misconceptions? 5. Does it address common misconceptions? 6. Does it contain distracting details?	**Display Slide 14.** Does Content Representation 1 Match the Main Learning Goal? (15 min) a. **Whole group:** Discuss participants' responses to the questions in part 1 of Analysis Guide D1. b. **Ask:** "How might this content representation be improved? Would you use it with your students?" **Observations:** • The arrows are clean and simple, without distracting details like actual numbers representing the strength of the force. They're also comprehensible, can be used in a scientifically accurate way, and are very closely matched to the learning goal. **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.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Content Representation 2: Hand-Strip Model • Read the main learning goal and description of the content representation in **Analysis Guide D2** (page 2 of handout 7.1). • Use your experience with this content representation to complete part 1 of the analysis guide.	**Display Slide 15.** Content Representation 2: Hand-Strip Model (5 min) a. Set the context for analyzing another content representation. 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.
		Content Representation 2: Hand-Strip Model  	**Display Slide 16.** Content Representation 2: Hand-Strip Model (10 min) a. **Individuals:** Have participants work independently on part 1 of Analysis Guide D2. **Note:** If time is short, just do partner work. b. **Pairs:** "Now pair up and discuss your answers to the analysis questions."

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Does Content Representation 2 Match the Main Learning Goal? How did you answer these questions from part 1 of the analysis guide? 1. Is the content representation scientifically accurate? 2. Is it closely matched to the main learning goal? 3. Does it present science ideas to students in comprehensible ways? 4. Does it reinforce/introduce any misconceptions? 5. Does it address common misconceptions? 6. Does it contain distracting details?	**Display Slide 17.** Does Content Representation 2 Match the Main Learning Goal? (15 min) a. **Whole group:** Discuss participants' responses to the questions in part 1 of Analysis Guide D2. b. **Ask:** "How might this content representation be improved? Would you use it with your students?" **Observations:** • **Scientifically accurate?** The hand-strip model is used to represent the bumps on surfaces that create friction and cause an object to stop moving. Conceptually, the representation is scientifically accurate, but this is by no means a large-scale model of actual bumps on surfaces. • **Matched to learning goal?** The hands printed on the tabs help students visualize how surface bumps "push back" against an object's motion, so the representation is well matched to the learning goal. • **Comprehensible to students?** The teacher might need to emphasize that the tabs or "flaps" represent bumps on the surface of an object and then show that these bumps can push or pull another object. This might be challenging for students to imagine! • **Misconceptions?** This representation is intended to address the student misconception that objects slow down and stop because they "run out of force." This misconception is replaced with a visual representation of a force that pushes

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			against an object's motion. **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 10 min	**BREAK**		
10:20–12:00 100 min **Lesson Analysis: SCSL Strategy D** Slides 18–25	**Purpose** • Develop participants' ability to analyze content representations to determine how well engaged students are in their use. • Use lesson analysis of classroom videos to better understand STeLLA strategy D. • Deepen participants' science-content knowledge of forces through lesson analysis. **Content** • Six criteria are used in analyzing and selecting a content representation that is well matched to the main learning goal. • Three criteria are used in analyzing how well teachers	Lesson Analysis: Focus Question 2 How can we engage students in using content representations and models in meaningful ways?	**Display Slide 18.** Lesson Analysis: Focus Question 2 (Less than 1 min) a. **Transition slide:** "Next we'll watch two video clips of strategy D in use during a lesson on forces. 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?"* b. "In the first video clip, the teacher engages students in using arrows to show the strength and direction of forces acting on objects in various scenarios. In the second clip, the teacher uses the hand-strip model to help students visualize why a heavy object might have more frictional force than a lighter object. These activities and science ideas are found in lessons 5

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	engage students in using content representations. • Heavier objects generate a greater frictional force because the bumps on the two interacting surfaces push together more closely. **What Participants Do** • Use Analysis Guide D to analyze student engagement with content representations in two video clips. • Use the analysis guide to analyze how well the content representations match the main learning goal. • Identify key ideas participants have learned about strategy D and the science content from the lesson analysis work. **Videos** • Video Clip 7.1, Wilde classroom • Video Clip 7.2, Wilde classroom • **Optional:** Video Clip 7.3, Kawamura classroom (6th-grade SEC lesson) **Handouts in PD Binder** • 7.1 Analysis Guide D (3 copies) • 7.2 Transcript for Video Clip 7.1 • 7.3 Transcript for Video Clip 7.2 • 7.4 Transcript for Video Clip 7.3 (optional) **PD Resources** • STeLLA strategies booklet		and 6 of our current RESPeCT lesson series."  **Display Slide 19.** Lesson Analysis 1: Strategy D (Foam-Board Arrows) (20 min) a. Orient participants to **Analysis Guide D3** and the transcript for video clip 1 (handout 7.2 in PD binder). b. Have participants read the main learning goal and description of the content representation at the top of the analysis guide. c. Show the video clip. d. **Pairs:** Have participants pair up and complete part 1 of the analysis guide. e. **Whole group:** Discuss participants' responses to the questions in part 1 of the guide. **Ideal responses for Analysis Guide, Part 1:** • **Main learning goal:** Ideas about forces can help us predict the motion of objects. • **Description of content representation:** In this clip, students use foam-board arrows of various lengths to describe the forces in two scenarios: two students arm wrestling, and a child gliding down a waterslide. In each scenario, the arrows are intended to help students make sense of the forces involved when they observe changes in motion. • **Scientifically accurate?** Yes, students use arrows of different lengths to accurately represent the strength and

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	• RESPeCT lesson plans binder • SCSL Z-fold summary chart (front pocket of PD binder) **Resources in Lesson Plans Binder** *Resources section:* • Content background document		direction of forces (pushes, gravity, friction). • **Closely matched to learning goal?** The activity isn't closely matched to the learning goal. The learning goal refers to ideas about forces helping students *predict* motion, whereas students in the video are using arrows to *describe* the motion they see. • **Comprehensible to students?** Yes, using the arrows helped students understand the strength and direction of the forces. • **Misconceptions?** Some misconceptions are apparent as students discuss forces. For example, in the arm-wrestling scenario, the girls represent the forces as unequal to show that one student is winning the match. However, as long as the boys' arms aren't moving, the forces they're exerting should be equal. Unequal forces apply only if there is a change in speed or direction of motion. Third-grade students aren't expected to understand the difference, but teachers should understand why this is an incorrect use of the arrows. • **Too many details or new terms?** No.

