RESPeCT Summer Institute Professional Development Leader Guide (PDLG)

Grade Level	6	**Day**	3	**STeLLA Strategy**	STL Strategy 4: Analyze and Interpret Data and Observations STL Strategy 5: Construct Explanations and Arguments	**Subject Matter Focus**	Genetics
Focus Questions	• How can analyzing data and constructing explanations help students *move forward* toward deeper understandings of science ideas? • How can we represent DNA, genes, and chromosomes to make sense of trait-variation patterns?						
Main Learning Goals	Participants will understand the following: • In addition to challenge questions, the Student Thinking Lens (STL) strategies include activities that move student thinking forward toward more-scientific understandings. • STL strategies 4 and 5 are two activities that can be used to move student thinking forward: Engage students in analyzing and interpreting data and observations (strategy 4), and engage students in constructing explanations and arguments (strategy 5). • Analyzing and interpreting go beyond making observations to organizing data, identifying patterns and looking for meaning in the data, and searching for relationships between science ideas and data. • Constructing explanations involves making a claim, supporting the claim with evidence and reasoning, and coming up with alternatives that challenge the claim (argumentation). • By understanding the movement of chromosomes (and the genes they contain) when egg and sperm are produced and unite to make a new individual, we can predict inheritance patterns and the likelihood of certain traits appearing among offspring. • Genes are sequences of nucleotide bases found at specific locations on strands of DNA in chromosomes. Genes provide the chemical codes for proteins in an organism that form the structures or trigger the chemical reactions that result in particular traits. • Alleles are different forms of the same gene with slight DNA-sequence variations. These variations may result in different proteins and thus change the trait associated with the gene. Most genes have more than two possible alleles, although any one individual can have at most two different alleles for a gene.						

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.	**Posters and Charts** • STeLLA Framework and Strategies poster • Day-3 Agenda (chart) • Day-3 Focus Questions (chart) • Norms for Working Together (chart) • Effective Science Teaching chart (from day 1) • Strategy charts from days 1 and 2 (STL strategies 1–3) • Parking Lot poster	• Video Clip 3.1: Kawamura classroom (analyze and interpret, strategy 4); 3.1_stella_GEN_kawamura_L3_c2 • Video Clip 3.2: Kawamura classroom (analyze and interpret, strategy 4; construct explanations and arguments, strategy 5); 3.2_stella_GEN_kawamura_L2.2_c6 • Video Clip 3.3: Lisa DeFoort classroom; 3.3_Lisa_Defoort_GEN_L1

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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 2 and create a summary slide.
- Watch video clips and anticipate participant responses.
- Prepare charts for the day's agenda and focus questions.
- Review the activities for Genetics lessons 3–5 in the lesson plans binder.

Handouts in RESPeCT PD Binder Front Pocket

- Z-fold summary chart: Student Thinking Lens Strategies

Handouts in RESPeCT PD Binder, Day 3

- 3.1 Quick Reference Tools for Strategies 4 and 5
- 3.2 Practice Identifying Strategies 4 and 5 in Student Work
- 3.3 Transcript for Video Clip 3.1
- 3.4 Transcript for Video Clip 3.2
- 3.5 Genes and Chromosomes (Teacher Master) (from Genetics lesson 3b)
- 3.6 Exploring Trait Patterns in Offspring (from Genetics lesson 5b)
- 3.7 Daily Reflections—Day 3

Handouts in RESPeCT Lesson Plans Binder

- 3.1 Understanding Inheritance: Results from Studies of Cells (from Genetics lesson 3a)
- 3.3 Sample Marked Essay (from Genetics lesson 3a)
- 4.5 Making Generation 2 Duckos (from Genetics lesson 4b)

PD Leader Masters, Days 1–4

- PD Leader Master: Practice Identifying Strategies 4 and 5 in Student Work

Supplies

- Science notebooks
- Chart paper and markers
- Lesson materials kit
- For content deepening:
  - Playdough, whiteboard, coin, and small allele cards labeled "P" and "p" (per group of 3, for simulating meiosis)
  - Allele cards and Legos (1 set per pair of participants)

PD Resources

	• STeLLA strategies booklet • RESPeCT PD program binder • RESPeCT lesson plans binder **Resources in Lesson Plans Binder** *Resources section:* • Genetics Content Background Document • Common Student Ideas about Variation and Inheritance of Traits	

DAY 3 SESSION OUTLINE

Time	Activities	Purpose
8:00–8:35 35 min	**Getting Started: Housekeeping, Agenda, Day-2 Reflections, Focus Questions, STL Strategies**	• Build community by sharing participants' reflections from day 2. • Set the stage for a day of learning. • Emphasize the theme for the rest of the week: What do we do with the ideas we've elicited from students? How do we help them change and advance their understandings of science concepts?
8:35–9:35 60 min	**Introducing Student Thinking Lens (STL) Strategies 4 and 5**	• Develop an initial understanding of strategy 4: Engage students in analyzing and interpreting data and observations. • Develop an initial understanding of strategy 5: Engage students in constructing explanations and arguments. • Examine the relationships among the science practices of observing, analyzing and interpreting, and constructing explanations and arguments.
9:35–12:00 145 min (Includes 10-min break)	**Lesson Analysis: STL Strategies 4 and 5**	• Use lesson analysis of classroom videos to better understand strategies 4 and 5, how they're related, and how they can challenge student thinking to move forward. • Deepen science-content knowledge of genetics through lesson analysis.
12:00–12:45 45 min	**LUNCH**	
12:45–3:15 150 min (Includes 10-min break)	**Content Deepening: Genetics**	• Deepen participants' understandings of inheritance patterns.
3:15–3:30 15 min	**Wrap-Up: Summary, Homework, and Reflections**	• Reflect on the day's learning and summarize key ideas about the science content and strategies 4 and 5, linking those ideas to participants' images of effective science teaching and changes they want to make in their individual teaching practices.

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DAY 3

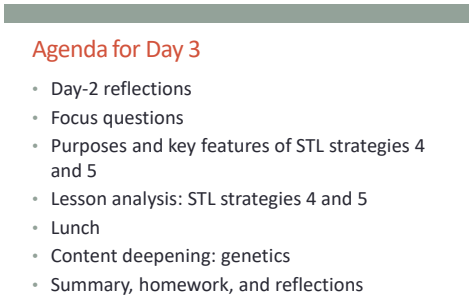
<table>
<tr><th>PD Model: Time/Phase</th><th>Purpose, Content, and What Participants Do</th><th>Slides</th><th>Process</th></tr>
<tr><td rowspan="3">8:00–8:35
35 min

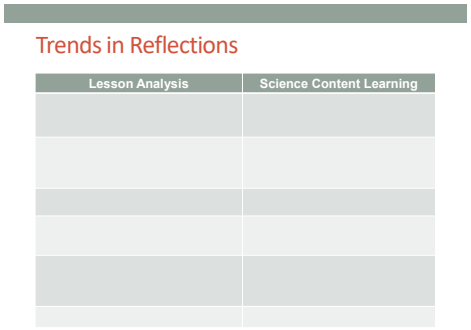
Getting Started

Slides 1–8</td><td rowspan="3">Purpose
• Build community by sharing participants' reflections from day 2.
• Set the stage for a day of learning.
• Emphasize the theme for the rest of the week: What do we do with the ideas we've elicited from students? How do we help them change and advance their understandings of science concepts?

