RESPeCT Summer Institute Professional Development Leader Guide (PDLG)

Grade Level	1	**Day**	5	**STeLLA Strategy**	Science Content Storyline Lens (SCSL) Strategy A: Identify One Main Learning Goal	**Subject Matter Focus**	Variations in Plants and Animals (VPA)

Focus Questions	• What is the Science Content Storyline Lens (SCSL)? • Why is one main learning goal essential for science content storyline coherence? • How do traits in living things help us understand how they're grouped and related? • How are trait variations important for the survival of living things? • How can we represent patterns of trait variation among individuals of a species?
Main Learning Goals	Participants will understand the following: • Research from the TIMSS Video Study of Science Teaching emphasizes the importance of creating science content storylines that support students in making links between classroom activities and science ideas. • The SCS Lens and strategies empower teachers to think in new ways about planning and teaching science lessons. • Identifying and focusing on one main learning goal in a lesson is an important strategy for creating a coherent science content storyline. • Plants or animals of the same kind share similar characteristics or traits that we can recognize. They also have variations in traits that help them survive. • The traits of individuals of the same kind of plant or animal can vary, and some of these traits can be measured. We can use the measurements to confirm how much variation exists in a trait.

Preparation	**Materials**	**Videos**

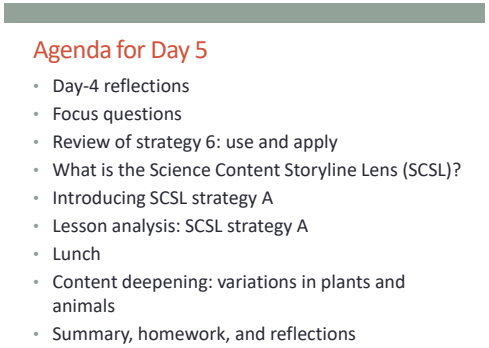
Daily Setup Tasks
• Check that video clips are correctly linked to PowerPoint (PPT) slides.
• Set up PowerPoint.
• Make sure video clips play correctly with good sound.
• Arrange furniture and food.
• Arrange participant materials.
• Put up posters and charts.
 	
Planning and Preparation Tasks
• Study the PDLG, PowerPoint slides (PPTs), video clips, and handouts. Make changes to PPTs if needed.
• Review the reflections from day 4 and create a summary slide.
	Posters and Charts
	• STeLLA Framework and Strategies poster
	• Day-5 Agenda (chart)
	• Norms for Working Together (chart)
	• Day-5 Focus Questions (chart)
	• Effective Science Teaching chart (from day 1)
	• Strategy charts from days 1–4 (STL strategies 1–6)
	• Parking Lot poster
	
	Handouts in RESPeCT PD Binder Front Pocket
	• Z-fold summary chart: Science Content Storyline Lens Strategies (blank)
	
	Handouts in RESPeCT PD Binder, Day 5
	• 5.1 Analysis Guide A: Identifying One Main
		• Video clips from the same VPA lesson:
		  • Video Clip 5.1: Griffin classroom (beginning of lesson); 5.1_mspcp_gr.1.tav_griffin_L8_c1
		  • Video Clip 5.2: Griffin classroom (during lesson); 5.2_mspcp_gr.1.tav_griffin_L8_c2
		  • Video Clip 5.3: Griffin classroom (end of lesson); 5.3_mspcp_gr.1.tav_griffin_L8_c3
		• Content deepening:
		  • *The Life Cycle of Painted Lady Butterflies* YouTube video (4:27); https://www.youtube.com /watch?v=63B1lnqPa8k

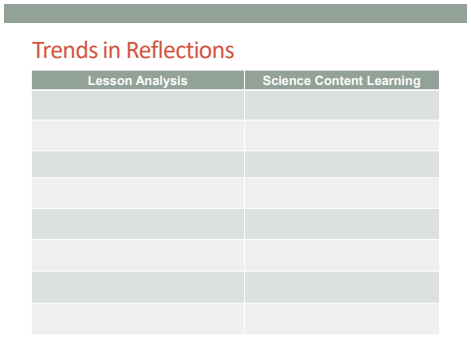
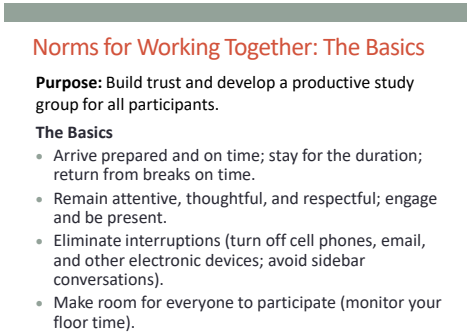
• Watch video clips and anticipate participant responses. • Prepare charts for the day's agenda and focus questions. • For content deepening: • Check the link for *The Life Cycle of Painted Lady Butterflies* YouTube video and review the clip.	Learning Goal (2 copies) • 5.2 Practice Identifying One Main Learning Goal • 5.3 Transcript for Video Clip 5.1 • 5.4 Transcript for Video Clip 5.2 • 5.5 Transcript for Video Clip 5.3 • 5.6 Traits and Groups (1 per pair) • 5.7 Celebrate Variation! • 5.8 Extended Homework: RESPeCT Lesson Plan Analysis • 5.9 Daily Reflections—Day 5 **PD Leader Masters, Days 5–8** • PD Leader Master: Practice Identifying One Main Learning Goal (Answer Key) **Supplies** • Science notebooks • Chart paper and markers • Rulers (for content deepening) **PD Resources** • STeLLA strategies booklet • RESPeCT PD program binder • RESPeCT lesson plans binder **Resources in Lesson Plans Binder** *Resources section:* • Variations in Plants and Animals and Variation in Traits Content Background Document • Common Student Ideas about Variations in Plants and Animals	

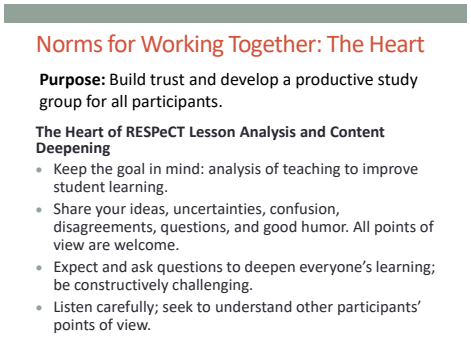
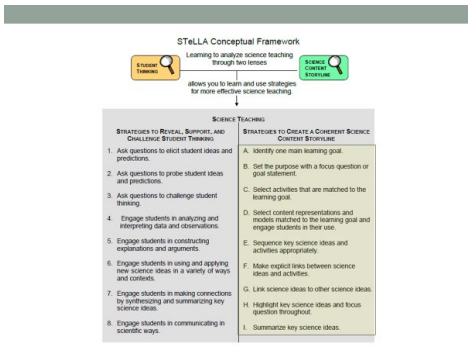
DAY 5 SESSION OUTLINE

Time	Activities	Purpose
8:00–8:25 25 min	**Getting Started: Housekeeping, Agenda, Day-4 Reflections, Norms, Focus Questions**	• Build community by sharing participants' reflections from day 4. • Set the stage for a day of learning.
8:25–8:40 15 min	**Review of Strategy 6: Use and Apply**	• Review STL strategy 6 (use and apply) and deepen participants' understandings of this strategy and the Sound lesson content.
8:40–8:55 15 min	**What Is the Science Content Storyline Lens (SCSL)?**	• Help participants develop strong initial understandings of the Science Content Storyline Lens.
8:55–10:10 75 min (Includes 10-min break)	**Introducing SCSL Strategy A**	• Clarify and deepen participants' understandings of SCSL strategy A: Identify one main learning goal. • Clarify the distinctions between science ideas, student ideas, and main learning goals.
10:10–12:00 110 min	**Lesson Analysis: SCSL Strategy A**	• Use lesson analysis of classroom videos to better understand SCSL strategy A. • Deepen participants' science-content knowledge of variations in plants and animals through lesson analysis.
12:00–12:45 45 min	**LUNCH**	
12:45–3:10 145 min (Includes 10-min break)	**Content Deepening: Variations in Plants and Animals**	• Determine participants' previous science-content knowledge related to traits, trait variation, and the levels of diversity in life. • Deepen participants' understandings of shared traits and trait variation among individuals within and across different species. • Consider how similarities and differences in traits across different species can be used to organize individual organisms into groups. • Explore patterns of trait variation within a species and how evidence of these patterns can be represented.
3:10–3:30 20 min	**Wrap-Up: Summary, Homework, and Reflections**	• Summarize and reflect on key ideas from today's learning, including the Science Content Storyline Lens, STeLLA strategy A, and the VPA science content.

DAY 5

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

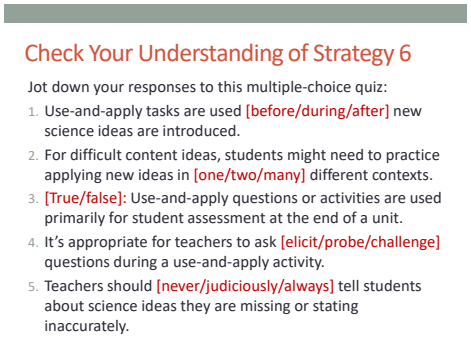
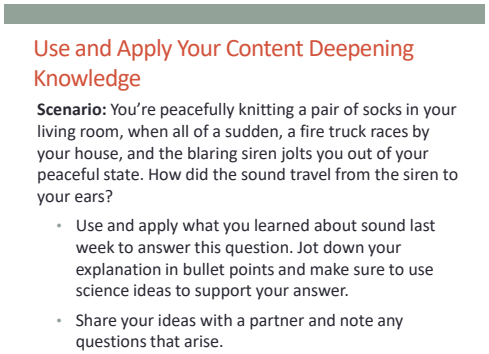
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 3.** Trends in Reflections (5 min) a. Give participants time to review your feedback on their reflections from day 4 and offer reactions, comments, or follow-up questions.
			**Display Slide 4.** Norms for Working Together: The Basics (5 min) a. Review the norms as a group. b. **Ask:** "Any comments or suggested changes? How are we doing with applying these norms?"