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		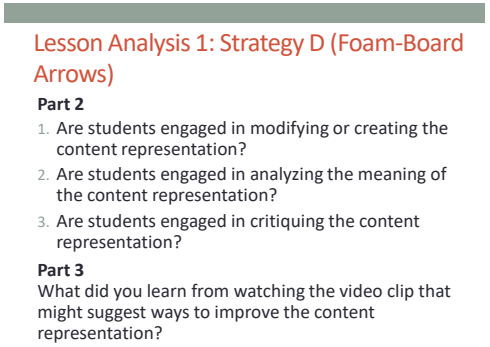	**Display Slide 20.** Lesson Analysis 1: Strategy D (Foam-Board Arrows) (15 min) a. "Now we're going to turn our attention to part 2 of strategy D, which engages students in using content representations. We'll also consider ways the content representation could be improved." b. **Individuals:** "Study the video transcript again and think about parts 2 and 3 of **Analysis Guide D3**. Be ready to share evidence that supports your conclusions." c. **Pairs:** "Compare your conclusions about student engagement with the content representation." 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. e. 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?" **Ideal responses for Analysis Guide, Parts 2 and 3:** • **Modifying/creating, analyzing, critiquing the representation?** In this clip, students are analyzing the meaning of the arrows by applying them to real-life scenarios. They're clearly using the content representation to make sense of the forces acting on objects in different

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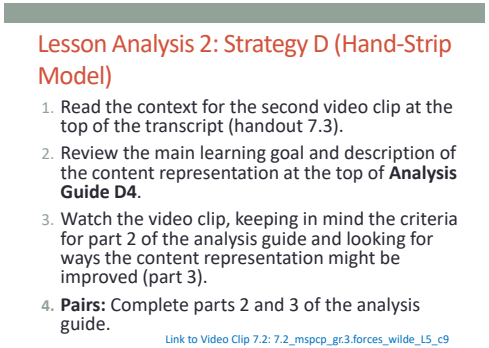
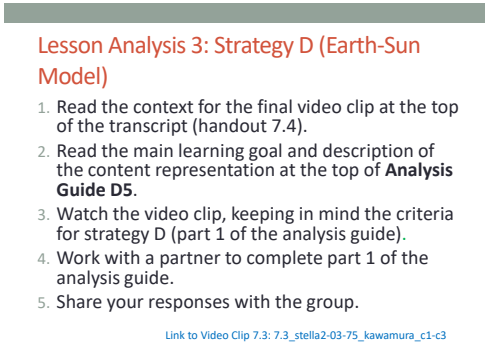
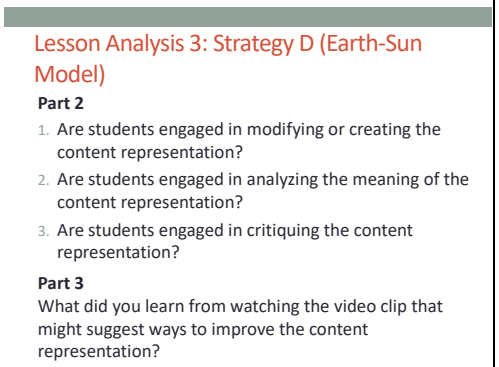
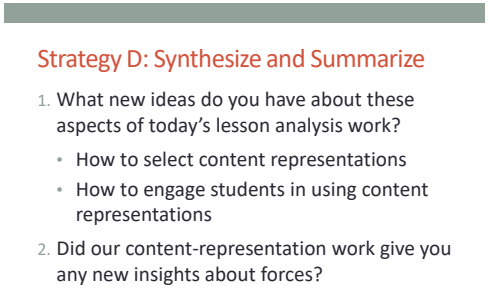
			situations. However, they aren't creating or modifying the content representation, nor are they critiquing its strengths and weaknesses. • **Suggestions for improvement:** Elicit a variety of ideas participants may have for improving the use of the arrow model as a way to represent the strength and direction of forces acting on an object.
			**Display Slide 21.** Lesson Analysis 2: Strategy D (Hand-Strip Model) (20 min) a. Orient participants to **Analysis Guide D4** and the transcript for the second video clip (handout 7.3 in PD binder). b. Have participants read the main learning goal and description of the content representation at the top of the analysis guide. **Emphasize** that they'll focus only on parts 2 and 3 of the guide for this clip. c. "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." d. Show the video clip. e. **Pairs:** Have participants pair up and complete parts 2 and 3 of the analysis guide.

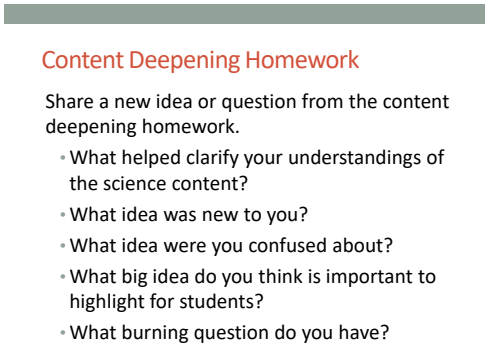
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Lesson Analysis 2: Strategy D (Hand-Strip Model) **Part 2** 1. Are students engaged in modifying or creating the content representation? 2. Are students engaged in analyzing the meaning of the content representation? 3. Are students engaged in critiquing the content representation? **Part 3** What did you learn from watching the video clip that might suggest ways to improve the content representation?	**Display Slide 22.** Lesson Analysis 2: Strategy D (Hand-Strip Model) (10 min) 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. 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?" **Ideal responses for Analysis Guide, Parts 2 and 3:** • **Modifying/creating, analyzing, critiquing the representation?** Some participants might say that with prompting from the teacher, students are modifying the content representations to represent the friction that heavier or lighter objects create. Others might say that students don't modify the hand-strip model but do analyze the meaning of the representation as they discuss why friction is greater in objects that weigh more. • **Suggestions for improvement:** Elicit a variety of ideas participants may have for improving the use of the hand-strip model as a way to represent the friction created when two objects interact, as well as the differences in friction in heavier or lighter objects.