Content
• Student Thinking Lens (STL) strategies reveal student thinking (elicit and probe strategies) and challenge student thinking (the rest of the strategies).
• STL strategies are divided into questions (elicit, probe, and challenge) and activities.
• A variety of strategies can be used to move student thinking forward. Today's focus is STL strategy 4 (Engage students in analyzing and interpreting data and observations) and strategy 5 (Engage students in constructing explanations and arguments).

What Participants Do
• Discuss the reflections from day 2.
• Listen to an overview of the agenda, the focus questions, and</td><td>  </td><td>Display Slide 1. RESPeCT PD Program (5 min)

a. Take care of any housekeeping issues.</td></tr>
<tr><td>  </td><td>Display Slide 2. Agenda for Day 3 (2 min)

a. Talk through the agenda for the day.</td></tr>
<tr><td>  </td><td>Display Slide 3. Trends in Reflections (5 min)

a. Invite participants to look at your feedback on their reflections from day 2 and offer reactions, comments, or follow-up questions.

b. Optional: Give participants an opportunity to refine the norms for working together.</td></tr>
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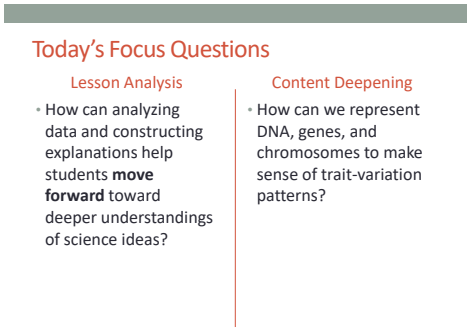
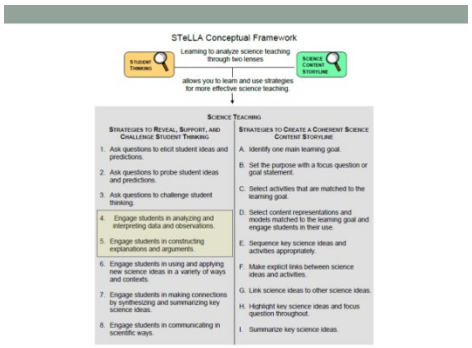
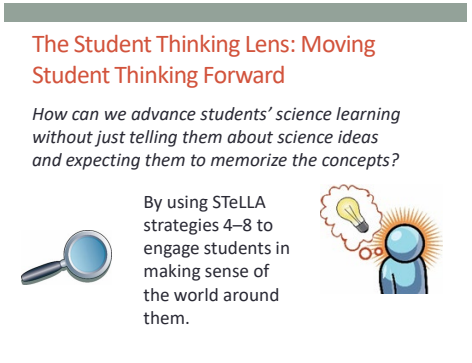
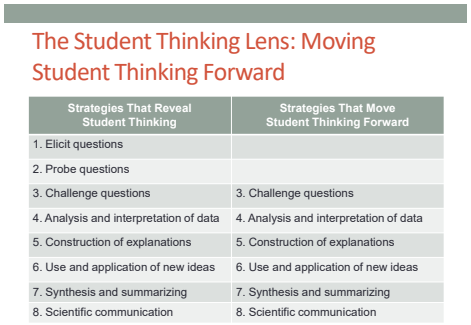
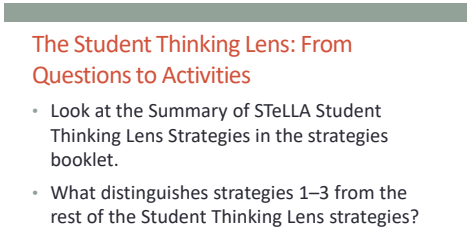
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	the theme for the day and the rest of the week: *moving student thinking forward*. • Review Summary of STeLLA Student Thinking Lens Strategies in the STeLLA strategies booklet and recognize two patterns: 1. Some strategies are designed only to reveal student thinking (strategies 1 and 2), while most are also designed to challenge student thinking. 2. The Student Thinking Lens includes three questioning strategies and five activity strategies. **Posters and Charts** • STeLLA Framework and Strategies poster • Day-3 Agenda (chart) • Day-3 Focus Questions (chart) • Strategy charts from day 1 (STL strategies 1–3) **PD Resources** • STeLLA strategies booklet		**Display Slide 4.** Today's Focus Questions (2 min) a. Introduce the focus questions that will guide today's session. b. "The words *moving forward* are in bold on the slide because that's our theme for today and the rest of the week. Yesterday we practiced asking elicit and probe questions, which are great for revealing student ideas. But what do we do with those ideas once we've elicited them? How do we support students in moving forward toward deeper understandings of science ideas?"
			**Display Slide 5.** STeLLA Conceptual Framework (1 min) a. Point out the strategies highlighted on the slide. b. "We'll continue working on understanding and using the Student Thinking Lens *questioning* strategies, but today we'll focus on two closely related *activity* strategies. Strategy 4 engages students in analyzing and interpreting data and observations, and strategy 5 engages students in constructing explanations and arguments."
			**Display Slide 6.** The Student Thinking Lens: Moving Student Thinking Forward (10 min) a. Initially, reveal **only** the question on the slide. b. Have participants think about the question for a minute; then open up a brief conversation about it. c. Ask the following questions to stimulate discussion if participants are struggling:

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			• What was your experience as a science student in school or college? • How were you expected to learn science ideas? What learning methods were used? • Did you ever have the opportunity in science classes to make sense of the experiments you performed (instead of just recording the correct answers in a lab report)? • Did science teachers ever support your learning in ways that went beyond merely having you take lecture notes, read from a textbook, or record the correct answers in lab reports? d. After discussing the questions, reveal the second part of the slide and emphasize the following points: • "Strategies 4 and 5 (as well as 6, 7, and 8) are designed to move student thinking forward by engaging students in sensemaking as they observe data. Rather than just spoon-feeding students science content to read or memorize, these activities lead them toward deeper understandings of science ideas as they construct meaning from evidence." • "Telling students about science ideas is important, but teachers tend to tell students too much. Instead of doing the hard cognitive work for them, we need to create more opportunities for students to do the thinking and sensemaking *themselves* so they can truly understand the science concepts. So don't be in such a hurry to tell students the right answers. **Slow down and give them a chance to think!**"

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 7.** The Student Thinking Lens: Moving Student Thinking Forward (5 min) a. Have participants look at the slide representation of the Student Thinking Lens strategies. b. **Ask:** "What do you notice?" **Key ideas:** • Elicit and probe questions are designed *only* to reveal student thinking, not to challenge it. • The rest of the strategies reveal *and* challenge student thinking.
			**Display Slide 8.** The Student Thinking Lens: From Questions to Activities (5 min) a. **Individuals:** Have participants briefly examine the summary chart of STL strategies in the STeLLA strategies booklet (Summary of STeLLA Student Thinking Lens Strategies). **Note:** Direct participants to the correct page in the strategies booklet or have them consult the table of contents. b. **Whole group:** "How are the first three strategies different from the rest?" **Key ideas:** • Strategies 1–3 are questions; the rest are activities. • Probe and challenge questions can and should be asked during all types of activities.