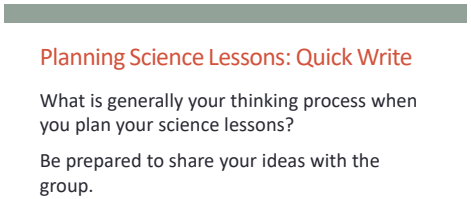
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 5.** Norms for Working Together: The Heart (5 min) a. Review these norms as a group. b. **Ask:** "Any comments or suggested changes? Which of these norms do you think we could get better at applying individually and as a group?" c. **Remind participants:** "These norms will become increasingly important during the Summer Institute and throughout the academic year as we analyze one another's classroom videos and learn together."
			**Display Slide 6.** STeLLA Conceptual Framework (2 min) a. **Transition:** This slide marks the transition from the STL strategies to the Science Content Storyline Lens strategies. b. "Throughout the PD program, we'll continue learning about the Student Thinking Lens (STL) strategies, but today we'll transition to the Science Content Storyline Lens strategies." c. Highlight the SCSL strategies on the slide.

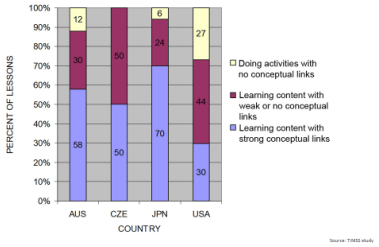
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process

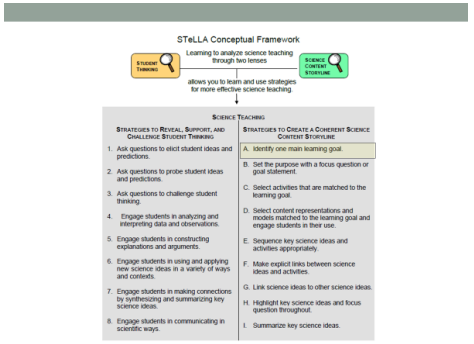
		Focus for the Week
		• Content area 2: variations in plants and animals (VPA)
		• Science Content Storyline Lens
		  • Strategies A, B, C, D, F, G, H, and I
		  • Video-based lesson analysis (VPA lessons)
		• VPA lesson plans review (last day)
		• Academic-year schedule (last day)
		  • Video recording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

		Today's Focus Questions • What is the Science Content Storyline Lens (SCSL)? • Why is one main learning goal essential for science content storyline coherence? • How do traits in living things help us understand how they're grouped and related? • How are trait variations important for the survival of living things? • How can we represent patterns of trait variation among individuals of a species?	**Display Slide 8.** Today's Focus Questions (1 min) a. Introduce the focus questions that will guide today's work.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
8:25–8:40 15 min **Review of Strategy 6: Use and Apply** Slides 9–10	**Purpose** • Review STL strategy 6 (use and apply) and deepen participants' understandings of this strategy and the Sound lesson content. **Content** • STL strategy 6 engages students in using and applying new science ideas in a variety of ways and contexts. **What Participants Do** • Take a multiple-choice quiz to check their understanding of STL strategy 6. • Work on a scenario that engages them in using and applying strategy 6 and the Sound lesson content. **Supplies** • Science notebooks		**Display Slide 9.** Check Your Understanding of Strategy 6 (7 min) **Note:** Display this slide only if it wasn't used on day 4. a. "To check your understanding of STL strategy 6, jot down your responses to this multiple-choice quiz in your science notebooks." b. Have participants discuss their answers either in pairs or as a group. (If time is short, just read the answers aloud.) **Answer key:** 1. After 2. Many 3. False 4. Challenge (and probe) 5. Judiciously (defined as "good or discriminating judgment; wise, sensible, or well advised")
			**Display Slide 10.** Use and Apply Your Content Deepening Knowledge (8 min) a. **Think-Pair-Share (3 min):** "Think about the scenario on the slide. Use and apply what you learned about sound last week to explain how the sound of the siren traveled to your ears. Jot down your explanation in bullet points in your notebooks, making sure to use science ideas to support your answer. Then share your ideas with an elbow partner and note any questions that arise." b. **Whole-group share-out (4 min):** "What ideas did you have for solving this use-and-apply scenario?"

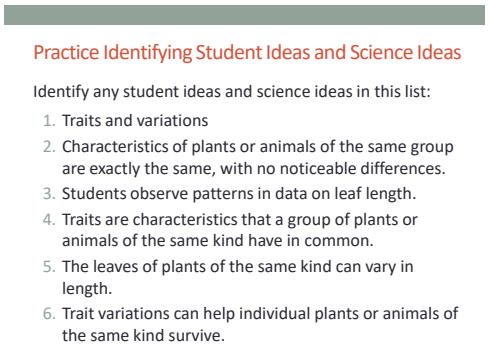
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			Ideal response: • When an object vibrates, it causes the air around it to vibrate. This vibrating air travels from the object (the siren) through the air to my ears and causes my eardrums to vibrate. My vibrating eardrums send a signal to my brain, and my brain interprets the vibrations as a loud siren that startled me from my peaceful state.
8:40–8:55 15 min **What Is the Science Content Storyline Lens (SCSL)?** Slides 11–13	**Purpose** • Help participants develop strong initial understandings of the Science Content Storyline Lens. **Content** • A science content storyline brings coherence within and across science lessons. **What Participants Do** • Write about and discuss their typical process of planning science lessons. • Discuss their reading about the definition of a science content storyline. • Review and discuss the TIMSS (Trends in Mathematics and Science Study) research basis for the Science Content Storyline Lens. **Posters and Charts** • STeLLA Framework and Strategies poster		**Display Slide 11.** Planning Science Lessons: Quick Write (6 min) **Note:** This activity is a lead-in for thinking about specific SCSL strategies. When planning science lessons, are participants thinking primarily about (1) SCSL issues, such as learning goals, (2) student misconceptions (an STL issue), which is a great start but doesn't include SCSL strategies, or (3) activities and/or classroom management and timing issues? a. **Individuals:** Direct participants to take 2–3 minutes to write down the key things they think about when planning science lessons. b. **Whole group:** Ask participants to share their reflections with the group. c. **Tell participants:** "The Science Content Storyline Lens strategies should provide some new or additional ways of thinking about planning your science lessons."

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

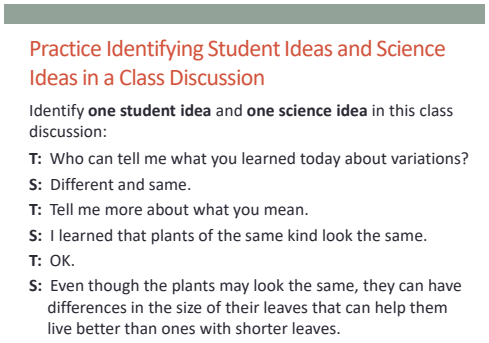
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			compared to other countries. c. **Summarize:** Point to strategies F and G on the STeLLA strategies poster: Make explicit links between science ideas and activities (strategy F) and link science ideas to other science ideas (strategy G). These strategies and the idea of a Science Content Storyline Lens grew out of the TIMSS research findings. d. "Today we'll begin our study of the Science Content Storyline Lens, with a focus on strategy A: Identify one main learning goal."
8:55–10:10 75 min (Includes 10-min break) **Introducing SCSL Strategy A** Slides 14–23	**Purpose** • Clarify and deepen participants' understandings of SCSL strategy A: Identify one main learning goal. • Clarify the distinctions between science ideas, student ideas, and main learning goals. **Content** • A main learning goal is a big idea that students are expected to learn and take away from a lesson or series of lessons. Everything in the lesson supports the development of this one main learning goal. **What Participants Do** • Make a chart highlighting the purpose and key features of SCSL strategy A. • Review the differences and relationships among student		**Display Slide 14.** Lesson Analysis: Focus Question 2 (1 min) a. Read the focus question on the slide.
			**Display Slide 15.** STeLLA Conceptual Framework (1 min) a. "Now let's dig into SCSL strategy A!" b. "As you can see, strategy A is the first of nine Science Content Storyline Lens strategies. It appears first because it's the foundation on which all the other SCSL strategies are built. This will become clearer as we delve into the other strategies and see how important it is that each of them is matched to the lesson's

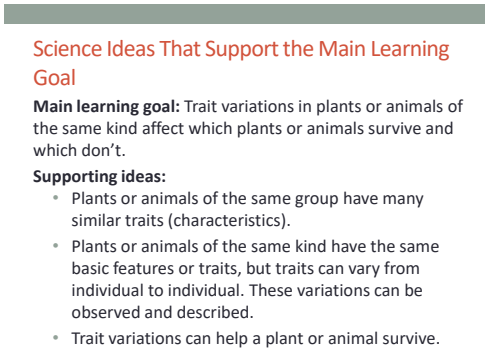
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	ideas, science ideas, and main learning goals. • Practice identifying student ideas and science ideas in a written list. • Practice identifying strong main learning goals using the analysis guide for strategy A. **Handouts in PD Binder** • 5.1 Analysis Guide A • 5.2 Practice Identifying One Main Learning Goal **PD Leader Masters** • PD Leader Master: Practice Identifying One Main Learning Goal (Answer Key) **Supplies** • Chart paper and markers **PD Resources** • STeLLA strategies booklet • SCSL Z-fold summary chart (blank copy in front pocket of PD binder) **Resources in Lesson Plans Binder** *Resources section:* • Content background document • Common Student Ideas		main learning goal." **Display Slide 16.** Purpose and Key Features of Strategy A (25 min) a. **Pairs:** "Share with a partner what you wrote on your Science Content Storyline Lens Z-fold summary chart about the purpose and key features of strategy A." b. **Whole group**: Have one or two participant volunteers lead the group in creating a chart that describes the purpose and key features of strategy A. c. **Transition:** "Next, we'll review the difference between a science idea and the main learning goal of a lesson. Then you'll practice identifying and clarifying this distinction."
		Purpose and Key Features of Strategy A • Review your SCSL Z-fold summary charts and share with a partner the purpose and key features of strategy A: Identify one main learning goal. • Remember to cite passages from the STeLLA strategies booklet. • Be prepared to share with the group.	
		A Main Learning Goal Is … • A big science idea that you want students to learn • A big idea that shows the relationship among science ideas • The focus of the lesson (or series of lessons) • Stated in a complete sentence (for planning purposes) • Stated by the teacher, a student, a text, or a multimedia resource • A support for teacher planning	**Display Slide 17.** A Main Learning Goal Is … (1 min) a. "This slide lists some key ideas about the definition of a main learning goal." b. Read through the ideas. c. **Emphasize:** "Notice the parenthetical reference to 'lessons' in the third bullet point. Each lesson should have only one main learning goal, but you might need two or more lessons to help students accomplish a difficult goal. So it's often necessary to spend more than one lesson on a specific learning goal."