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

			**Display Slide 23.** Lesson Analysis 3: Strategy D (Earth-Sun Model) (15 min)
			
			Note: This analysis is optional.
			
			a. Orient participants to **Analysis Guide D5** and the transcript for the final video clip (handout 7.4 in PD binder).
			
			b. Have participants read the main learning goal and description of the content representation at the top of the analysis guide.
			
			c. Show the video clip.
			
			d. **Pairs:** Have participants pair up and complete part 1 of the analysis guide.
			
			e. **Whole group:** Discuss participants' responses to the questions in part 1 of the guide.
			
			Observations:
			• Students are engaged in comparing the content representation with their understandings of what the positions and movements of Earth and the Sun really involve. The teacher challenges students to describe what's good and not so good about the content representation. They also discuss similarities and differences between the model and the actual Earth-Sun system. The following student ideas (misconceptions) are made visible during this discussion:
			  • Earth's orbit around the Sun is more like an oval than a circle.
			  • The Sun isn't in the center of Earth's orbit but is skewed to one side.

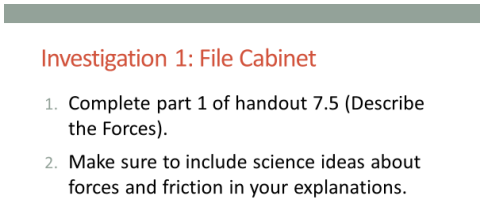
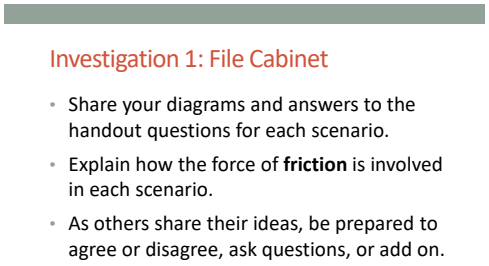
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			• The distance between the Sun and Earth vary over the course of the year, causing seasonal temperature changes and differences in the size of shadows based on the position of the Sun. • While student thinking is revealed during this discussion, it also provides a sensemaking opportunity. When the teacher asks a student to draw on the board his concept of the Earth-Sun system and explain his thinking, she raises a key question: "Whose summer did you represent?" (video segment 0:03:35.4). The student's attempts to talk his way around the inconsistencies in his thinking allow other students to consider the proposed model in greater depth and present ideas and evidence for why it's wrong. • Rather than summarizing what she *thinks* this final student was trying to express, the teacher could have asked probe questions to make his thinking visible.
			**Display Slide 24.** Lesson Analysis 3: Strategy D (Earth-Sun Model) (10 min) **Note:** This analysis is optional. a. "Now let's focus on parts 2 and 3 of strategy D." b. **Individuals:** "Study the video transcript again and think about parts 2 and 3 of **Analysis Guide D5**. Be ready to share evidence that supports your conclusions." c. **Pairs:** "Compare your conclusions about

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			student engagement with the content representation in the video clip." 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. e. 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 25.** Strategy D: Synthesize and Summarize (10 min) 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). 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 45 min	**LUNCH**		

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
12:45–3:15 150 min (Includes 10-min break) **Content Deepening: Forces** Slides 26–59	**Purpose** • Deepen participants' science-content knowledge of forces by conducting investigations from Forces lessons 5a/b and 6a. • Deepen participants' understandings of the ways scientists think about speed, velocity, and acceleration and how they relate to mass. **Content** • *Speed* is the rate or amount of distance an object travels over time without regard to direction. • *Velocity* is the speed of an object in a particular direction. • *Acceleration* is a change in the velocity of an object in a moment of time. • Velocity and acceleration are represented using vectors. • The acceleration of an object is directly proportional to the net force acting on the object and inversely proportional to the mass of the object. • Objects with more mass experience less acceleration. • *Mass* is the amount of substance that makes up an object. • *Weight* is the force of gravity pulling an object toward the center of Earth.		**Display Slide 26.** Content Deepening: The Sun's Effect on Climate (Less than 1 min) a. **Transition:** This slide marks the transition to the content deepening phase of the session. **Note:** Throughout this content deepening phase, refer as needed to the content background document and Common Student Ideas about Forces and Motion.
			**Display Slide 27.** 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
	What Participants Do • Conduct investigations from Forces lessons 5a/b and 6a. • Explore and discuss key science ideas behind the Forces lessons. • Investigate the distinctions between speed, velocity, and acceleration in various scenarios. • Compare acceleration with net force. • Explore the forces involved in moving objects at rest and the variations in acceleration, speed, and velocity based on an object's mass. • Explain the differences between mass and weight. • Explain how mass relates to acceleration. **Handouts in PD Binder** • 7.5 Describe the Forces (from Forces lessons 5a/b) • 7.6 Velocity and Acceleration of a Baseball • 7.7 Baby Pushing a Soccer Ball and a Bowling Ball • 7.8 Shoving a Shopping Cart **Supplies** • Science notebooks • Chart paper and markers • Red and green pencils and markers (for drawing vectors) • For investigations from lessons 5a/b:	Content Deepening: Focus Question 1 What happens if more than one force pushes or pulls an object?	**Display Slide 28.** Content Deepening: Focus Question 1 (Less than 1 min) a. Read the focus question on the slide. b. Emphasize that this focus question will guide student learning throughout Forces lessons 5a and 5b. c. Ask participants to 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: File Cabinet A student is trying to move a heavy file cabinet across a carpeted floor, but the cabinet doesn't move. Why do you think the cabinet won't move? 	**Display Slide 29.** Investigation 1: File Cabinet (3 min) a. Introduce the scenario on the slide. b. **Whole group:** "Why do you think the cabinet won't move? What forces are acting on the cabinet in this scenario?" c. Encourage participants to include science ideas about frictional forces (sliding friction and static friction) and net force in their explanations. d. Invite a few participants to use the foam-board arrows to show the strength and direction of each force acting on the cabinet. Ask them to explain their arrow selections. e. "Does everyone agree with the choice of arrows our volunteers made? Why or why not?"