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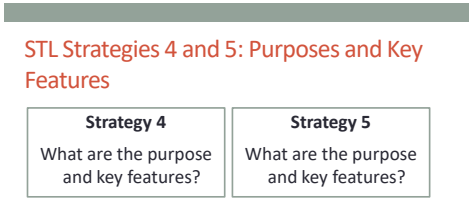
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
8:35–9:35 60 min **Introducing Student Thinking Lens (STL) Strategies 4 and 5** Slides 9–11	**Purpose** • Develop an initial understanding of strategy 4: Engage students in analyzing and interpreting data and observations. • Develop an initial understanding of strategy 5: Engage students in constructing explanations and arguments. • Examine the relationships among the science practices of observing, analyzing and interpreting, and constructing explanations and arguments. **Content** • STL strategy 4 engages students in analyzing and interpreting data and observations. Activities involve organizing data and/or observations, identifying patterns, and looking for meaning in the data. • STL strategy 5 engages students in constructing explanations and arguments. Activities involve using logical thinking, evidence, and science ideas to construct explanations of scientific data or observed phenomena, as well as critiquing proposed explanations using scientific argumentation.		**Display Slide 9.** STL Strategies 4 and 5: Purposes and Key Features (30 min) a. **Small groups (12 min):** Divide participants into two groups and assign one strategy to each group. Have one group create a chart listing the purpose and key features of strategy 4, and have the other group chart the purpose and key features of strategy 5. Each group should be prepared to answer the discussion question for the assigned strategy. b. **Whole-group share-out (18 min):** Have groups report on the purpose and key features of each strategy. **Key ideas:** • Strategy 4 involves activities that engage students in organizing their data and/or observations and looking for patterns and meaning in them. They aren't just "doing" activities or describing their observations. • Strategy 5 engages students in learning how to use logical thinking, evidence, and science ideas to construct explanations of scientific data or phenomena they have observed. It also engages them in critiquing various proposed explanations through scientific argumentation. • Remind participants that these strategies are closely related and will overlap in some activities. However, each has a specific purpose and unique attributes.

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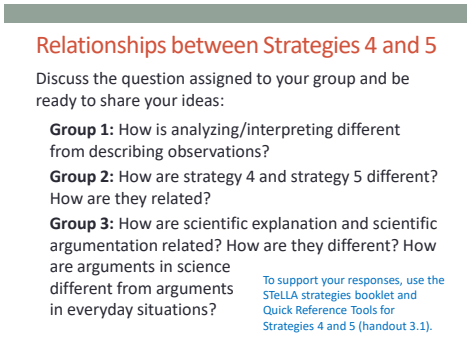
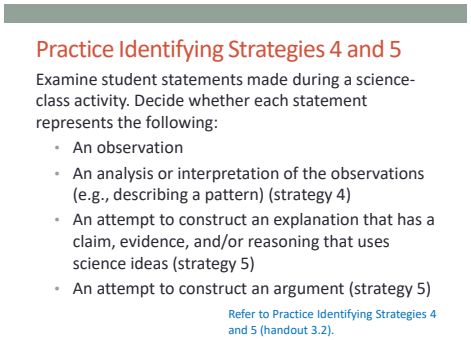
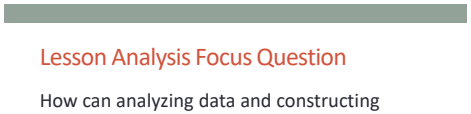
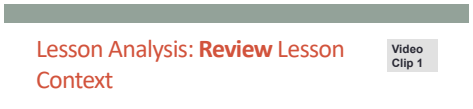
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	What Participants Do • Create and discuss strategy charts summarizing the purposes and key features of strategies 4 and 5. • Discuss the differences and relationships among observing, analyzing and interpreting, and constructing explanations and arguments. • Use written scenarios to practice identifying instances of observing, analyzing and interpreting, and constructing explanations and arguments. **Handouts in PD Binder** • 3.1 Quick Reference Tools for Strategies 4 and 5 • 3.2 Practice Identifying Strategies 4 and 5 **PD Leader Masters** • PD Leader Master: Practice Identifying Strategies 4 and 5 **Supplies** • Chart paper and markers **PD Resources** • STeLLA strategies booklet		**Display Slide 10.** Relationships between Strategies 4 and 5 (15 min) a. **Small groups (5 min):** Divide participants into three small groups or pairs. Assign each group one question to discuss and tell participants to be ready to share their ideas with the entire group. b. **Emphasize:** Participants should use the STeLLA strategies booklet and Quick Reference Tools for Strategies 4 and 5 (PD handout 3.1) to support their responses. c. **Whole-group share-out (10 min):** • "What did you come up with for the first question?" **Key ideas for question 1:** Analysis and interpretation involve moving beyond simply describing observations to *doing* something with the data, including (but not limited to) making comparisons, identifying relationships, and organizing data in ways that will reveal patterns (such as using charts, diagrams, and graphs). • "What did you come up with for the second question?" **Key ideas for question 2:** Strategy 4 lays the groundwork for strategy 5. Before we can build a scientific explanation for a specific phenomenon, we need to make some observations, analyze the data to reveal patterns, and organize the data to gather the necessary evidence to support construction of a scientific explanation. A scientific explanation includes a claim that answers the question being studied, evidence that supports the claim, and reasoning that links the claim to the

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			evidence and to science ideas. • "What did you come up with for the third question?" **Key ideas for question 3:** A scientific explanation includes a claim that answers the question being studied, evidence that supports the claim, and reasoning that links the claim to the evidence and to science ideas. Scientific arguments involve assessing the strength and quality of the evidence and reasoning in different scientific explanations for the same observations and determining which proposed explanation has the best supporting evidence, science ideas, and reasoning.
			**Display Slide 11.** Practice Identifying Strategies 4 and 5 (15 min) a. "Before we view classroom video clips to identify and analyze strategies 4 and 5, we're going to practice identifying observations, analyses, interpretations, explanations, and arguments from a handout of student statements. Learning to distinguish which strategy students are using in these examples will help us when we review the classroom videos, where the strategies aren't always as clear cut." b. Refer participants to handout 3.2 in their PD program binders (Practice Identifying Strategies 4 and 5). c. **Pairs:** Have participants work in pairs to analyze student statements in the handout. d. **Whole group:** As participants discuss and clarify their analyses of the student statements, encourage them to refer frequently to the STeLLA strategies booklet and the Quick Reference Tools

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			handout (PD handout 3.1). **Note:** For examples of ideal participant responses, see PD Leader Master: Practice Identifying Strategies 4 and 5.
9:35–12:00 145 min (Includes 10-min break) **Lesson Analysis: STL Strategies 4 and 5** Slides 12–22	**Purpose** • Use lesson analysis of classroom videos to better understand strategies 4 and 5, how they're related, and how they can challenge student thinking to move forward. • Deepen science-content knowledge of genetics through lesson analysis. **Content** • STL strategy 4 engages students in analyzing and interpreting data and observations. Activities involve organizing data and/or observations, identifying patterns, and looking for meaning in the data. • STL strategy 5 engages students in constructing explanations and arguments. Activities involve using logical thinking, evidence, and science ideas to construct		**Display Slide 12.** Lesson Analysis Focus Question (Less than 1 min) a. Review the focus question that will guide today's lesson analysis work.
			**Display Slide 13.** Lesson Analysis: Review Lesson Context, Video Clip 1 (2 min) a. "Now let's see if we can recognize students analyzing and interpreting data in a classroom video clip." b. Review the lesson context at the top of the transcript for video clip 1 (handout 3.3 in PD binder), making sure participants understand both the content and activity in focus.