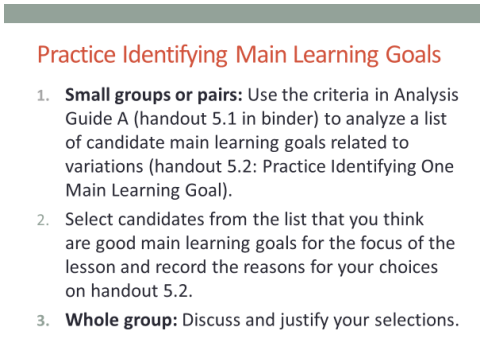
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		A Main Learning Goal Is NOT … • A topic or phrase • An activity • A question • A performance task or objective • A supporting detail, definition, or fact • A student misconception or idea that isn't scientifically accurate	**Display Slide 18.** A Main Learning Goal Is NOT … (1 min) a. Review what is **not** considered a main learning goal.
		Definitions: One Main Learning Goal and Science Ideas 1. Read these sections in the STeLLA strategies booklet: (1) STeLLA Strategy A: Identify One Main Learning Goal, and (2) Student Ideas and Science Ideas Defined. 2. Based on these readings, what are the differences between a main learning goal and a science idea?	**Display Slide 19.** Definitions: One Main Learning Goal and Science Ideas (10 min) a. Have participants locate these two readings in the strategies booklet: (1) STeLLA Strategy A: Identify One Main Learning Goal, and (2) Student Ideas and Science Ideas Defined. b. "After you read these sections in the strategies booklet, we'll discuss the differences between a science idea and a main learning goal." c. **Individuals (3 min):** Give participants time to read the specified sections in the strategies booklet. d. **Whole group (7 min):** Discuss the question on the slide. e. **Emphasize:** "While you might incorporate several science ideas that support the main learning goal of a lesson, be careful not to plan an 'all about' lesson with too many different science ideas that will likely come across to students as a bunch of disconnected

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			facts to be memorized."
			**Display Slide 20.** Practice Identifying Student Ideas and Science Ideas (5 min) a. "Next, we'll practice identifying student ideas and science ideas just to make sure you understand the way we're defining these terms." **Note:** As needed, refer participants to the section in the strategies booklet where student ideas are defined (Student Ideas and Science Ideas Defined). b. **Individuals:** "First, identify examples of **science ideas** on the slide. If you need help, refer to the document in your lesson plans binders titled Common Student Ideas about Variations in Plants and Animals. Then identify examples of **student ideas** on the slide." c. **Whole group:** Discuss participants' responses and the correct answers (see answer key). **Answer key:** • Student ideas: 2 • Science ideas: 4, 5, 6 • Neither: 1, 3

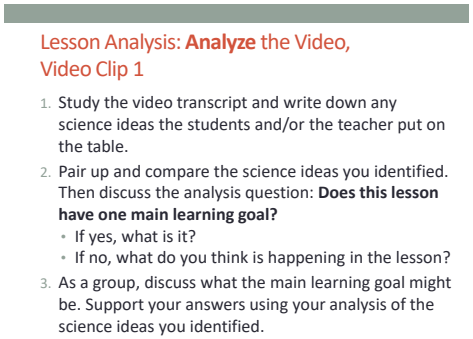
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process

			**Display Slide 21.** Practice Identifying Student Ideas and Science Ideas in a Class Discussion (5 min)
			
			a. "It's a little trickier to recognize student ideas and science ideas in class discussions because students sometimes give only one- or two-word answers to teacher questions. But if you link the teacher's question with a student's response, you can sometimes find a science idea or a student idea."
			
			Note: In the RESPeCT PD program, we encourage students to speak in complete sentences as much as possible.
			
			b. "Let's practice linking the teacher's question with student responses in the sample discussion on the slide."
			
			c. **Pairs:** "Work with a partner to see if you can identify one student idea and one science idea in this discussion."
			
			d. **Whole-group share-out:** Have participants share the ideas they identified in the sample discussion. Then review the answers (see answer key below).
			
			e. **Emphasize**: "Here's some food for thought: To make student thinking more visible, why not require students to speak in complete sentences during classroom discussions about science ideas?"
			
			Answer key:
			• *Student ideas:*
			  • Plants of the same kind look the same.
			  • "Different and same" is not a complete sentence or a fully articulated idea.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			• *Science ideas:* • "Even though the plants may look the same, they can have differences in the size of their leaves that can help them live better than ones with shorter leaves."
			**Display Slide 22.** Science Ideas That Support the Main Learning Goal (6 min) a. Display **only** the main learning goal on the slide. b. **Pairs:** "Work with a partner to come up with two or three science ideas that might support the development of this main learning goal. Use the VPA content background document and the Common Student Ideas chart as resources." c. **Whole group:** Have pairs share the supporting science ideas they came up with. d. Next, reveal the list of possible supporting science ideas one by one on the slide and compare them with participants' ideas. e. **Highlight:** "Some of these supporting science ideas could also be a main learning goal for a lesson."

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

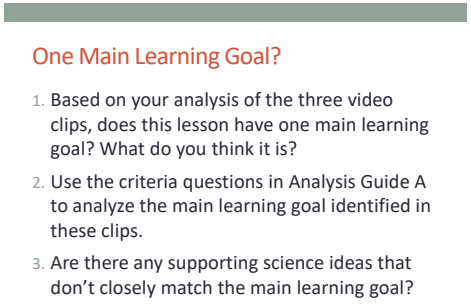
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
10:10–12:00 110 min **Lesson Analysis: SCSL Strategy A** Slides 24–32	**Purpose** • Use lesson analysis of classroom videos to better understand SCSL strategy A. • Deepen participants' science-content knowledge of variations in plants and animals through lesson analysis. **Content** • Using one main learning goal brings coherence within and across lessons. • A main learning goal is a big idea that students are expected to learn and take away from a lesson or series of lessons. Everything in the lesson supports the development of this one main learning goal. **What Participants Do** • Watch a sequence of three video clips from one lesson. Analyze the science ideas in each clip and determine whether they're organized to support one main learning goal. • Use the criteria in Analysis Guide A to determine the quality of the main learning goal identified for this lesson. • Examine a lesson plan from the VPA unit to see how the main learning goal and supporting	Lesson Analysis: Strategy A Next, we'll watch a sequence of three video clips from a single lesson on variations in plants and animals. **Analysis question for all three clips:** Does this lesson have one main learning goal? **Follow-up questions:** • If yes, what is it? • If no, what do you think is happening in the lesson?	**Display Slide 24.** Lesson Analysis: Strategy A (1 min) a. Make sure participants understand that they will be viewing a sequence of three video clips from the same lesson on variations in plants and animals. b. "For all three clips, we'll answer the analysis question, *Does this lesson have one main learning goal?*" c. "If the answer is yes, what is the learning goal? If no, why do you think that's the case? What do you think is happening in the lesson?"
		Lesson Analysis: **Review** Lesson Context, Video Clip 1 1. Read the lesson context on the video transcript (handout 5.3 in PD program binder). 2. As you watch the clip, keep the analysis question in mind: **Does this lesson have one main learning goal?** • If yes, what is it? • If no, what do you think is happening in the lesson? Link to video clip 1: 5.1_mspcp_gr.1.tav_griffin_L8_c1	**Display Slide 25.** Lesson Analysis: Review Lesson Context, Video Clip 1 (5 min) a. Have participants read the lesson context at the top of the video transcript (handout 5.3 in PD program binder). (Less than 1 min) b. Read the information on the slide. (Less than 1 min) c. Show the video clip. (4 min)

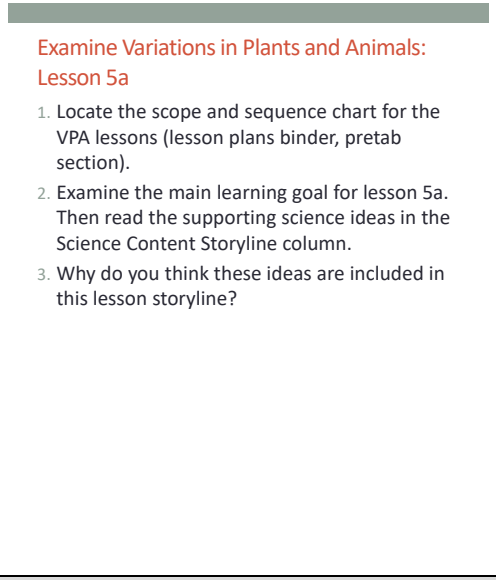
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	science ideas are identified. **Videos** • Video Clip 5.1, Griffin classroom (beginning of lesson) • Video Clip 5.2, Griffin classroom (during the lesson) • Video Clip 5.3, Griffin classroom (end of lesson) **Handouts in PD Binder** • 5.1 Analysis Guide A • 5.3 Transcript for Video Clip 5.1 • 5.4 Transcript for Video Clip 5.2 • 5.5 Transcript for Video Clip 5.3 **Supplies** • Science notebooks • Chart paper and markers **PD Resources** • RESPeCT lesson plans binder		**Display Slide 26.** Lesson Analysis: Analyze the Video, Video Clip 1 (25 min) a. Before participants analyze the video transcript, remind them of these key points: (1 min) • A science idea is a full-sentence idea that students could take away as something they learned during the lesson. • Science ideas are sometimes identified by linking the teacher's question with the student's response. b. **Individuals (8 min):** "Study the video transcript and write in your notebooks any science ideas you identify in the discussion." c. **Pairs (5 min):** "Pair up and compare the science ideas you identified in the transcript. Then discuss the questions on the slide." d. **Whole group (11 min):** Have participants share what they think might be the main learning goal of this lesson, using their analyses of the science ideas they identified to support their suggestions. e. List the possible learning goals on chart paper. f. Let participants know they'll revisit this list of possible main learning goals for the lesson after they watch the remaining video clips. **Science ideas:** • **Video segment 0:03:33:** "Will some of [the dandelions] … survive to produce new seeds?" **Possible main learning goal:** "Variations in