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	• Foam-board arrows of different lengths (2 short, 2 medium, 2 long) • 2 hand strips • For investigations from lesson 6a: • Portable fan • Small cotton balls (cut large cotton balls into quarters) • Foam-board arrows of different lengths (2 short, 2 medium, 2 long) **PD Resources** • RESPeCT lesson plans binder **Resources in Lesson Plans Binder** *Resources section:* • Content background document • Common Student Ideas	Investigation 1: File Cabinet Think about the tiny bumps on the bottom surfaces of the file cabinet and the floor. How could we use our hand-strip model to represent the bumps on these surfaces interacting or pushing against one another? 	**Display Slide 30.** Investigation 1: File Cabinet (6 min) a. Ask participants to think about the tiny bumps on the surfaces of the heavy file cabinet and the floor. b. Pose the question on the slide and elicit a variety of ideas. Ask elicit and probe questions to clarify participants' thinking. c. During this discussion, invite participants to use the hand-strips to illustrate their ideas and reasoning. Address any misconceptions or confusion about the science concepts involved. **Key ideas:** The amount of friction created depends on the mass of the file cabinet. A heavier cabinet generates greater friction with the floor, causing the bumps on both surfaces to push together more closely. The frictional force is equal to the force of the push, so the cabinet won't move. d. "Now think about what would happen if the file cabinet were empty. How would the bumps on the surfaces interact? Do you think the girl will be able to move the cabinet if it's lighter?" e. Invite participants to use the hand strips to illustrate their ideas and explanations. **Key ideas:** The empty cabinet would generate less friction with the floor, so the bumps on the surfaces wouldn't push together as tightly. With less frictional force working against the pushing force of the girl, the forces become unequal, and

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			the cabinet should begin to move in the direction of the stronger pushing force.
			**Display Slide 31.** Investigation 1: File Cabinet (8 min) a. "Your next challenge is to use the ideas about forces and friction that we've been talking about to complete part 1 of this handout." b. Distribute handout 7.5 (Describe the Forces) and briefly review the directions for each scenario in part 1. c. Have participants work independently on the tasks. **Note:** Participants may want to use different-colored pencils to distinguish the bumps and arrows on their diagrams.
			**Display Slide 32.** Investigation 1: File Cabinet (5 min) a. **Whole group:** Invite as many participants as possible to share their diagrams and explanations for each scenario with the group. b. Make sure participants' explanations include how the force of friction is involved in each scenario. c. Encourage participants to agree or disagree with others' ideas, add their own ideas to the discussion, or ask questions and offer comments.

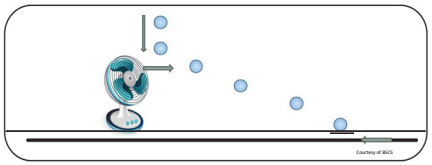
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Investigation 2: Describe the Forces • Complete part 2 of handout 7.5 (Describe the Forces) using science ideas about forces to support your ideas. • Think about how gravity is involved in each scenario.  Courtesy of BSCS  Courtesy of BSCS	**Display Slide 33.** Investigation 2: Describe the Forces (8 min) a. "In our next investigation, we'll explore ideas about gravity from lesson 5b." b. Have participants turn to part 2 in handout 7.5 (Describe the Forces). c. Read through the directions and questions for each scenario; then have participants complete the tasks on the handout. **Note:** Participants explanations should include ideas about gravity, normal force, and net force.
		Investigation 2: Describe the Forces • Share your diagrams and answers to the handout questions for each scenario. • Explain how the force of **gravity** is involved in each scenario. • As others share their ideas, be prepared to agree or disagree, ask questions, or add on.	**Display Slide 34.** Investigation 2: Describe the Forces (5 min) a. **Whole group:** Invite as many participants as possible to share their diagrams and explanations for each scenario with the group. b. Make sure participants' explanations include how the force of gravity is involved in each scenario. c. Encourage participants to agree or disagree with others' ideas, add their own ideas to the discussion, or ask questions and offer comments.

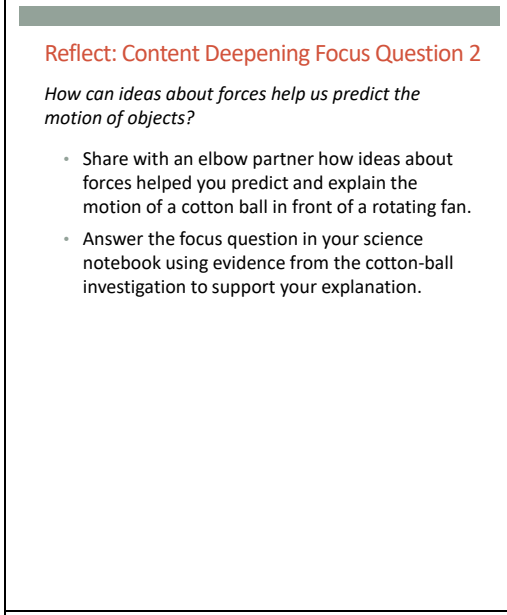
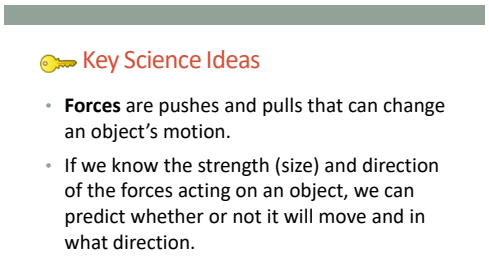
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Reflect: Content Deepening Focus Question 1 *What happens if more than one force pushes or pulls an object?* Answer the focus question in your science notebook using these sentence starters: • *If forces of **equal** (the same) strength are pushing or pulling an object in opposite directions, the object will _____.* • *If forces of **unequal** (not the same) strength are pushing or pulling an object in opposite directions, the object will _____.*	**Display Slide 35.** Reflect: Content Deepening Focus Question 1 (6 min) a. Revisit the first content deepening focus question. b. Remind participants that this focus question from Forces lessons 5a and 5b appears in the scope and sequence and on the overview page for each lesson in their lesson plans binders. c. **Individuals:** Have participants answer the focus question in their science notebooks using the sentence starters on the slide. d. **Whole group:** Invite a few participants to share their response with the group. Encourage them to include evidence from the previous investigations to support their ideas.
		Key Science Ideas • A force can be a push or a pull. • A force has a strength and direction. • Arrows can be used to represent both the strength and direction of a force. • When bumps on the surfaces of two objects push against one another, they create a force called **friction**. • The pushing force of friction makes a moving object slow down and eventually stop.	**Display Slide 36.** Key Science Ideas (1 min) a. Highlight the key science ideas on the slide. b. Ask participants, "Does everyone agree with these ideas? Would you like to add or revise anything?"