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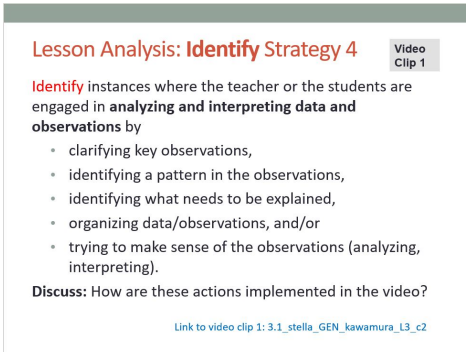
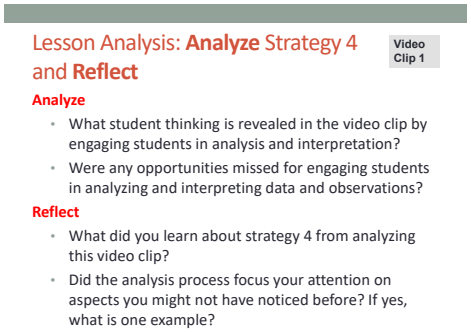
	explanations of scientific data or observed phenomena, as well as critiquing proposed explanations using scientific argumentation. **What Participants Do** • Watch a classroom video clip to identify strategy 4 and analyze student thinking that this strategy reveals and challenges. • Examine transcript excerpts in the STeLLA strategies booklet for practice identifying strategies 4 and 5. • Watch a second classroom video clip to identify strategy 5 and analyze student thinking this strategy reveals and challenges. • Summarize key ideas about the relationships between strategies 4 and 5. **Videos** • Video Clip 3.1, Kawamura classroom • Video Clip 3.2, Kawamura classroom **Handouts in PD Binder** • 3.1 Quick Reference Tools for Strategies 4 and 5 • 3.3 Transcript for Video Clip 3.1 • 3.4 Transcript for Video Clip 3.2 **PD Resources** • STeLLA strategies booklet		**Display Slide 14.** Lesson Analysis: Identify Strategy 4, Video Clip 1 (25 min) a. "As we watch the video clip, we'll identify actions that illustrate strategy 4. Be on the lookout for instances where the teacher or the students do something listed on the slide. That's what we'll discuss first." b. Show the video clip. c. **Individuals:** "Think about the strategy 4 actions listed on the slide." d. **Whole group:** "Discuss the question on the slide. Make sure to support your claims with evidence from the video transcript." **Observations:** • In this video clip, students realize that one pair of their classmates didn't get the same results as the others. They think critically about the representation they used to demonstrate alleles passing from one generation to another, and they try to make sense of the outlier data point.
			**Display Slide 15.** Lesson Analysis: Analyze Strategy 4 and Reflect, Video Clip 1 (25 min) a. **Individuals:** "For the first analysis question on the slide, study the transcript for video clip 1 and come up with a claim, evidence, and reasoning to support your claim. For the second analysis question, consider alternative moves the teacher could have made as you identify missed opportunities." b. **Whole group:** After participants have shared

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			their analyses, ask, “Were there any missed opportunities for engaging students in analyzing and interpreting data?” c. **Reflect:** Discuss the reflection questions on the slide, making sure participants share specifically what they learned about strategy 4. **Possible claim:** Most students understand that this simulation of parents passing genes to offspring resulted in the traits expressed in the offspring. They also sufficiently understand the roles of dominant and recessive alleles and therefore are able to identify that the production of one brown-billed ducko in the simulation didn’t match their understandings of the inheritance process. **Evidence:** The evidence for this claim begins at video segment 0:01:37.6, when one student says, “That … shouldn’t have happened.” Again at segment 0:03:42.7, the teacher mentions that several students think the brown-billed duck shouldn’t have happened and asks them to explain their thinking. The teacher missed an opportunity to push students to clarify their thinking about inheritance in this simulation when they explain one possible reason the brown-billed ducko appeared: student error. The teacher could have pressed for other students to explain how the inheritance process helped them know this data point wasn’t correct.

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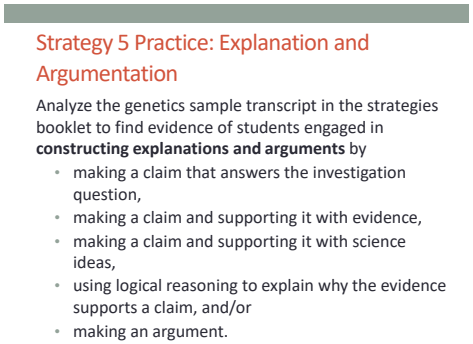
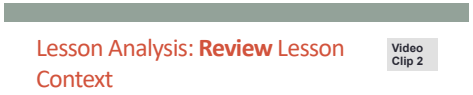
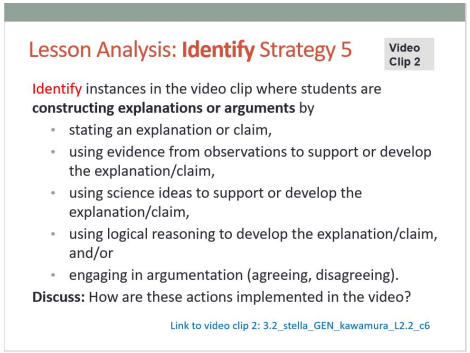
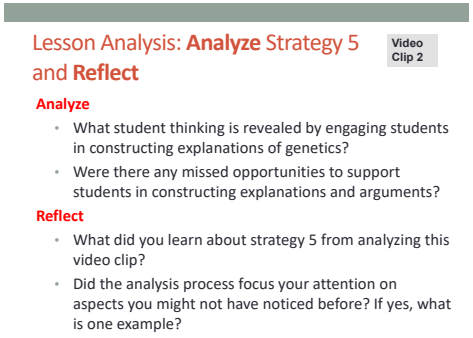
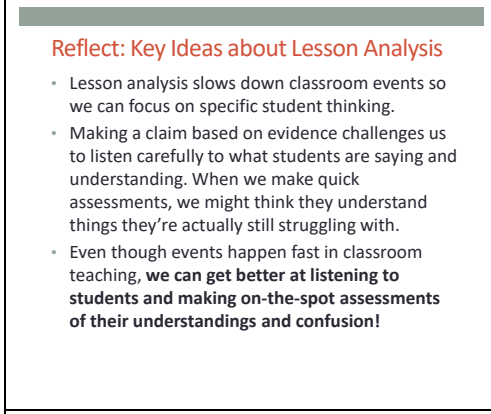
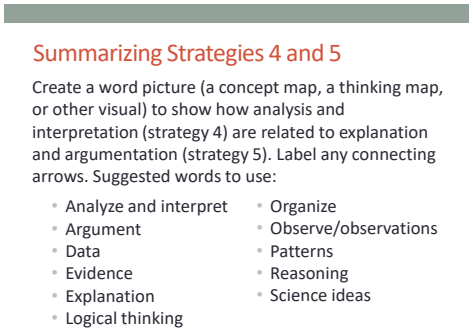
			**Display Slide 16.** Strategy 5 Practice: Explanation and Argumentation (10 min) a. "Strategy 5 is the focus of the next video clip, although you may also see evidence of strategy 4 being used." b. Have participants analyze the second transcript example (under "About Genetics" in the strategy 5 chapter) in the STeLLA strategies booklet and look for evidence of students engaging in constructing explanations and arguments. **Note:** This is an important activity, but it can be cut if time is short. c. "Before we view another classroom video, let's practice analyzing one of the examples of strategy 5 in the STeLLA strategies booklet. Read the sample transcript in the "About Genetics" section and see if you can find any evidence of the teacher engaging students in constructing explanations and arguments. Refer to the action list on the slide for guidance." d. **Individual work time (5 min).** e. **Whole-group share-out:** Have participants share evidence from the transcript of students engaging in strategy 5, noting the specific action illustrated from the list on the slide. **Observations:** • In this sample transcript, students are comparing data from the offspring of long- and short-haired dachshunds with three possible explanations. None of the proposed claims have evidentiary support, so students must use logic and reasoning to see which claim about how traits are passed from parents to offspring best fits their