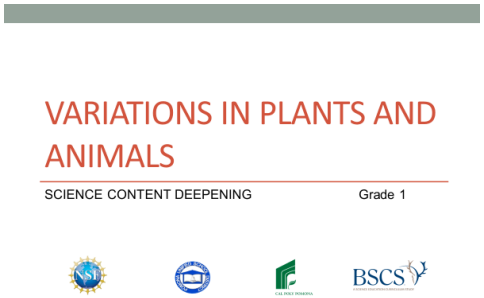
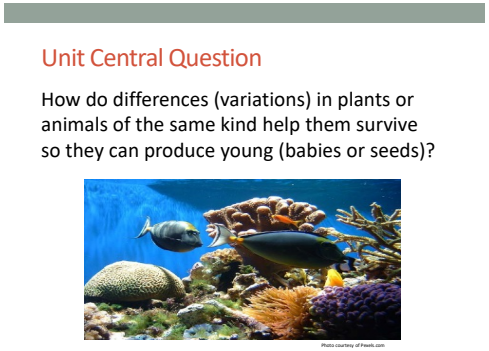
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			plants and animals of the same kind help them to survive [long enough] so they can produce babies" (segment 0:00:02).
		Lesson Analysis: **Review** Lesson Context, Video Clip 2 1. Read the lesson context on the video transcript (handout 5.4 in PD binder). 2. As you watch the clip, keep the analysis question in mind: **Does this lesson have one main learning goal?** • If yes, what is it? • If no, what do you think is happening in the lesson? Link to video clip 2: 5.2_mspcp_gr.1.tav_griffin_L8_c2	**Display Slide 27.** Lesson Analysis: Review Lesson Context, Video Clip 2 (5 min) a. Have participants read the lesson context at the top of the video transcript (handout 5.4 in PD binder). (Less than 1 min) b. Review the instructions on the slide. (Less than 1 min) c. Show the video clip. (4 min)
		Lesson Analysis: **Analyze** the Video, Video Clip 2 1. Study the video transcript and write down any **student ideas** and **science ideas** you identify. 2. Pair up and compare the student ideas and science ideas you identified. Then discuss this question: **Are these ideas consistent with the possible main learning goal you identified for video clip 1?** 3. As a group, discuss the possible main learning goal for this lesson. Make sure to support your answers using your analysis of the science ideas you identified.	**Display Slide 28.** Lesson Analysis: Analyze the Video, Video Clip 2 (25 min) a. Review the definitions of a science idea and a student idea. Remind participants that students can express correct science ideas and inaccurate student ideas at the same time. (1 min) b. **Individuals (8 min):** "Study the video transcript and write in your notebooks any student ideas and science ideas you identify." c. **Pairs (5 min):** "Pair up and compare the student ideas and science ideas you identified in the transcript. Then discuss the questions on the slide." d. **Whole group (11 min):** Have participants share what they think might be the main

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			learning goal of this lesson, using their analyses of the science ideas they identified to support their suggestions. e. List the possible learning goals on chart paper. f. Let participants know they'll revisit this list of possible main learning goals for the lesson after they watch one more video clip. **Student ideas:** • **Video segment 0:00:11:** "I think the small one [dandelion] will … will survive because the lawnmower only cuts off, like, half of [it]." • **Segment 0:00:29:** "Maybe the wind … will blow off the seeds and blow them to a new place and grow." • **Segment 0:05:46:** "Because dandelions make the new seed." **Science ideas:** • In several instances, the teacher asks students to clarify their thinking about what happens to the dandelions after the lawn is mowed, but the science ideas aren't fully explained. For example, at segment 0:04:21, the teacher repeats another student's idea ("He doesn't think that the big dandelion is gonna survive"), but the student doesn't explain why at this point. **Are the ideas consistent with the MLG in clip 1?** • Yes. In this clip, students complete drawings that show what they think will happen when the grass in the park is mowed. This scenario was introduced in clip 1.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Lesson Analysis: **Review** Lesson Context, Video Clip 3 1. Read the lesson context on the video transcript (handout 5.5 in PD binder). 2. As you watch the clip, keep the analysis question in mind: **Does this lesson have one main learning goal?** • If yes, what is it? • If no, what do you think is happening in the lesson? Link to video clip 2: 5.3_mspcp_gr.1.tav_griffin_L8 _c3	**Display Slide 29.** Lesson Analysis: Review Lesson Context, Video Clip 3 (5 min) a. Have participants read the lesson context at the top of the video transcript (handout 5.5 in PD binder). (Less than 1 min) b. Review the instructions on the slide. (Less than 1 min) c. Show the video clip. (4 min)
		Lesson Analysis: **Analyze** the Video, Video Clip 3 1. Study the video transcript and write down any **student ideas** and **science ideas** you identify. 2. Pair up and compare the student ideas and science ideas you identified. Then discuss this question: **Are these ideas consistent with the possible main learning goal you identified for clips 1 and 2?** 3. As a group, discuss the possible main learning goal for this lesson. Make sure to support your answers using your analysis of the science ideas you identified.	**Display Slide 30.** Lesson Analysis: Analyze the Video, Video Clip 3 (24 min) a. **Individuals (8 min):** "Study the video transcript and write in your notebooks any student ideas and science ideas you identify." b. **Pairs (5 min):** "Pair up and compare the student ideas and science ideas you identified on the transcript. Then discuss the questions on the slide." c. **Whole-group (11 min):** Have participants share what they think might be the main learning goal of this lesson, using their analyses of the science ideas they identified to support their suggestions. d. List the science ideas and possible learning goals on chart paper. e. **Ask:** "Did the three video clips develop coherence across the lesson or include too many ideas that didn't support the main learning goal?"

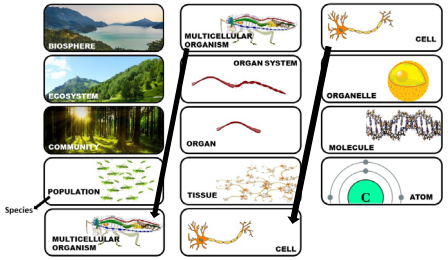
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			Student ideas: • The dandelions will survive because they'll bend. **Science ideas:** • The tall dandelion won't survive. • The tall dandelion won't produce seeds. • The short dandelion will survive and produce seeds. • Since only the short dandelion survives to produce seeds, there will be only short dandelions in the park the next year.
			**Display Slide 31.** One Main Learning Goal? (15 min) a. **Whole group:** Discuss the first question on the slide and reach a consensus on the main learning goal for the lesson. **Ideal response:** *Variations in the length of the dandelion stem (trait) and the environment (mower) affect which plants survive long enough to produce babies (seeds), and thus which variation (short stem) becomes more common in the next generation.* b. **Pairs:** Have participants work in pairs to answer the criteria questions in Analysis Guide A for the main learning goal they agreed upon for this lesson. Also have them identify any supporting science ideas that don't closely match the main learning goal. c. **Whole group:** Discuss participants' responses to the questions in Analysis Guide A and the final question on the slide. **Science ideas:** • The tall dandelion doesn't survive because the

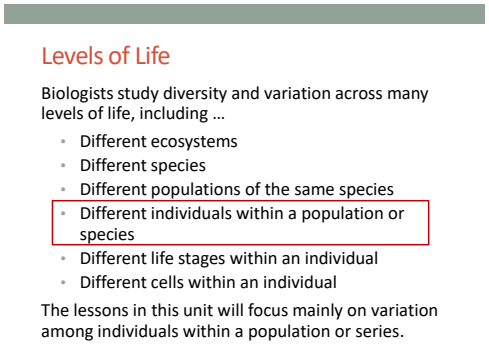
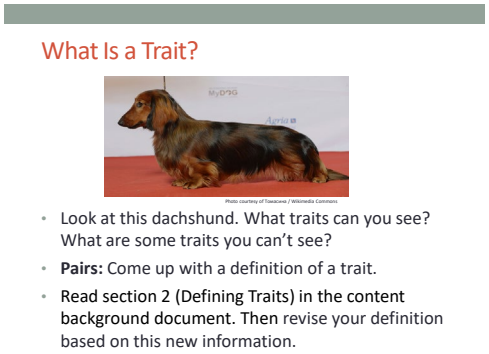
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			mower cuts off its flower, so there won't be any seeds. • The small-stemmed dandelion survived with its flower. • The trait that varied was the stem. • The variation was the stem length. • The dandelions with the short-stemmed variation are more likely to survive the mower, so they're more likely to disperse new seeds. **Is the MLG consistent in clips 1, 2, and 3:** • Yes, the learning goal overlaps in all three clips during this use-and-apply activity.
			**Display Slide 32.** Examine Variations in Plants and Animals: Lesson 5a (5 min) **Note:** This slide is **optional** if time is running short. It's designed to help participants see how the lesson plans are written to highlight the main learning goal and science ideas that support the main learning goal. a. Have participants examine the main learning goal for lesson 5a in the scope and sequence chart of their lesson plans binders. Then have them review the supporting science ideas in the Science Content Storyline column. b. **Ask:** "Why do you think these ideas are included in this lesson storyline?"
12:00–12:45 45 min	**LUNCH**		

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
12:45–3:10 145 min (Includes 10-min break) **Content Deepening: Variations in Plants and Animals** Slides 33–73	**Purpose** • Determine participants' previous science-content knowledge related to traits, trait variation, and the levels of diversity in life. • Deepen participants' understandings of shared traits and trait variation among individuals within and across different species • Consider how similarities and differences in traits across different species can be used to organize individual organisms into groups. • Explore patterns of trait variation within a species and how evidence of these patterns can be represented. **Content** • Biologists study diversity and variation across many levels of life. • *Traits* are features or characteristics of an organism that may be visible or hidden. • The traits of individuals of the same kind of plant or animal may or may not vary within a species. • Traits help biologists identify related groups of organisms. • The traits of organisms include		**Display Slide 33.** Content Deepening: Variations in Plants and Animals (Less than 1 min) a. "Now let's begin our investigation of variations in plants and animals." **Note:** Throughout this content deepening phase, refer as needed to Variations in Plants and Animals Content Background Document and Common Student Ideas about Variations in Plants and Animals.
			**Display Slide 34.** Unit Central Question (Less than 1 min) a. Introduce the unit central question on the slide and point out that this is the same question students will think about during the VPA lesson sequence. b. "This week, we'll explore science ideas about variations in plants and animals that will help us answer this question." c. Have participants write the unit central question in their science notebooks and draw a double-lined box around it to reinforce the practice they'll follow with their students.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	physical traits, molecular traits, behavioral traits, chemical pathways, and developmental pathways. • A *species* is a group of individuals that can mate and produce fertile offspring under natural conditions. • Shared traits help biologists define groups of organisms related by common ancestry. • One reason groups of organisms share so many features is common ancestry. • Common ancestry explains why organisms have many shared features and one might think they are closely related. • Patterns of trait variation among individuals of a species are represented in different ways and can be recorded on frequency distribution tables and histograms. **What Participants Do** • Explore the definition of a trait. • Identify examples of traits and variations among painted lady		**Display Slide 35.** Content Deepening: Focus Question 1 (2 min) a. Introduce the focus question on the slide. b. Have participants copy the question into their science notebooks. c. Then elicit some initial ideas from participants and record them on chart paper.
			**Display Slide 36.** Thinking about Differences (2 min) a. "What do you think of when you hear words like *diversity* or *variation*? Let's hear some of your ideas." **Note:** This elicit question is designed to uncover participants' initial ideas. Don't try to correct their ideas at this point or lead them to the right answers. b. As participants share their ideas, record them on chart paper. Ask probe questions to clarify their thinking.