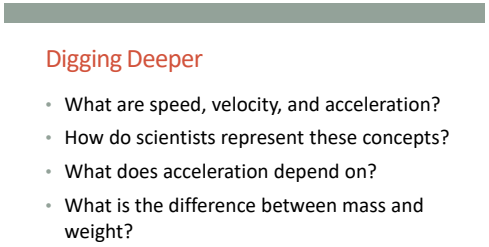
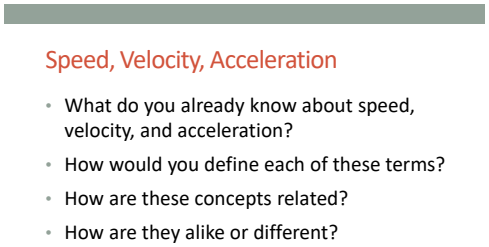
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Key Science Ideas • More than one force can push or pull an object at the same time. One of those forces can be friction. • If two forces of **equal** strength are pushing or pulling an object in opposite directions, the object won't move. • If two forces of **unequal** strength are pushing or pulling an object in opposite directions, the object will move in the direction the stronger force is pushing or pulling.	**Display Slide 37.** Key Science Ideas (1 min) a. Highlight the key science ideas on the slide. b. Ask participants, "Does everyone agree that these key ideas answer our focus question? Would you like to add or revise anything?"
		Content Deepening: Focus Question 2 How can ideas about forces help us predict the motion of objects?	**Display Slide 38.** Content Deepening: Focus Question 2 (Less than 1 min) a. Read the focus question on the slide. b. Emphasize that this focus question will guide student learning throughout lessons 6a and 6b. c. Ask participants to 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.

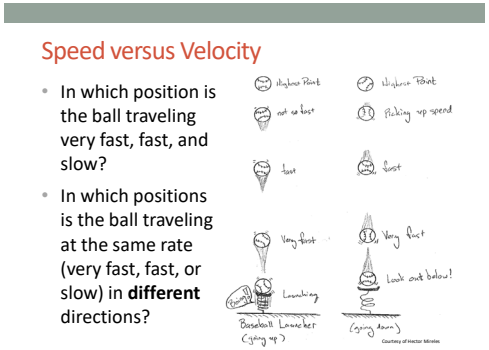
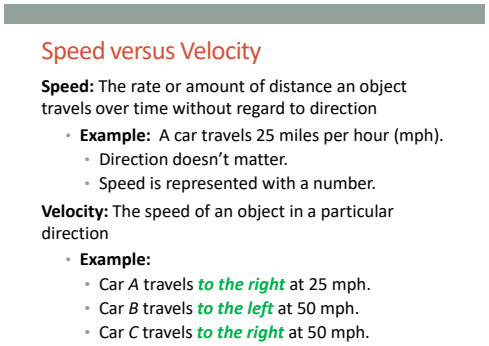
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Investigation 3: Cotton Balls in the Wind 	**Display Slide 39.** Investigation 3: Cotton Balls in the Wind (5 min) a. "For our next investigation, we'll work together as a group to investigate the forces acting on a cotton ball when it's dropped in front of a rotating fan." b. "First, let's predict what will happen when a cotton ball is dropped in front of a fan rotating at full speed. For now, just think about how the cotton ball will move." c. **Individuals:** "Write your predictions in your science notebooks and draw a rough sketch of how you think the cotton ball will move." **Note:** While participants are writing their predictions, set up the fan for the demonstration. d. **Whole group:** Invite participants to share their predictions and sketches with the group. Reach a consensus on the predicted motion of the cotton ball and record it on chart paper.

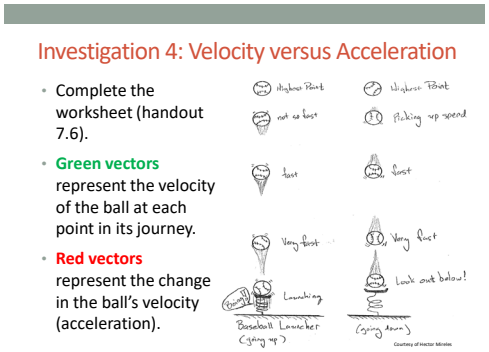
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Investigation 3: Cotton Balls in the Wind  Photo courtesy of BSCS	**Display Slide 40.** Investigation 3: Cotton Balls in the Wind (10 min) a. "Now we'll test our predictions by dropping a few cotton balls, one at a time, in front of the fan at high speed. Pay close attention to the motion of the cotton ball from the moment it's dropped until it stops moving. Make sure to record your observations in your science notebooks." b. Turn on the fan and drop one cotton ball at a time in front of the stream of air. Make sure the cotton ball has stopped moving before dropping another cotton ball in front of the fan. **Note:** Drop at least three cotton balls in front of the fan so that participants can track the pattern of motion and record their observations in their notebooks. c. Discuss participants' observations about the movement of the cotton balls from the moment they were dropped until they stopped moving. d. Record key steps in the cotton ball's motion on chart paper and try to reach a consensus on each step.