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			observations. Students aren't making a claim in this example, so the first three options on the slide aren't visible; however, they are using logical reasoning to explain why the evidence supports one of the claims. Student 3 makes a counterargument that rules out explanation 2. • This particular activity in the lesson sequence is intended to help students develop explanations and arguments by articulating why one claim is better than others. It's a stepping-stone that supports students in generating good explanations and arguments (with evidence) later in the lesson sequence.
	10-MINUTE BREAK		
			**Display Slide 17.** Lesson Analysis: Review Lesson Context, Video Clip 2 (1 min) a. "Now we're going to look at another video clip and focus on identifying strategy 5: Engage students in constructing explanations and arguments." b. Read the context of the lesson at the top of the transcript for video clip 2 (handout 3.4 in the PD program binder).

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 18.** Lesson Analysis: Identify Strategy 5, Video Clip 2 (25 min) a. "As you watch the video clip, identify instances where students are engaged in constructing explanations and arguments (strategy 5). You might notice examples of strategy 4 (analyzing and interpreting data), but focus on identifying strategy 5. Also notice the kinds of questions the teacher asks (elicit, probe, or challenge)." b. Before showing the video clip, read the list of actions on the slide. c. **Individuals:** "Think about the strategy 5 actions listed on the slide." d. **Whole group:** "Discuss the question on the slide. Make sure to support your claims with evidence from the video transcript." e. **Emphasize:** "Strategy 5 is designed to help move student thinking forward toward deeper understandings of science ideas, so we should see challenge questions as well as probe questions in the video clip." **Observations:** • In this video clip, the teacher asks students to make a general statement about the trait patterns they observe from one generation to the next and to support that general statement with evidence from two class activities. In identifying that all the generations showed the same pattern, students are engaged in data analysis. And in developing a general statement, they're interpreting that data. As they support their general statement with evidence from their observations, they're constructing arguments

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			to support their claims. Notice that the teacher doesn't use probe questions in this clip but instead uses two distinct challenge questions: At video segment 0:00:38.9 (video clip 2b in transcript), she presses students to use evidence from previous activities, and at segment 0:04:09.5, she encourages them to incorporate new vocabulary into their explanations.
			**Display Slide 19.** Lesson Analysis: Analyze Strategy 5 and Reflect, Video Clip 2 (25 min) a. **Individuals:** "For the first analysis question on the slide, study the video transcript and come up with a claim, evidence, and reasoning to support your claim. For the second analysis question, consider alternative moves the teacher could have made as you identify any missed opportunities." b. **Whole group:** After participants have shared their analyses, ask, "Were there any missed opportunities for engaging students in constructing explanations and arguments?" c. **Reflect:** Discuss the reflection questions on the slide, making sure participants share specifically what they learned about strategy 5. **Observations:** • In this video clip, students are doing a good job incorporating their observations, bringing up the different kinds of organisms they worked with (dachshunds, cows, frogs), and even including evidence from their own lives as they talk about the traits they inherited from their parents. Although at first they have a hard time understanding how to connect a claim with evidence, the teacher has one

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			student share her explanation to model this connection (video segments 0:02:17.8 and 0:02:17.8–0:02:52.3).
			**Display Slide 20.** Reflect: Key Ideas about Lesson Analysis (2 min) a. "Let's reflect on some key ideas you can take away from your lesson analysis experiences. These ideas may not reflect your personal experiences with lesson analysis so far, but hopefully you'll see their value in the lesson analysis process over time." b. Read the key ideas on the slide. c. Ask participants for their reactions to these ideas.
			**Display Slide 21.** Summarizing Strategies 4 and 5 (15 min) **Note:** Skip this activity if time is short. a. **Individuals:** To summarize strategies 4 and 5, have participants work independently to create visuals that show how analysis and interpretation (strategy 4) are related to explanation and argumentation (strategy 5). b. **Pairs:** "Share and compare your visuals with a partner." c. **Whole group:** "What questions did this activity raise for you?"

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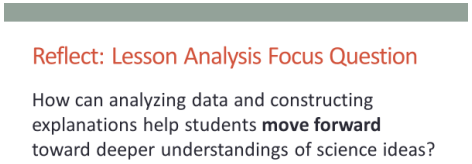
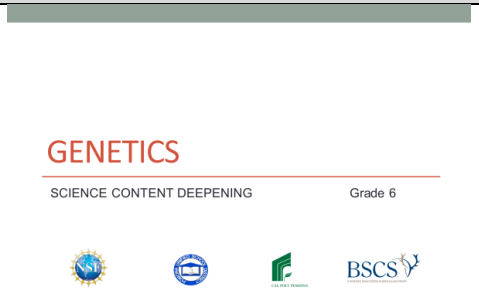
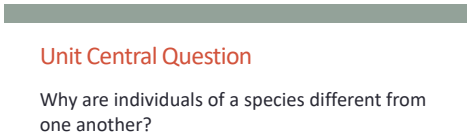
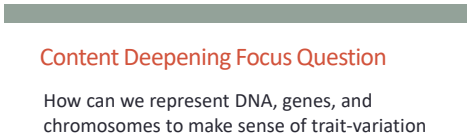
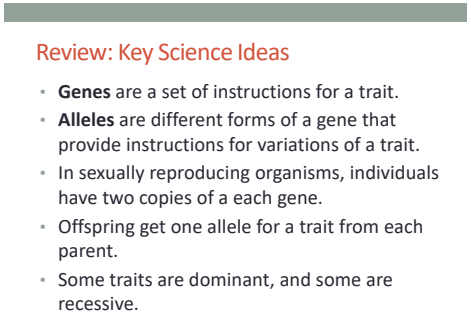
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 22.** Reflect: Lesson Analysis Focus Question (5 min) a. Review today's lesson analysis focus question. b. **Think-Pair-Share:** "Think for a moment about this focus question and how you might convince parents or colleagues that analyzing data and constructing explanations moves student thinking forward toward deeper understandings of science ideas. Then share your ideas with an elbow partner."
12:00–12:45 45 min	**LUNCH**		
12:45–3:15 150 min (Includes 10-min break) **Content Deepening: Genetics**	**Purpose** • Deepen participants' understandings of inheritance patterns. **Content** • Mendelian inheritance patterns are linked to the production of proteins.		**Display Slide 23.** Content Deepening: Genetics (Less than 1 min) **Note:** Refer to the Genetics Content Background Document and the Common Student Ideas about Variation and Inheritance of Traits as needed throughout this phase. a. "Now let's dig into today's content deepening work."