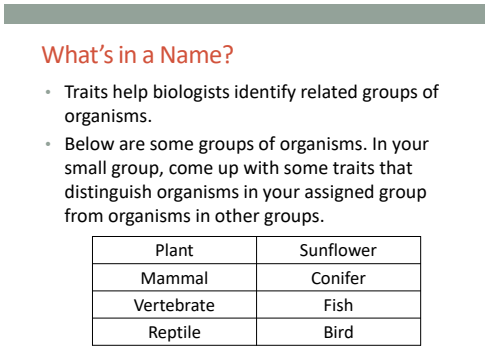
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	butterflies • Identify shared traits among groups of organisms related by common ancestry. • Examine four different species, list their traits, and categorize them. • Learn how biologists organize living organisms into groups based on the presence or absence of certain traits. • Assign organisms to related groups and make a claim stating why each organism belongs in a particular group. • Identify traits that differ among species of organisms and explain how trait variations might affect survival. • Link activities to the NGSS performance expectations for 1st grade. • Investigate trait-variation patterns by collecting and analyzing data for 10–20 individual plants of the same species. • Demonstrate trait-variation patterns within a plant species using data from the investigation to create a histogram and a frequency distribution table. **Videos** • *The Life Cycle of Painted Lady Butterflies* (YouTube video) **Handouts in PD Binder** • 5.6 Traits and Groups (1 per pair)	Traits and Trait Variations in Butterflies • As you watch the video clip, identify examples of traits and variations among painted lady butterflies. • Record your observations and ideas in your notebook.  Photo courtesy of Pixabay.com Link to YouTube video clip: https://www.youtube.com/watch?v=63B1InqPa8k	**Display Slide 37.** Traits and Trait Variations in Butterflies (5 min) a. "As you watch a video clip about the life cycle of painted lady butterflies, look for examples of traits and trait variations in the butterflies and record your observations in your notebooks." b. Show the YouTube video from the beginning to segment 4:27. c. Invite one or two participants to share their observations of butterfly traits and variations with the group. **Observations:** • Some traits that vary are the size and shape of the caterpillars, the timing of the silk-button formation, and the timing of butterflies emerging from the chrysalis.
		Traits and Trait Variation in Butterflies What traits did all of the individual butterflies share?  Photo courtesy of Pixabay.com	**Display Slide 38.** Traits and Trait Variations in Butterflies (Less than 1 min) a. "What traits did all of the individual butterflies in the video share?" **Possible responses:** • The number of legs • The number of body segments • The number of eyes • The life cycle • The basic pattern of colors in the same life stages.

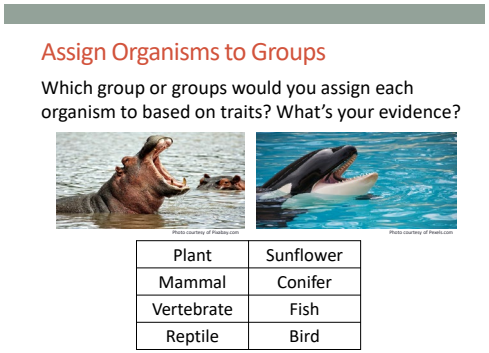
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	• 5.7 Celebrate Variation! **Supplies** • Science notebooks • Chart paper and markers • Rulers **PD Resources** • RESPeCT lesson plans binder **Resources in Lesson Plans Binder** *Resources section:* • Content background document • Common Student Ideas about Variations in Plants and Animals	Levels of Life In the video clip, we identified trait variations among individual butterflies, but life has many levels of organization. What do you think the phrase "levels of life" means?	**Display Slide 39.** Levels of Life (1 min) **Note:** This slide marks a transition into a discussion of trait variation at different levels of life. a. "In the video clip, we identified several trait variations among *individual* butterflies, but life has many levels of organization." b. "What do you think the phrase "levels of life" means?" c. Invite a few participants to share their initial ideas.
		Levels of Life  	**Display Slide 40.** Levels of Life (1 min) a. "Biologists study life at various levels of organization. Let's briefly review the levels of life on the slide." b. Walk participants through the various levels of life on the slide, but don't dwell on the details or differences between levels at this point. c. "Variations can be observed at all of these levels, with the exception of the biosphere, since it's unlikely we'll find other biospheres in the universe." d. "Each higher level of life may have properties that aren't necessarily predictable from lower levels. For example, cells may have certain functions and accomplish things that we wouldn't necessarily be able to predict based on knowing which organelles and molecules make up the cells."

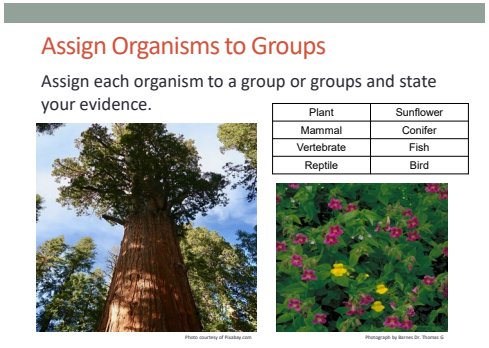
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 41.** Levels of Life (Less than 1 min) a. "Biologists study diversity and variation across many levels of life, such as across different ecosystems, species, populations within a species, individuals within a population or species, life stages within an individual, and cells within an individual." b. Emphasize that the lessons in this unit will focus mainly on variation among individuals within a population or species.
			**Display Slide 42.** What Is a Trait? (8 min) a. "Look at this photo of a dachshund. What traits do you see? What are some traits you can't see?" b. As participants share their observations, record five or six traits on chart paper. c. **Individuals:** Ask participants to come up with a concise working definition of a trait. Direct them to write this definition in their notebooks. d. **Whole group:** Invite a few participants to share their definitions with the group. As time allows, ask probe questions, such as "What do you mean when you say …?" "Can you define this more precisely?" and "Can you elaborate on that idea?" e. After the discussion, have participants locate the content background document in their lesson plans binders and read the section titled "Defining Traits." Give them a minute or

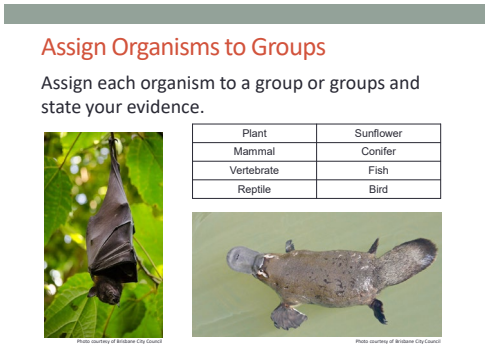
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			two to revise their definitions based on this information. Their revisions should be in their own words. f. Emphasize from the reading that traits are features or characteristics of organisms that may be visible or hidden. They aren't just physical features; they can also be behaviors, molecular characteristics like DNA, chemical pathways, or developmental pathways.
			**Display Slide 43.** Categories of Traits (6 min) a. **Pairs (3 min):** "Now I'd like you to work with an elbow partner to create a thinking map showing categories of traits. Come up with at least one example for each category. Your examples may include traits of dachshunds and other kinds of organisms." b. **Whole-group discussion (3 min):** "What categories of traits and examples did you come up with?" **Note:** Ideally, pairs should come up with most or all of the following categories of traits and cite at least one example for each category : • External physical traits (e.g., fur color, eye color, hair length) • Internal physical traits (e.g., brain size, bone structure) • Behavioral traits (e.g., mother feeding offspring with milk) • Molecular traits (e.g., DNA) • Developmental pathways (e.g., stages of butterfly life) • Chemical pathways (e.g., how food is broken down and used)

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 44.** Identifying and Categorizing Traits (7 min) **Note:** Hide the photographs during the synonym discussion. Then reveal one photo at a time in the following order: (1) dolphin, (2) tardigrade (water bear), (3) *Staphylococcus aureus* bacteria, and (4) human beings. Don't reveal the next organism in the sequence until participants have listed traits for the current organism. a. "What synonyms can you think of for the word *trait*? Let's try to come up with three or four." b. Write the synonyms on the board; then ask participants which ones their students are most likely to use. c. Next, reveal one photograph at a time (see note above) and ask participants to come up with three traits for each of the following organisms: • A dolphin • A tardigrade or water bear. (**Note:** These amazing organisms can survive in temperatures between −458 ºF to about 300 ºF, and they can live 30 years without food or water.) • A bacteria called *Staphylococcus aureus*. (**Note:** Some forms of this bacteria are resistant to antibiotics (methicillin-resistant *Staphylococcus aureus*) and cause outbreaks in schools and hospitals. Biologists categorize bacteria using common traits, such as the kinds of foods they eat and the chemicals they break down.)

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			• Human beings d. List the organisms on chart paper and record the traits participants come up with. e. "Now let's try to categorize these traits using the categories we listed earlier: physical traits, behavioral traits, molecular traits, developmental pathways, or chemical pathways."
			**Display Slide 45.** What's in a Name? (6 min) a. "Traits help biologists identify related groups of organisms like the ones on this slide. Let's see if we can identify traits that distinguish each of these groups from other groups of organisms." b. **Small groups (3 min):** Have participants divide up into small groups of two or three. Then assign each pair or threesome one group of organisms on the slide to investigate. To find information about their assigned organism, participants may use a search engine on their smartphones. Direct them to come up with a list of traits that distinguish their group of organisms from other groups on the chart. c. **Whole-group discussion (3 min):** Invite a few participants to share the traits they listed for their assigned group of organisms. Ask probe questions to find out why they think these traits distinguish their group of organisms from other groups. d. "Why might the elicit question 'What's in a name?' be useful to ask from a teaching and learning perspective?"