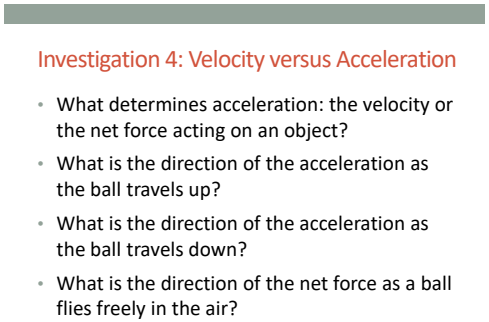
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Investigation 3: Cotton Balls in the Wind Do you agree or disagree with this pattern of motion based on our observations? 1. When the cotton ball was dropped, it fell toward the ground. 2. When the fan blew on the cotton ball, it moved forward, but it also continued falling toward the ground. 3. When the cotton ball hit the ground, it stopped moving.	**Display Slide 41.** Investigation 3: Cotton Balls in the Wind (1 min) a. Review the pattern of motion on the slide and ask participants whether they agree with it or want to suggest any revisions.
		Investigation 3: Cotton Balls in the Wind **Step 1: Gravity** pulls the cotton ball toward the ground. **Step 2: Air from the fan** pushes the cotton ball horizontally while gravity keeps pulling it down. **Step 3: Friction** between the cotton ball and the floor slows the cotton ball to a stop after it hits the ground. 	**Display Slide 42.** Investigation 3: Cotton Balls in the Wind (1 min) a. "The diagram on the slide shows the forces that were acting on the cotton ball. How does this description compare with our ideas?"

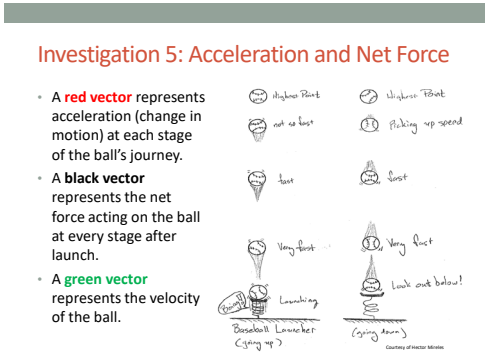
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 43.** Reflect: Content Deepening Focus Question 2 (5 min) a. Review the focus question on the slide. b. **Turn and Talk:** Direct participants to share with an elbow partner how ideas about forces helped them predict and explain the motion of a cotton ball in front of a rotating fan. Then have them answer the focus question in their notebooks. c. **Whole group:** Invite one or two participants to share their responses with the group.
			**Display Slide 44.** Key Science Ideas (Less than 1 min) a. Review the key science ideas on the slide.
	10-MINUTE BREAK		

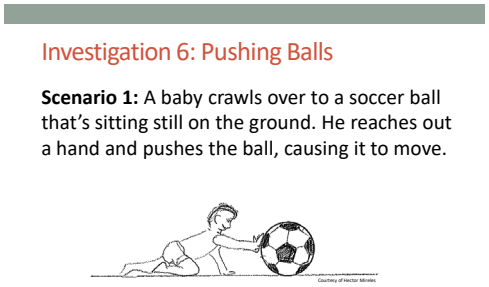
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 45.** Digging Deeper (Less than 1 min) a. Introduce the questions on the slide. b. "For the rest of our content deepening session, we'll think about these questions."
			**Display Slide 46.** Speed, Velocity, Acceleration (4 min) a. Discuss the questions on the slide. b. **Emphasize:** "By the end of today's session, you should understand the important distinctions between these three concepts."

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 47.** Speed versus Velocity (4 min) a. "The diagram on the slide shows a baseball being launched into the air. It travels upward on the left and comes back down on the right." b. Pose the questions on the slide. c. **Turn and Talk:** Have participants discuss these questions with an elbow partner. They should consider only the stages where the ball is *not* in contact with the launcher. d. **Whole group:** Invite participants to share their ideas and explanations with the group. e. **Emphasize:** At the highest point in the ball's path, it isn't moving at all.
			**Display Slide 48.** Speed versus Velocity (3 min) a. Walk participants through the definitions and examples on the slide. b. **Emphasize:** Velocity specifies direction, but speed doesn't. c. Ask participants, • Do cars B and C have the same speed? How do you know? • Do cars B and C have the same velocity? How do you know? **Ideal response:**

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			• Cars B and C have the same speed but not the same velocity because they're moving in opposite directions.
			**Display Slide 49.** Investigation 4: Velocity versus Acceleration (10 min) a. "Next, we'll investigate the distinction between velocity and acceleration in the same scenario." b. Distribute handout 7.6 (Velocity and Acceleration of a Baseball) and go over the instructions. c. Highlight the following guidelines: • A vector is an arrow that is drawn from the center of an object outward. A long vector indicates a high velocity. • Only velocity is drawn with a vector. Speed doesn't show direction, so a vector can't be used to represent it. Numbers are used instead (such as 25 mph). • At the ball's highest point, velocity is zero. This is represented with a dot. d. Direct participants to complete the worksheet using different-colored pencils. Green vectors represent the velocity of the ball at each point in its journey, and red vectors represent the change in the ball's velocity, or its acceleration. e. Allow participants to struggle with the worksheet for a while. Circulate while they're working and provide support as needed.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			Key ideas: • The change in the ball's velocity (acceleration) is a consequence of net force. At each stage of ball's flight, the net force consists of nothing more than the weight of the ball (gravity). So the acceleration at all stages (except the launch) is downward, and there is no change in its length. • Acceleration (in red) causes the changes in velocity (in green), since it's consistently downward. • The velocity of the ball does indeed change. At the highest point of the ball's flight, the velocity is zero.
			**Display Slide 50.** Investigation 4: Velocity versus Acceleration (3 min) a. Discuss the questions on the slide. b. **Emphasize the following points:** • Velocity is not acceleration. • Velocity and acceleration can point in opposite directions.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 51.** Investigation 5: Acceleration and Net Force (5 min) a. "Now let's compare the acceleration of the ball at each stage of its path with the net force." b. Display handout 7.6 (Velocity and Acceleration of a Baseball) on a document reader or Smart Board and ask participants how they would represent the acceleration, net force, and velocity at each stage of the ball's journey. Draw the vectors based on participants' input. c. Have participants compare the acceleration and net force at each stage of the ball's flight and explain their reasoning. d. Highlight the following points: • Acceleration is a change in the velocity of an object in a moment of time. • The acceleration of an object is proportional to the net force acting on the object and inversely proportional to the object's mass. • The direction of an object's acceleration is the same as the direction of the net force on the object. This causes a change in the object's motion. • When an object's acceleration is in the opposite direction of velocity, the object slows down. • When an object's acceleration is in the same direction as the velocity, the