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
Slides 23–41	**What Participants Do** • Use the results from Mendel's experiments and other more recent experiments with dogs to better explain trait variations and inheritance patterns. • Explore the actual protein changes that cause the white and purple flower-color trait variations in pea plants and use this information to further explain how inheritance works. **Videos (Optional)** • Video Clip 3.3, Lisa DeFoort classroom **Handouts in PD Binder** • 3.5 Genes and Chromosomes (from Genetics lesson 3b) • 3.6 Exploring Trait Patterns in Offspring (from Genetics lesson 5b) **Handouts in Lesson Plans Binder** • 3.1 Understanding Inheritance: Results from Studies of Cells (from Genetics lesson 3a) • 3.3 Sample Marked Essay (from Genetics lesson 3a) • 4.5 Making Generation 2 Duckos (from Genetics lesson 4b) **Supplies** • Science notebooks • Lesson materials kit		**Display Slide 24.** Unit Central Question (Less than 1 min) a. Remind participants of the unit central question that students will answer in the Genetics lesson sequence. b. "Today we'll gather more information to help us answer this question. We'll also use what we already know about the movement of chromosomes and genes to better explain trait variations and inheritance patterns."
			**Display Slide 25.** Content Deepening Focus Question (Less than 1 min) a. "Our focus question for today's content deepening work should look familiar. We'll continue investigating this question from yesterday's session."
			**Display Slide 26.** Review: Key Science Ideas (5 min) a. Read through the key science ideas on the slide. b. "Do you have questions about any of these key science ideas?"

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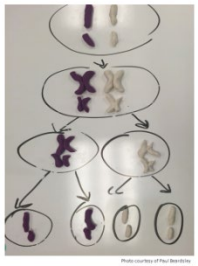
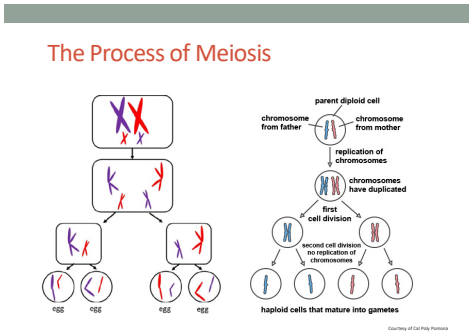
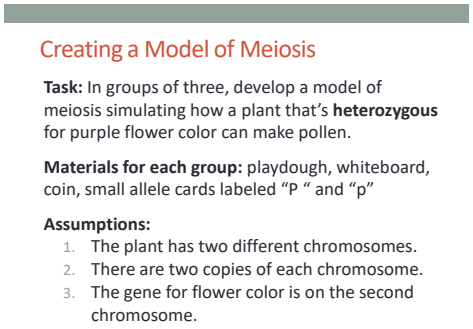
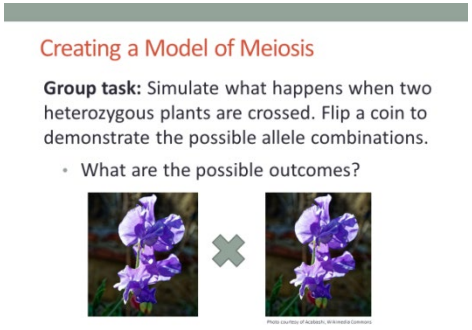
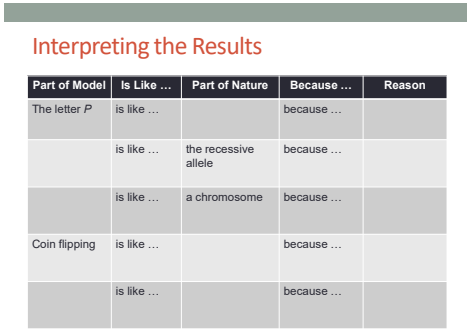
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process

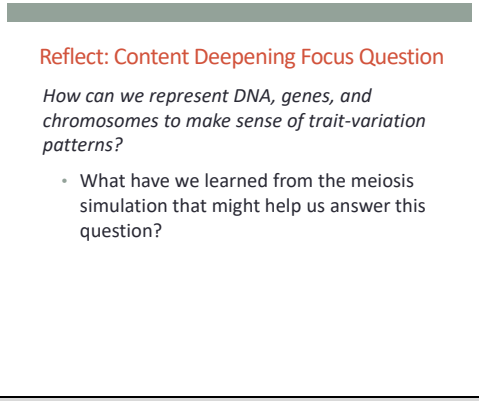
	• For meiosis simulation:
	  • Playdough
	  • Whiteboard
	  • Allele cards
	• For ducko simulation from lesson 4:
	  • Allele cards
	  • Legos
	
	PD Resources
	• RESPeCT lesson plans binder
	
	Resources in Lesson Plans Binder
	Resources section:
	• Content background document
	• Common Student Ideas
		The Dance of Chromosomes
		• Read the essay Understanding Inheritance: Results from Studies of Cells (handout 3.1 in lesson plans binder)
		• Work with a partner to complete the Genes and Chromosomes worksheet (handout 3.5 in PD program binder).
		• **Group discussion:** How can we support students as they work with these complex science ideas?
			Display Slide 27. The Dance of Chromosomes (25 min)
			
			a. Ask participants to locate Genetics lesson handout 3.1 (Understanding Inheritance: Results from Studies of Cells) in their lesson plans binders and handout 3.5 (Genes and Chromosomes) in their PD program binders.
			b. Have participants complete the first task on the slide independently and then work with a partner to complete the Genes and Chromosomes worksheet.
			c. "When you teach this lesson, it would be helpful to have a set of sample answers prepared in advance for this worksheet."
			d. After pairs complete the worksheet, have a group discussion about the best ways to support students as they wrestle with these complex science ideas. Highlight the sample marked-up essay (handout 3.3 in lesson plans binder) to support student reading strategies.

		A Model of Meiosis 	**Display Slide 28.** A Model of Meiosis (5 min) a. Walk participants through the content representation on the slide. b. "This is a model of meiosis for a species that has two different chromosomes and two copies of each chromosome. The purple chromosomes came from the dad, and the white chromosomes came from the mom. Meiosis is the process of making sex cells. In meiosis, a single cell divides into four daughter cells, each of which has one copy of each chromosome."

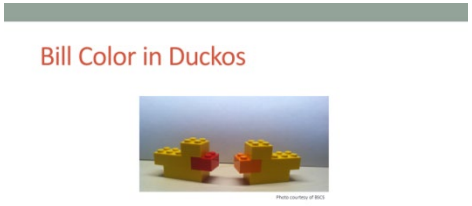
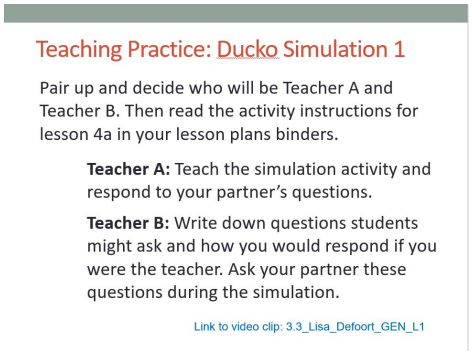
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 29.** The Process of Meiosis (7 min) a. Ask participants to compare the two content representations on the slide. They should observe that in the diagram on the right, the organism has a total of only one pair of chromosomes, whereas in the other diagram, the organism has two pairs of chromosomes. The image on the right also shows the chromosomes being duplicated initially, which is essential for the process to work. b. "What do the blue and red colors represent in these diagrams?" *[Answer: Whether the chromosome came from the mother or the father.]* c. "How many copies of each chromosome will be present in each of the sex cells?" *[Answer: One copy.]* d. "A human body cell has 46 chromosomes. How many would there be in an egg or sperm cell?" *[Answer: Each cell would have 23 chromosomes.]* e. "Where would we find alleles?" *[Answer: Along DNA strands in the chromosomes.]* f. Emphasize that alleles represent very small portions of the chromosomes that are shown. g. "Next, we'll use a simulation from one of the Genetics lessons to help us understand how the movement of genes and chromosomes relates to inheritance patterns."