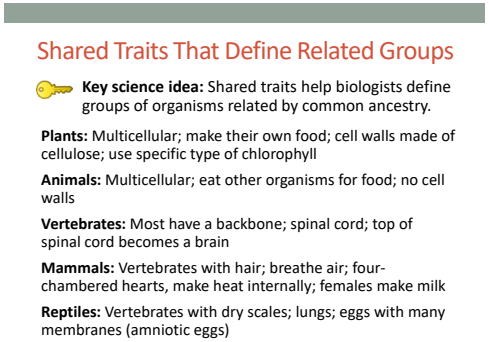
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 46.** Assign Organisms to Groups (5 min) **Note:** Initially, display only the questions at the top of the slide. a. "Next, we'll use our knowledge of traits to assign different organisms to groups." b. Reveal the image of the hippo and the chart of organisms. c. "Look at the organism chart on the slide and think about where you would place the hippo based on specific traits. Which group would be the most specific, or least inclusive? What evidence supports your decision?" d. Next, reveal the image of the orca whale and ask participants to assign the organism to the least inclusive group on the chart based on specific traits. Make sure participants back up their answers with evidence. e. Highlight the traits that hippos and the orcas have in common. Then ask, "What are some differences between these organisms? How might these differences help the two species live in its environment?" **Ideal responses:** • *Similarities:* Hippos and whales are both mammals. This means they're vertebrates with hair, they breathe air and have four-chambered hearts, they make heat internally, and females make milk. Both hippos and whales are large and heavy and have very little hair. Interestingly, they're closely related in evolutionary history. • *Differences:*

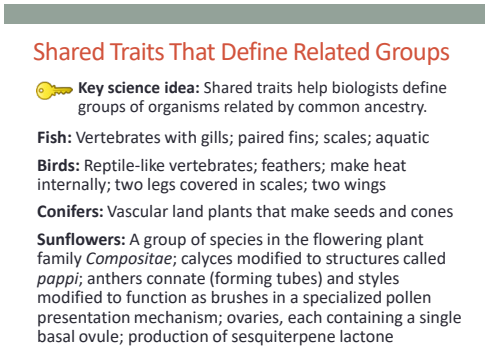
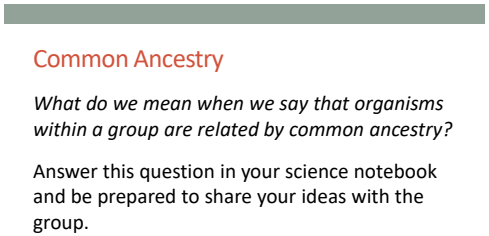
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			• Whales live in a water environment, while hippos live on land, although they also spend quite a bit of time walking or floating in water (but not swimming). • Hippos have legs (for walking and running); whales have fins (for swimming). • Hippos are herbivores that eats plants, whereas whales are carnivores that eat fish, seals, sharks, and other organisms. • Hippos have smaller teeth for grinding food and larger teeth for cutting food; whales use their teeth only for cutting food, and they swallow smaller fish whole. • The coloring of hippos and orcas is quite different. Orcas are black and white, while hippos are bluish gray or black with pink skin around the eyes and ears and on the belly. • Orcas form pods and are highly social, while hippos aren't social at all.
			**Display Slide 47.** Assign Organisms to Groups (4 min) **Note:** Initially, display only the instructions and chart at the top of the slide and the image of the sequoia tree. a. Ask participants to assign the sequoia tree to the most specific (least inclusive) group based on traits and include their evidence. b. Next display the image of the monkeyflower bush and ask participants to assign the organism to the most specific (least inclusive) group based on traits. Make sure they support their choices with evidence. c. Highlight the traits these plants have in

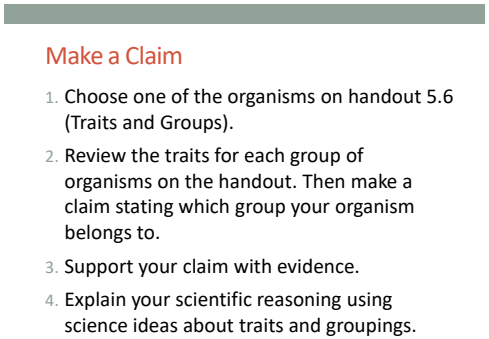
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			common. Then ask, "What are some differences between sequoias and monkeyflower bushes? How might these differences help the two species live in its environment?" **Ideal responses:** • *Similarities:* Both the sequoia tree and the monkeyflower bush are plants. This means they're multicellular, make their own food, have cell walls made of cellulose, produce and use a specific type of molecule called *chlorophyll* for photosynthesis. • *Differences:* Sequoia trees are conifers, which have needles instead of leaves and produce pine cones. They also don't lose their needles in winter. Monkeyflower bushes aren't conifers. They're also much smaller than sequoias and produce colorful flowers.
			**Display Slide 48.** Assign Organisms to Groups (4 min) **Note:** Initially, display only the instructions and chart at the top of the slide and the platypus photo. a. Ask participants to assign the platypus to the most specific (least inclusive) group based on traits and include their evidence. b. Next display the photo of the bat and have participants assign the organism to the most specific (least inclusive) group based on traits. Make sure they support their choices with evidence. c. Highlight the traits these animals have in common. Then ask, "What are some differences between platypuses and bats?

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

			How might these differences help the two species live in its environment?"
			
			Ideal responses:
			• *Similarities:* Both platypuses and bats are mammals. This means they're vertebrates with hair, they breathe air and have four-chambered hearts, they make heat internally, and females make milk.
			• *Differences:*
			  • Platypuses are semiaquatic; bats aren't.
			  • Platypuses eat insect larvae, worms, and shrimp; bats primarily eat insects, as well as fruits, flower nectar, and blood.
			  • Platypuses are egg-laying mammals; bats deliver their offspring.
			  • Platypuses have legs; bats have webbed wings.
			  • Platypuses live only in Australia and Tasmania; bats are present throughout most of the world.

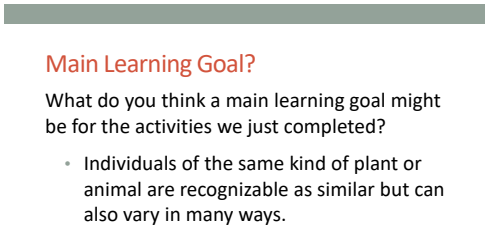
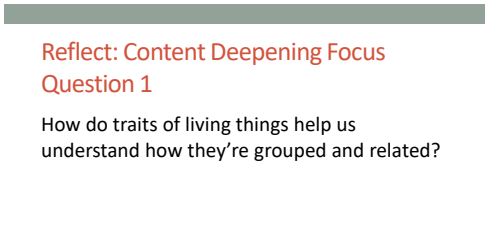
			**Display Slide 49.** Shared Traits That Define Related Groups (Less than 1 min) a. "This slide and the next list some of the shared traits that define groups of organisms." b. Instead of reading all of the traits, list two traits and then highlight the key science idea: *Shared traits help biologists define groups of organisms related by common ancestry.*

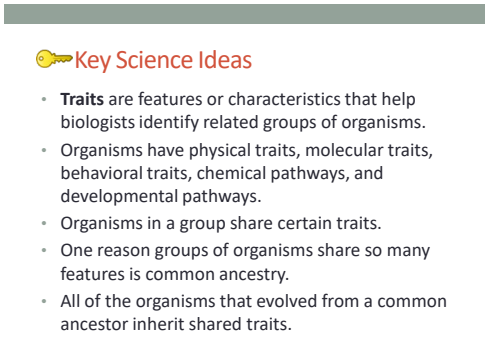
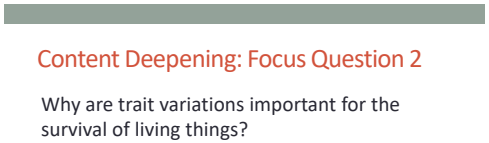
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 50.** Shared Traits That Define Related Groups (Less than 1 min) a. List two of the traits on the slide and note that some traits become quite specialized in sunflowers. b. Then highlight the key science idea again: *Shared traits help biologists define groups of organisms related by common ancestry*.
			**Display Slide 51.** Common Ancestry (1 min) a. "What do you think we mean when we say that organisms within a group are related by common ancestry?" b. As participants share their ideas, record them on chart paper. c. "Common ancestry explains why organisms have many shared features and one might think they are closely related." **Note:** During this discussion, make sure participants understand that heredity is involved and that these two different groupings are related to evolutionary relationships.

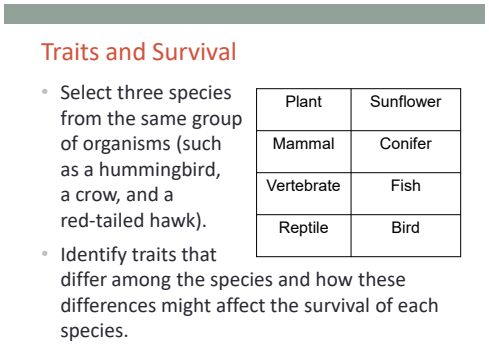
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 52.** Make a Claim (10 min) **Note:** Participants may refer to their resources (e.g. STeLLA strategies booklet) to complete this activity. a. "For this next activity, you'll work with a partner to develop a claim stating which group you think an organism belongs to and supporting your claim with evidence and reasoning." b. Have participants pair up; then give each pair a copy of handout 5.6 (Traits and Groups). c. **Pairs:** Review the instructions on the slide and handout. Then answer any questions before pairs begin working on the tasks. d. **Whole group:** Invite pairs to share their claims, evidence, and reasoning. Ask challenge questions as needed, such as "Can you use science ideas we've been talking about to further support your claim?" Encourage other participants to agree or disagree, add on, or ask questions. e. Emphasize that developing an explanation by making a claim and supporting it with evidence and reasoning is an important skill in the NGSS and Common Core and is one of the Student Thinking Lens strategies they'll explore in more detail later in the PD program. For now, note that one of the most difficult parts of developing an explanation is linking the claim to scientific reasoning and underlying science ideas. For example, the scientific reasoning that explains why dolphins are mammals is that all mammals at one point in time shared a common ancestor. This

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

			common ancestor must have had traits (such as having hair and a four-chambered heart, breathing air, generating heat, and making milk) that it passed on to the groups that evolved from it. This reasoning relates to one of the teacher learning goals for this session: One reason groups of organisms share so many features is common ancestry.
			