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			object speeds up.
			**Display Slide 52.** Investigation 6: Pushing Balls (7 min) a. "Our next investigation will focus on the force required to get different balls moving." b. Distribute handout 7.7 (Baby Pushing a Soccer Ball and a Bowling Ball) and introduce the first scenario. c. **Individuals:** Ask participants to complete the tasks on the handout, drawing vectors to show the forces acting on the ball and the acceleration or change in motion. d. **Whole group:** Invite participants to describe the forces acting on the ball and the change in motion (acceleration). Ask probe and challenge questions as needed. e. Ask, "How does the speed of the ball change in response to the force?" **Ideal responses:** • The baby exerts a pushing force on the ball to the right. • The ball accelerates to the right in the direction of the net force, and the speed goes from zero to nonzero to the right.

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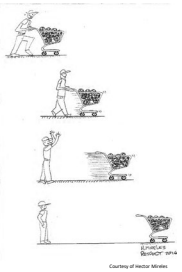
		Investigation 6: Pushing Balls **Scenario 2:** The same baby crawls over to a bowling ball that's sitting still on the ground. He reaches out a hand and pushes on the ball with the same amount force he used to get the soccer ball moving. 	**Display Slide 53.** Investigation 6: Pushing Balls (6 min) a. Introduce the second scenario on the handout. b. **Individuals:** Ask participants to complete the tasks on the handout, drawing vectors to show the forces acting on the bowling ball and the acceleration or change in motion. c. **Whole group:** Invite participants to describe the forces acting on the ball and the change in motion (acceleration). Ask probe and challenge questions as needed. **Ideal responses:** • The baby exerts a pushing force on the bowling ball to the right. • The bowling ball accelerates to the right in the direction of the net force, but not as much as the soccer ball. The speed increases a small amount from zero to the right.
		Investigation 7: Shoving a Shopping Cart **Scenario 1:** A man finds a shopping cart filled with soccer balls and easily gets it moving with a push. He continues pushing the cart to increase the speed. Then he gives the cart a final shove and lets it coast down the aisle. After a while, the cart slows to a stop. 	**Display Slide 54.** Investigation 7: Shoving a Shopping Cart (6 min) a. "Next, we'll explore what happens when a man shoves two different shopping carts—one filled with soccer balls and the other filled with bowling balls." b. Distribute handout 7.8 (Shoving a Shopping Cart) and introduce the first scenario.

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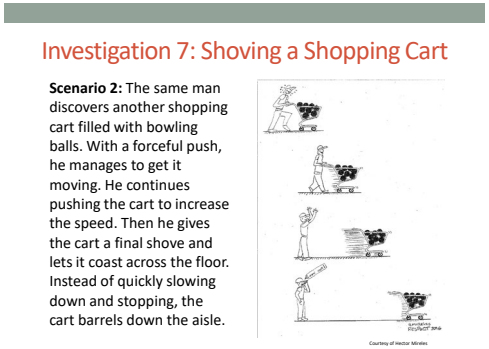
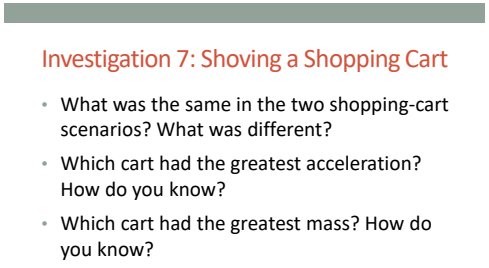
			c. **Individuals:** Ask participants to complete the tasks on the handout, drawing vectors to show the forces acting on the shopping cart, as well as the velocity and the acceleration or change in motion. d. **Whole group:** Invite participants to describe the forces acting on the shopping cart, as well as the velocity and the change in motion (acceleration). Ask probe and challenge questions as needed.
			**Display Slide 55.** Investigation 7: Shoving a Shopping Cart (6 min) a. Introduce the second scenario on the slide. b. **Individuals:** Ask participants to complete the tasks on the handout, drawing vectors to show the forces acting on the shopping cart, as well as the velocity and the acceleration or change in motion. c. **Whole group:** Invite participants to describe the forces acting on the shopping cart, as well as the velocity and the change in motion (acceleration). Ask probe and challenge questions as needed.

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

			**Display Slide 56.** Investigation 7: Shoving a Shopping Cart (4 min)
			
			a. Discuss the questions on the slide.
			
			b. Remind participants that acceleration is directly proportional to the net force and inversely proportional to the mass of an object.
			