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 30.** Creating a Model of Meiosis (10 min) a. Divide participants into groups of three for this activity. b. To remind participants of the steps in meiosis, you may want to display the previous slide throughout this simulation. **Note:** For a brief review of the difference between *heterozygous* and *homozygous* offspring, see section 7 (Key Terms) in the content background document. c. Review the instructions on the slide and highlight the three assumptions participants will begin with. Make sure participants have the supplies they need and understand what to do. d. Circulate among the groups as they work on the simulation and ask the following questions: • "How are you demonstrating which allele is which?" • "Why do plants go through meiosis?" • "What role does chance play in this process?"
			**Display Slide 31.** Creating a Model of Meiosis (10 min) a. As groups develop their models of meiosis, have them flip a coin to select the alleles represented in each of the heterozygous parents' sex cells. This will highlight the role of chance in the possible allele combinations. b. Groups should notice that the possible genotypes (or allele combinations) for the offspring are PP, Pp, and pp. The phenotypes (traits exhibited) are

<table>
<tr><th>PD Model:
Time/Phase</th><th>Purpose, Content, and
What Participants Do</th><th>Slides</th><th>Process</th></tr>
<tr><td></td><td></td><td></td><td>purple flowers (PP or Pp) or white flowers (pp).</td></tr>
<tr><td></td><td></td><td> 
</td><td>Display Slide 32. Interpreting the Results (4 min)

a. Walk the group through this table to help participants interpret their models.</td></tr>
<tr><td></td><td></td><td> 
</td><td>Display Slide 33. Reflect: Content Deepening Focus Question (2 min)

a. “Before we take a short break, let’s review our focus question for this content deepening work.”
b. “What have we learned from the meiosis simulation that might help us answer this question?”</td></tr>
<tr><td></td><td colspan="3">10-MINUTE BREAK</td></tr>
</table>

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 34.** Bill Color in Duckos (2 min) a. "Next, we're going to simulate how alleles are passed from parents to offspring by tracing the bill-color trait in fictional organisms called *duckos*." b. Build a model ducko from the Legos in the lesson materials kit so participants can see how simple these organisms are to make.
			**Display Slide 35.** Teaching Practice: Ducko Simulation 1 (15 min) a. Have participants pair up for this activity and decide who will be Teacher A and Teacher B. Review the roles of each teacher on the slide. b. Ask participants to read the activity instructions for lesson 4a in their lesson plans binders. Make sure they have the supplies they need before they begin the simulation. c. If there's time following this activity, consider showing the video clip of Lisa DeFoort teaching the simulation (video segments 30:21–39:10). Afterward, ask participants to summarize what students seemed to understand and not understand about the science ideas in the simulation.

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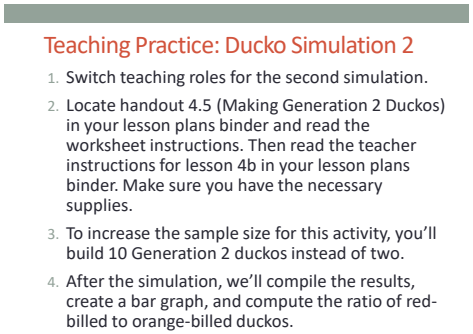
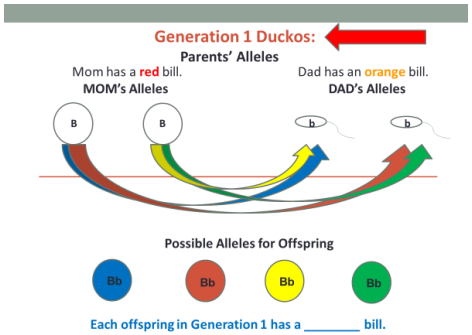
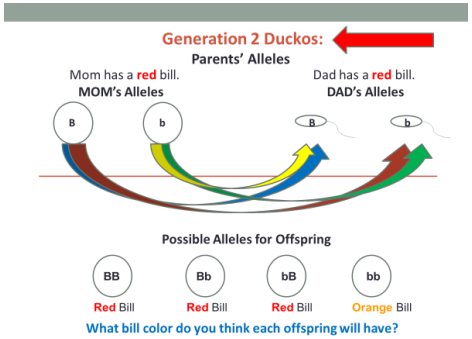
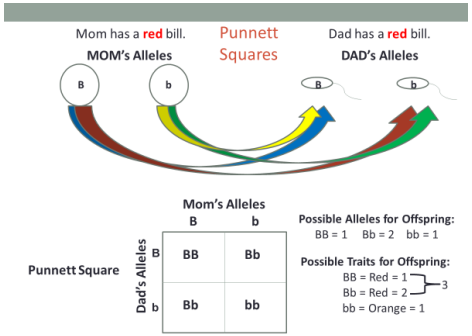
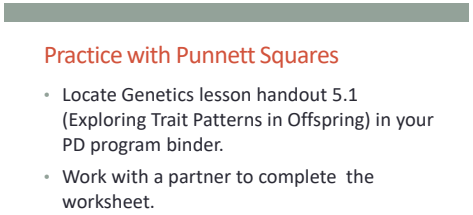
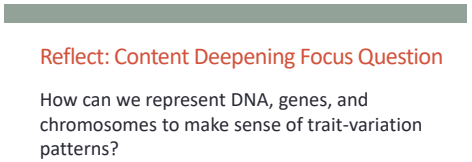
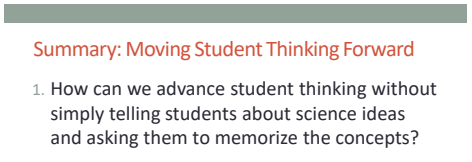
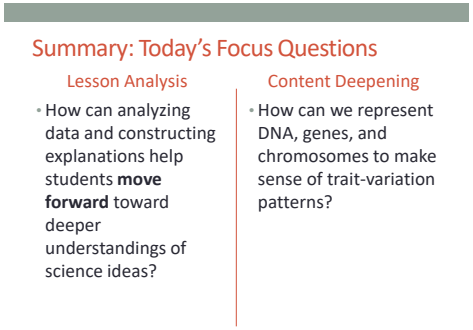
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 36.** Teaching Practice: Ducko Simulation 2 (20 min) a. Ask participants to locate handout 4.5 (Making Generation 2 Duckos) in their lesson plans binders and read through the activity instructions. Then have them read the teacher instructions for lesson 4b in their lesson plans binders. Note that for this simulation, pairs should switch teaching roles (Teacher A and B). b. In this activity, students build only two baby duckos for Generation 2, but to increase the sample size, have pairs build 10 offspring. c. After pairs have finished the simulation, compile the results from all the pairs and make a bar graph showing the number of red-billed and orange-billed duckos. Compute the ratio of red-billed to orange-billed offspring to see whether it comes close to 3:1. d. "Why do you think we're more likely to see a 3:1 ratio with a larger sample size?"
	Purpose • Relate the movement of alleles on chromosomes to the possible genotypes of offspring.		**Display Slide 37.** Generation 1 Duckos (7 min) **Note:** The slide animations for this activity come from lesson 5a. a. "Next, we'll use a series of slide animations from lesson 5 to explain the ducko results." b. First display only the top portion of the slide showing one allele (B or b) in each parent's sex cells. c. "The capital *B* in this diagram represents the dominant allele, and the lowercase *b* represents the recessive allele. The letter *b* was selected to