			Ideal responses:
			• *Question 2 (least inclusive group):*
			  • Dolphin: mammal
			  • Lamprey: vertebrate (**Note:** The lamprey is interesting because it's classified as a vertebrate but lacks a true backbone. Instead, it has a similar structure made out of cartilage.)
			  • Snail: Animal
			  • Penguin: Bird
			• *Questions 3 and 4 (sample claim, evidence, and reasoning):*
			  • I claim that the penguin is a bird. My evidence is that penguins have the following traits of birds: They have vertebrae, feathers, two legs covered in scales, and two wings, and they make heat internally. My reasoning is that scientists put organisms into groups that share certain traits. Scientists believe that these traits have been passed down to them through common ancestors. Penguins have the same traits and the same ancestors as other organisms in the birds group. They aren't mammals because they don't share common ancestors or the traits of mammals, such as having hair or making milk.

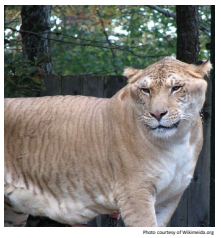
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 53.** Main Learning Goal? (2 min) **Note:** At first, show only the question at the top of the slide. a. Read the question on the slide and record participants' ideas on chart paper. b. Then reveal the main learning goal on the slide. Emphasize that this is also a learning goal for the VPA lessons. c. Briefly discuss how well the previous activities aligned with this learning goal.
			**Display Slide 54.** Reflect: Content Deepening Focus Question 1 (3 min) a. Review the focus question on the slide. b. **Individuals:** Have participants answer this question in their science notebooks. c. **Whole group:** Invite one or two participants to share their answers and reasoning with the group.

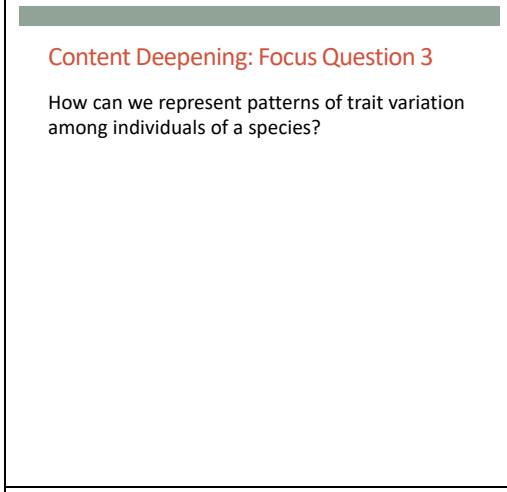
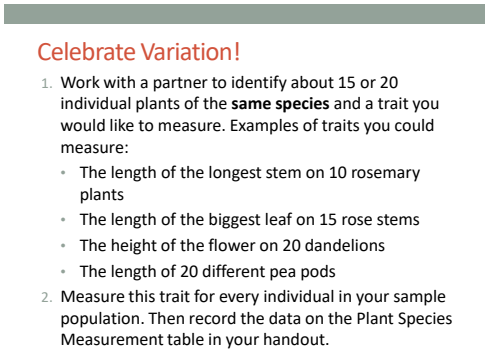
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 55.** Key Science Ideas (Less than 1 min) a. Highlight the key science ideas on the slide.
			**Display Slide 56.** Content Deepening: Focus Question 2 (Less than 1 min) a. Read the focus question on the slide. b. Ask participants to write the question in their science notebooks.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 57.** Traits and Survival (7 min) **Note:** Don't spend too much time on this activity, since participants should understand the reasoning involved. To stay within the allotted time, you may need to reduce the number of species participants examine. a. "The purpose of this next activity is to set the stage for understanding the origins of traits in different species." b. Direct participants to pair up for this activity. c. **Pairs:** "Select three species from the groups of organisms listed on the slide. For example, you might choose a hummingbird, a crow, and a red-tailed hawk. Identify traits that differ among the species and describe how these differences might affect the survival of each organism. For example, you might describe differences in the beaks, feet, and body size among the hummingbird, crow, and red-tailed hawk. Then describe how these trait variations might help each species survive in its environment. For example, the hawk is an active predator with a sharp, hooked beak that helps it tear apart and eat its prey. This trait enables the hawk to tear apart its prey, giving it a survival advantage." d. **Whole group:** Invite one pair of participants to share their descriptions and explanations with the group.

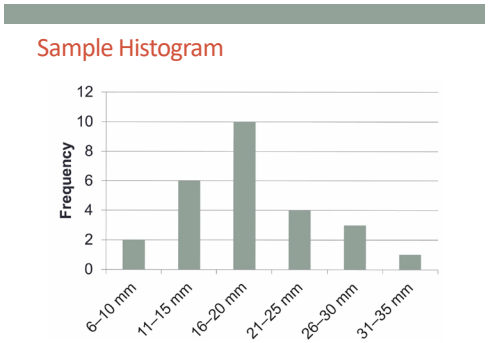
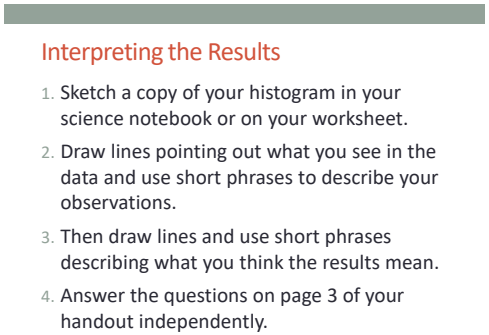
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		Reflect: Content Deepening Focus Question 2 Why are trait variations important for the survival of living things?	**Display Slide 58.** Reflect: Content Deepening Focus Question 2 (3 min) a. Review the focus question on the slide. b. **Individuals:** Ask participants to answer the question in their science notebooks and support their ideas with evidence from the activity they just completed. c. **Whole group:** Invite one or two participants to share their explanations and evidence with the group.
		NGSS Performance Standards **1-LS3.B. Variation of Traits** • Individuals of the same kind of plant or animal are recognizable as similar but can also vary in many ways. (1-LS3-1) **1-LS1.A: Structure and Function** • All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow (1-LS1-1)	**Display Slide 59.** NGSS Performance Standards (Less than 1 min) a. Highlight the NGSS performance standards on the slide.

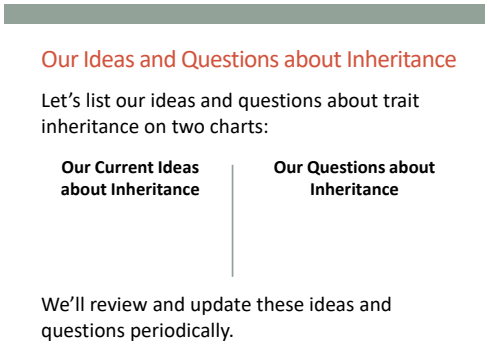
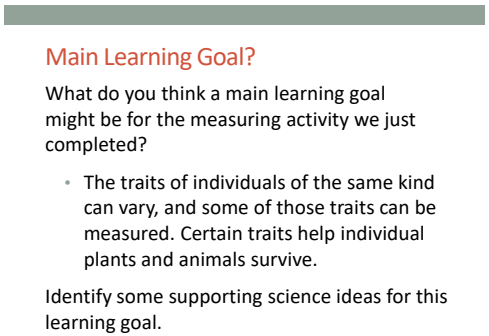
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		What Is a Species? How would you define the word *species*?	**Display Slide 60.** What Is a Species? (1 min) a. "How would you define the word *species*?" b. As participants share their ideas, record them on chart paper.
		Defining a Species   A **species** is a group of individuals that can mate and produce fertile offspring under natural conditions.	**Display Slide 61.** Defining a Species (Less than 1 min) a. How many species do you see on the slide? **Note:** Participants should identify two species: lion and tiger. b. Read the definition on the slide and indicate that this is a common definition of a species.

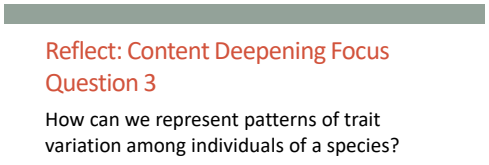
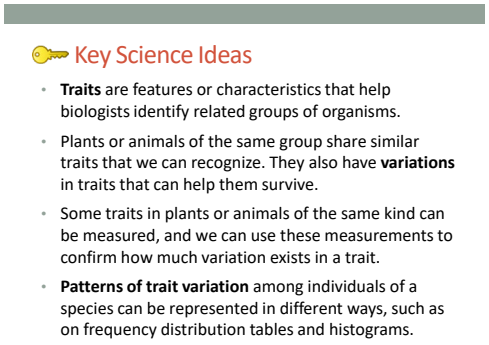
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
		A "Special" Level of Life  **Species:** A group of individuals that can mate and produce fertile offspring under natural conditions. A liger is a cross between a lion and a tiger.	**Display Slide 62.** A "Special" Level of Life (Less than 1 min) a. "The animal on this slide is called a *liger*, which is a cross between a lion and a tiger. Ligers don't exist naturally in the wild but are the result of crossbreeding practices. Due to crossbreeding, ligers often have birth defects and die prematurely." b. "Based on this evidence, do you still think lions and tigers represent two different species?" c. Emphasize the words "under natural conditions" in the definition of species. Note under natural conditions lions and tigers don't overlap and mate, so it's reasonable to classify them as two different species. However, defining species can be very difficult, especially since the common definition does not apply to special groups of organisms like bacteria or ligers.
		Summary Statements **Focus questions:** 1. How do traits of living things help us understand how they're grouped and related? 2. Why are variations in traits important for the survival of living things? Think about the big ideas we've explored so far in this content deepening session and write two or three concise sentences in your science notebooks describing these ideas.	**Display Slide 63.** Summary Statements (3 min) a. Revisit the focus questions on the slide. b. **Individuals:** "Think about the big ideas we've explored so far in this content deepening session and write two or three concise sentences in your notebooks describing these ideas." c. **Whole group:** Invite one or two participants to share their sentences with the group.