			Ideal responses:
			• **Similarities:** Once the carts are moving, the man continues applying force to increase speed; then he shoves the carts.
			• **Differences:**
			  • The cart filled with bowling balls is heavier than the cart filled with soccer balls. The bowling balls have more mass.
			  • The man has to apply more force to get the heavier shopping cart moving.
			  • The heavier cart creates more friction as the wheels interact with the floor tiles, but the smoother surface allows the cart to travel farther because objects with more mass experience less acceleration.
			  • The lighter cart generates less friction between the wheels and the flooring, but since it has less mass, it experiences greater acceleration in the direction of the frictional force and slows down more quickly.
			  • **Acceleration:** The lighter cart has the greatest acceleration because it has the least mass.
			  • **Mass:** The heavier cart has the greatest mass and therefore the least

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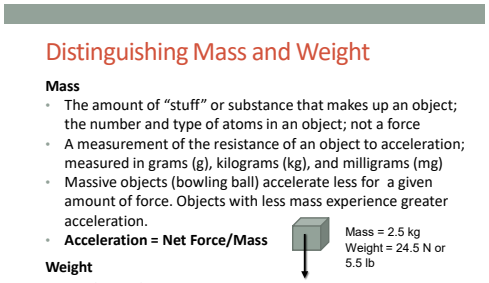
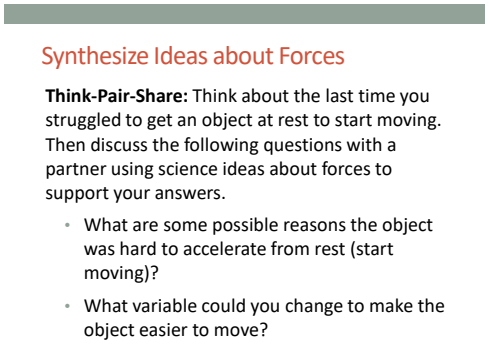
			acceleration.
			**Display Slide 57.** Distinguishing Mass and Weight (5 min) a. Walk participants through the science ideas on the slide. b. **Whole group:** Discuss the following questions: • What is the difference between mass and weight? • What does mass have to do with acceleration? c. Challenge participants to use the science ideas on the slide to support their explanations.
			**Display Slide 58.** Synthesize Ideas about Forces (8 min) **Note:** This activity may be skipped if time is running short. a. "To synthesize what we've learned so far about forces and motion, I'd like you to think about the scenario on the slide and discuss the questions with a partner. Try to use the science ideas we've been talking about in our content deepening sessions to support your answers." b. **Pairs:** Have pairs discuss the questions on the slide. c. **Whole group:** Invite one pair of participants to briefly share their objects and answers to the questions. Challenge

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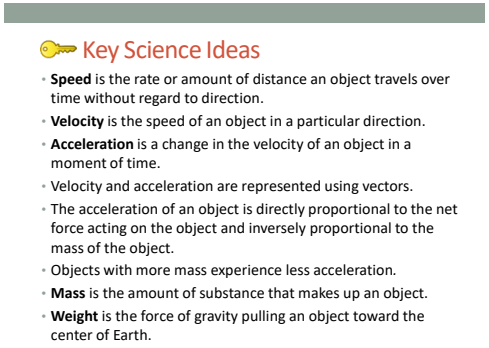
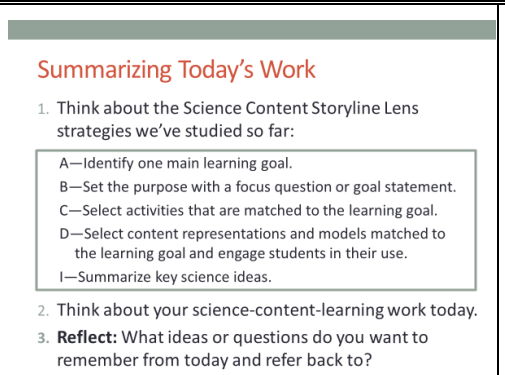
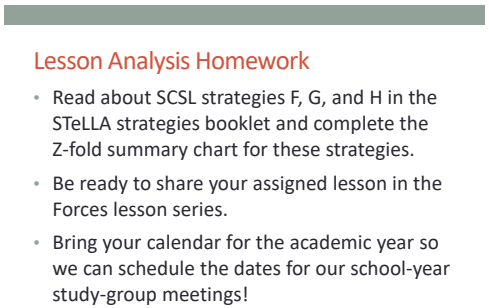
			them to answer the questions in complete sentences using key science concepts, including friction, speed, velocity, acceleration, and mass. d. **Individuals:** "Now think for a moment about how you'd like your students to answer these questions and come up with ideal student responses in complete sentences." e. **Whole group:** Briefly discuss ideal student responses and record them on chart paper. **Possible variable changes:** • Place the object on wheels or a slippery surface (less friction = less net force). • Make the object lighter (less mass). • Use a machine or get some help (more net force). • Let the object roll down a ramp (add the force of gravity).
			**Display Slide 59.** Key Science Ideas (Less than 1 min) a. Review the key science ideas on the slide. b. "After today's content deepening work, you should understand these ideas much better."

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
3:15–3:30 15 min **Wrap-Up: Summary, Homework, and Reflections** Slides 60–63	**Purpose** • Summarize and reflect on key ideas about SCSL strategies A, B, C, D, and I and the Forces science content, lesson plans, and lesson analysis work. **What Participants Do** • Write about and share key ideas from SCSL strategies A, B, C, D, and I. • Write about and share key ideas about today's content deepening work. • Copy down the homework assignment for day 8. • Write reflections on today's learning. **Handouts in PD Binder** • 7.9 Daily Reflections—Day 7 **Supplies** • Science notebooks		**Display Slide 60.** Summarizing Today's Work (6 min) 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. b. **Whole group (2 min):** Ask for volunteers to share an idea or question from their responses to the reflection question.
			**Display Slide 61.** Lesson Analysis Homework (2 min) a. Review the lesson analysis homework assignment and have participants write it in their notebooks. b. Make sure participants understand the assignment. 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."

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		Content Deepening Homework Read sections 8 and 10 in the content background document and be prepared to discuss these questions next time: • Does the reading clarify ideas we explored this week? • What new questions do you have?	**Display Slide 62.** 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.
		Reflections on Today's Session • What are your reactions to the strategy of selecting content representations and models that are matched to the lesson's main learning goal? • What is something new you've learned about forces? Did your content-representation analyses support this learning in any way? • Provide feedback about today's session and the PD program so far (likes, dislikes, questions, concerns, and suggestions).	**Display Slide 63.** Reflections on Today's Session (6 min) 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 7.9 in PD program binder).