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			represent bill color, but scientists use any letter or symbol that makes sense." d. "Remember, the way the parents' sex cells come together is entirely random. Any egg could combine with any sperm when offspring are made, so let's see what might happen with the ducko parents' cells." e. Click through the slide animation to reveal how each egg could combine with either sperm. Emphasize that no matter which sex cells combine, all the offspring have the same allele combination: Bb. f. "So what color bill do all the first-generation duckos have? Why do you think there were no orange-billed duckos in Generation 1? Talk about this with a partner and see if you can come up with an explanation for this result." g. "Next, we'll see what happens with the second generation of duckos."
			**Display Slide 38.** Generation 2 Duckos (5 min) a. First display only the top portion of the slide. Point out that both parents have one dominant allele and one recessive allele. b. "Why do you think each of the parents has a dominant allele and a recessive allele?" **Note:** Participants should recognize that the parents (the Generation 1 offspring) received a dominant and a recessive allele from their parents. c. "Now let's see the possible allele combinations for the Generation 2 duckos. Remember, the parents' sex cells join together randomly, so any

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			sperm could combine with any eggs." d. Reveal each possible allele combination on the slide animation one at a time. When the animation shows an arrow pointing from one allele to another, ask participants to describe which two alleles the offspring would have. Then advance the animation to confirm the answer.
	Purpose • Relate the movement of alleles on chromosomes to Punnett squares.		**Display Slide 39.** Punnett Squares (10 min) a. Walk participants through this simulation from lesson 5a. Reveal the top portion of the slide first and review the Generation 1 parents' alleles. Then advance the animation to demonstrate how a Punnett square works. b. "The Punnett square on this slide is another way to represent the possible allele combinations for the Generation 2 ducko offspring. The mom's alleles appear at the top of the square, and the dad's alleles appear along the left side. To show the different allele combinations for the offspring, an allele at the top of the square is combined with an allele on the side of the square and recorded in the appropriate box." c. Click through the slide animation to demonstrate filling in the Punnett square for Generation 2 duckos. d. "How would you describe the different alleles the Generation 2 offspring received from their parents?" • "How many of the four offspring inherited two dominant alleles from their parents?" • "How many inherited both a dominant allele and a recessive allele?" • "How many inherited two recessive alleles?"

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			e. Advance the slide animation to reveal the possible allele combinations for the offspring (BB, Bb, and bb) and the number of offspring that inherited each combination. f. "Based on these allele combinations which bill color do you think each of these offspring will have? Think about this for a moment and then share your answers with a partner to see if you agree." g. After participants have shared their predictions, reveal the possible bill-color traits of the Generation 2 offspring and how many duckos exhibit each bill color.
			**Display Slide 40.** Practice with Punnett Squares (10 min) a. Have participants locate handout 3.6 (Exploring Trait Patterns in Offspring) in their PD program binders. This handout is from Genetics lesson 5b. b. Ask participants to work with a partner to complete the worksheet.

PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
			**Display Slide 41.** Reflect: Content Deepening Focus Question (2 min) a. Review the focus question on the slide. b. "Reflect on the content deepening work we completed today and then answer this question in your science notebooks."
3:15–3:30 15 min **Wrap-Up: Summary, Homework, and Reflections** Slides 42–45	**Purpose** • Reflect on the day's learning and summarize key ideas about the science content and strategies 4 and 5, linking those ideas to participants' images of effective science teaching and changes they want to make in their individual teaching practices. **What Participants Do** • Discuss ways of moving student thinking forward. • Add to/modify the Effective Science Teaching chart. • Review and discuss (as needed) today's focus questions. • Learn about the homework assignment and the focus of tomorrow's work. • Write reflections on today's learning. **Posters and Charts** • Effective Science Teaching chart • Strategy charts created today for		**Display Slide 42.** Summary: Moving Student Thinking Forward (5 min) a. Have participants share ideas about the first question on the slide. Then ask, "What are some things we've discussed today that address this question?" b. Refer participants to the Effective Science Teaching chart from day 1 and discuss the remaining questions on the slide. Modify the chart as participants share their ideas.
			**Display Slide 43.** Summary: Today's Focus Questions (5 min) a. Review today's focus questions. b. **Discuss:** "The STeLLA strategies booklet claims that strategies 4 and 5 are ways of moving student thinking forward. How would you support or challenge that claim? In other words, are you convinced that letting students analyze data and construct explanations will help them move forward toward deeper understandings of science ideas?"

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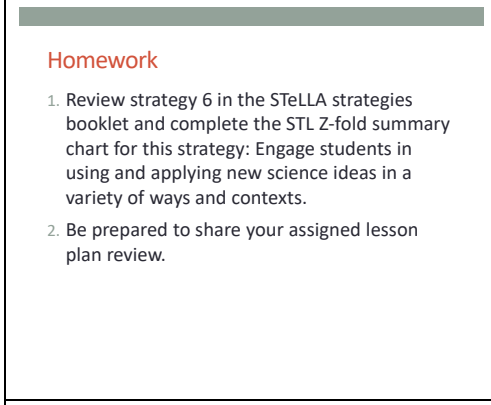
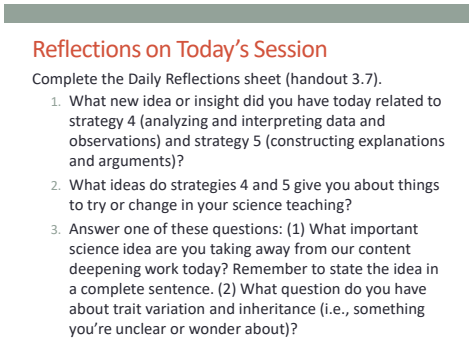
PD Model: Time/Phase	Purpose, Content, and What Participants Do	Slides	Process
	STL strategies 4 and 5 **Handouts in PD Binder** • 3.7 Daily Reflections—Day 3 **Supplies** • Science notebooks **PD Resources** • STeLLA strategies booklet • STL Z-fold summary chart (front pocket of PD binder)		c. **Ask:** "What key ideas do you now have about how to address our content deepening focus question?"
			**Display Slide 44.** Homework (1 min) a. "Tomorrow we'll focus on another strategy to help move student thinking forward toward deeper understandings of science ideas." b. Review the homework assignment and have participants copy it into their science notebooks.
			**Display Slide 45.** Reflections on Today's Session (4 min) a. Have participants reflect on today's session and answer the questions on the Daily Reflections sheet (handout 3.7 in PD program binder). **Note:** To support this task, encourage participants to refer to the STeLLA strategies booklet, the charts they created for STL strategies 4 and 5, the Effective Science Teaching chart, and their STL Z-fold summary charts.

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