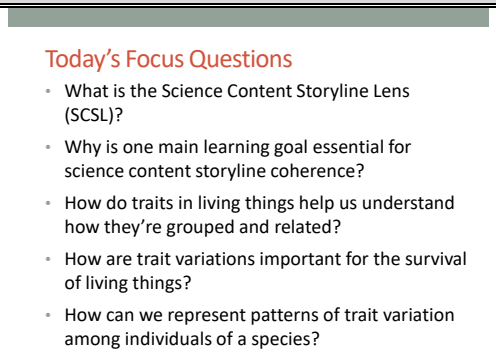
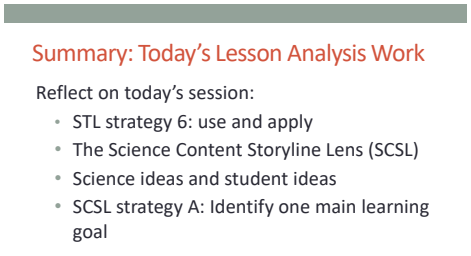
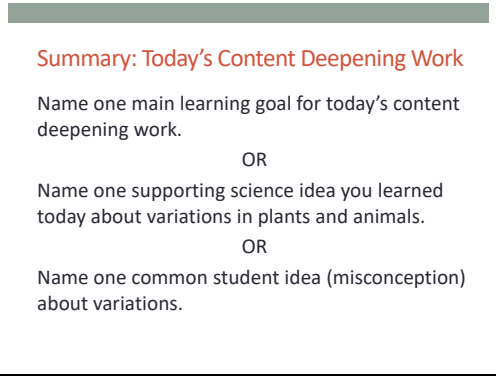
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	10-MINUTE BREAK		
			**Display Slide 64.** Content Deepening: Focus Question 3 (3 min) a. Read the focus question on the slide. b. **Individuals:** Ask participants to write the focus question in their science notebooks and jot down their initial ideas. c. **Whole group:** "What ideas do you have for ways we can *represent* patterns of trait variation with a species?" d. "To gather information that will help us answer this question, we'll explore trait variation within a species of plant."
			**Display Slide 65.** Celebrate Variation! (20 min) a. "To find trait-variation patterns among individuals of a species, we need to work like scientists. This means collecting data on a specific trait from a sample population and then recording the data on a table. That's what we're going to do next." b. Walk participants through the steps on the slide; then distribute handout 5.7 (Celebrate Variation!). Have participants record their data on the Plant Species Measurements table in their handouts. **Option to save time:** To save time, instead of having participants collect their data outside, bring in samples of the same kind of fruit, vegetable, or plant (e.g., 20 bananas, 20 carrots,

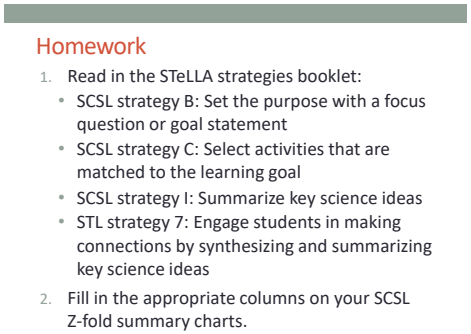
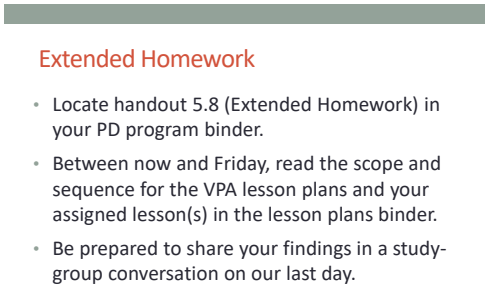
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			20 green beans) for participants to measure.
		Create a Histogram 1. Determine the range in your sample by finding the difference between the largest and smallest measurement. 2. Divide the resulting range into 4 to 6 intervals. 3. Count the number of measurements that fall into each interval and record this data on the frequency distribution table in your handout (page 2). 4. Use the data in your frequency distribution table to create a histogram (bar graph) on your handout that illustrates the results. (See the sample histogram on page 1.)	**Display Slide 66.** Create a Histogram (15 min) a. "Now that you and your partner have collected and recorded your data, let's go over the steps for creating a histogram." b. Walk participants through the steps on the slide. Then display the sample frequency distribution table and histogram on the next two slides. **Note:** As pairs work on their histograms, be available to answer questions and give direction as needed. c. After participants have created their histograms, ask them to copy them onto chart paper and then display all the histograms for participants to see.
		Sample Frequency Distribution Table Length Range / Number of Individuals in That Range 6–10 mm: 2 11–15 mm: 6 16–20 mm: 10 21–25 mm: 4 26–30 mm: 3 31–35 mm: 1	**Display Slide 67.** Sample Frequency Distribution Table (Less than 1 min) a. Show participants the sample frequency distribution table and note that it also appears in their handouts.

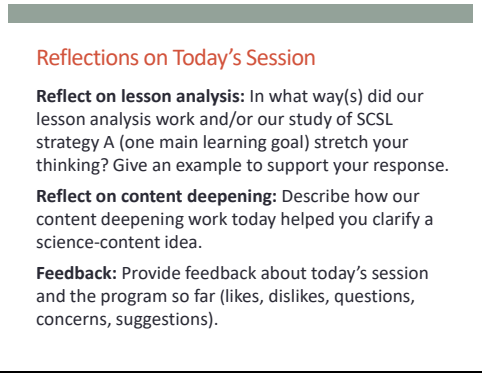
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 68.** Sample Histogram (Less than 1 min) a. Show participants this sample histogram and note that it also appears in their handouts. Highlight the information that should appear on the *x*- and *y*-axes.
			**Display Slide 69.** Interpreting the Results (7 min) a. Have participants complete the first three steps on the slide. Then have a brief group discussion about their observations and explanations. b. During this discussion, keep participants focused on what they see in the data (observations of patterns) and what they think the results mean (inferences). Use probe questions to clarify their thinking as needed. c. Highlight that a common trait-variation pattern is a bell-shaped curve that scientists call *continuous variation*. Later in the session, participants will contrast this trait-variation pattern with another pattern. d. "What would the bar graph look like if the trait in our sample showed no variation?" **Note:** Participants should recognize that the bar graph would have only one bar.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			e. "Now I'd like you to answer the questions on page 3 of your handouts, using what you already know about traits. Work on this task independently."
			**Display Slide 70.** Our Current Ideas and Questions about Inheritance (4 min) a. "Let's list our ideas and questions about trait inheritance on two charts so we can review and update them during our content deepening sessions this week." b. "What do you think accounts for the differences in traits among individuals of the same species? Which types of traits are inherited, and what role might the environment play in some of the differences among individuals?" **Note:** Keep this discussion brief.
			**Display Slide 71.** Main Learning Goal? (2 min) **Note:** At first, show only the question at the top of the slide. a. Read the question on the slide and record participants' ideas on chart paper. b. Then reveal the main learning goal on the slide. Emphasize that this is also a learning goal for the VPA lessons. c. Briefly discuss how well the previous activities aligned with this learning goal. d. Then ask participants to identify some supporting science ideas for this learning goal. e. Emphasize that one way teachers can

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			support this learning goal is by developing histograms and determining what any trait-variation patterns mean.
			**Display Slide 72.** Reflect: Content Deepening Focus Question 3 (3 min) a. Review the focus question on the slide. b. **Individuals:** Ask participants to reflect on the question and record their current ideas in their science notebooks. c. **Whole group:** Invite one or two participants to share their ideas with the group.
			**Display Slide 73.** Key Science Ideas (Less than 1 min) a. Review the key science ideas on the slide.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
3:10–3:30 20 min **Wrap-Up: Summary, Homework, and Reflections** Slides 74–79	**Purpose** • Summarize and reflect on key ideas from today's learning, including the Science Content Storyline Lens, STeLLA strategy A, and the VPA science content. **What Participants Do** • Review today's focus questions. • Share key ideas from today's lesson analysis (SCSL strategy A) and content deepening work. • Copy down the homework assignment for day 6 • Discuss expectations for the extended homework assignment (VPA lesson plan review). • Write reflections on today's learning. **Posters and Charts** • Effective Science Teaching chart **Handouts in PD Binder** • 5.8 Extended Homework • 5.9 Daily Reflections—Day 5 **Supplies** • Science notebooks		**Display Slide 74.** Today's Focus Questions (1 min) a. Review the focus questions addressed during today's session.
			**Display Slide 75.** Summary: Today's Lesson Analysis Work (3 min) a. **Individual think time (1 min):** Ask participants to reflect on the work they accomplished during today's lesson analysis and think about the questions on the slide. b. **Whole-group share-out (2 min):** Invite participants to share their ideas for modifying the image of effective science teaching based on today's work. Revise the chart as needed.
			**Display Slide 76.** Summary: Today's Content Deepening Work (3 min) a. **Individual think time (1 min):** Present the options on the slide and give participants 1 minute to come up with a statement that summarizes today's content deepening work in one of these areas. b. **Whole-group round-robin (2 min):** Go quickly around the room and have each participant share one summarizing statement.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			Push for complete sentences!
			**Display Slide 77.** Homework (3 min) a. Review the homework assignment on the slide and have participants write it in their notebooks. b. Make sure participants are clear about the reading and writing tasks.
			**Display Slide 78.** Extended Homework (3 min) a. Go over the information on the slide. b. Have participants review the Extended Homework assignment sheet (handout 5.8), which provides further details about the assignment. c. In the VPA lesson-plan sequence, lesson 1 has four parts (A–D); lessons 2, 3, and 4 have two parts (A and B); lesson 5 has three parts (A–C); and there are two supplemental math lessons. Assign each two-part lesson (A and B) to one participant; then assign lessons 1a/b to one participant and lessons 1c/d to another participant. Assign lesson 5 (parts A, B, and C) to one participant and have one or two participants review the supplemental math lessons. d. Ask if there are any questions about the assignment.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			e. **Emphasize:** The group share-out on the last day of the PD program (day 8) should focus on the assignment-sheet questions (section 2). Participants won't have time to share all the details of each lesson plan.
			**Display Slide 79.** Reflections on Today's Session (7 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 5.9 in PD program binder).