Five Tools and Processes for Translating the NGSS into Instruction and Classroom Assessment

Tool 4: Using the 5E Instructional Model to Design Learning Sequences

Introduction

Tool 1 focused on using information from an NGSS page to develop a Unit Blueprint and Tool 2 involved developing Evidence of Learning Specifications to inform the planning of classroom assessments. Tool 3 introduced the 5E Instructional Model and the research that grounds the model to develop conceptual coherence for an instructional sequence from the Unit Blueprint.

The purpose of Tool 4 process is to continue to deepen participant understanding of the 5E Instructional Model as they develop lessons and activities for each lesson in the instructional sequence. Teachers use the phenomena and conceptual flow grounded in the 5E instructional model determined in Ms. Rivera's lessons from Tool 3 and start to outline a more complete instructional sequence. They apply each stage of the 5Es—engage, explore, explain, elaborate and evaluate— and think about what the teacher does and what the students do in each lesson of the instructional sequence, while continuing to focus on the three dimensions of the NGSS.

In Tool 4, teachers refine the 5E alignment of their instructional sequence by using Analysis Guides for each phase of the 5Es to "keep" or "tweak" activities, so they support the three dimensions. Teachers consider existing resources and activities to inform the design of their instructional sequence and gain a deeper level of alignment with NGSS. Teachers also develop key questions for each activity focused on phenomena and the ideal student responses.

Goals and Outcomes:

- Develop a shared vision for science teaching and learning informed by the NGSS
- Deepen understanding of how Conceptual Flow, Storyline about Phenomena, and the 5E Instructional Model support Three-Dimensional Learning
- Use instructional materials and the results of work with Tools 1, 2, and 3 to outline lessons for one 5E sequence that supports implementation of the NGSS

Prerequisite: Participants should have experience using Tools 1-3.

Total Time **365 minutes not including breaks (6 hours and 5 minutes or a one-day workshop)**

Part 1 **Introduction** (Slides 1-7) [15 minutes]

Purpose: Provide an opportunity for participants to connect with one another, review their prior work with Tools 1-3, and connect to the content of the day.

Summary: Participants review the work completed in previous sessions, consider the goals of the session, and how the goals will be accomplished

Part 2 **Revisit Ms. Rivera and her Instructional Sequence** (Slides 8-12) [135 minutes or 2 hours and 15 minutes]

Purpose: Consider coherence and alignment of instruction to the NGSS and the 5E Instructional Model.

Summary: Participants revisit the Teacher B Scenario charts they created during their work with Tool 3. They add color-coded sticky notes to the charts to indicate evidence of the three dimensions and Connections. They review what the teacher is doing and what the students are doing in each lesson to reinforce their understanding of alignment with each phase in the 5E Model and connect the work they will do with Tool 4 to the work completed in Tool 3.

Part 3 Tool 4 Example (Slides 13-18) [60 minutes]

Purpose: Develop understanding of the Tool 4 process and template and the Tool 4 Analysis Guides.

Summary: Participants compare Ms. Rivera's Tool 4 example with what their charts for each lesson. They practice using an Analysis Guide on Explore activities.

Part 4 Design a Learning Sequence Using Tool 4 and the Analysis Guides (Slides 19-21) (155 min)

Purpose: Identify, analyze, and revise activities to match specific phases of the BSCS 5E Instruction Model and align with the NGSS.

Summary: Participants are provided time to review activities aligned with their developed conceptual flow from Tool 3 and the BSCS 5E Instructional Model. They share their work with another group and reflect on the Tool 4 process.

Total Time = 365 minutes not including breaks (6 hours and 5 minutes)

Materials:

- Teacher Scenario B charts and sentence strips from Tool 3
- Tool 4 Electronic Template
- 3x3 Sticky notes: orange, blue, green, and purple (one set of each color per group)
- Markers
- Connections to Common Core cards from Tool 1 deck (yellow for ELA/Literacy and brown for Mathematics)

Handouts

HO 1 5E Teacher/Student

HO 2 Tool 4 Template Example

HO 3 Analysis Guides for 5E Instructional Model

a. Engage
b. Explore
c. Explain
d. Elaborate
e. Evaluate

HO 4 Disruptions in Ecosystems Activity 1.2

HO 5 BSCS Activity 1.2

Resources (Optional for this session)

Text Resources

R 1	*A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas* (2012) by National Research Council
R 2	*Next Generation Science Standards For States, By States Volume 1: The Standards* (2013) by NGSS Lead States
R 3	*Next Generation Science Standards For States, By States Volume 2: The Appendices* (2013) by NGSS Lead States

Slides

Slide 1	Five Tools and Processes for NGSS
Slide 2	Tool 1 Summary
Slide 3	Tool 2 Summary
Slide 4	Tool 3 Summary
Slide 5	Five Tools and Processes graphic
Slide 6	Goals
Slide 7	How Will We Accomplish These Goals?
Slide 8	Ms. Rivera (optional)
Slide 9	Tool 4
Slide 10	Linking to the NGSS
Slide 11	Alignment with the 5E Model
Slide 12	Connection to Tool 3
Slide 13	Tool 4
Slide 14	BSCS 5E Instructional Model
Slide 15	Tool 4 Example
Slide 16	Ms. Rivera's Tool 4 Example
Slide 17	Steps for Completing Tool 4
Slide 18	Using Analysis Guides
Slide 19	Using Analysis Guides
Slide 20	Steps for Completing Tool 4
Slide 21	Share Your Work
Slide 22	Reflection

PD Leader Resources (NOT used by participants)

- *Assessment-Centered Teaching: A Reflective Practice* (2008), DiRanna, Osmundson, Topps, Barakos, Gearhart, Cerwin, Carnahan, & Strang, Corwin Press, Thousand Oaks, CA.
- The BSCS 5E Instructional Model: Origins and Effectiveness (pp. 113-184) in BSCS | Measuring Our Success: The First 50 Years of BSCS http://www.bscs.org/estore/bscs-measuring-our-success-first-50-years

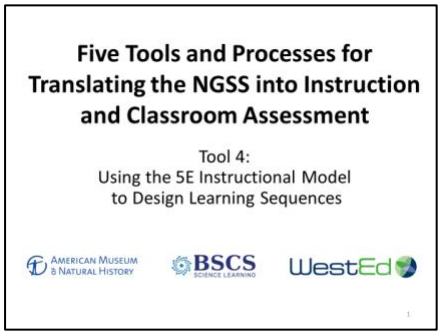
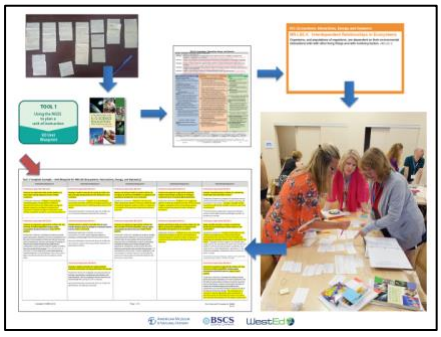
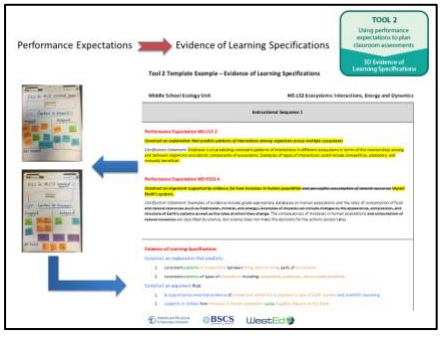
Advance Preparation:

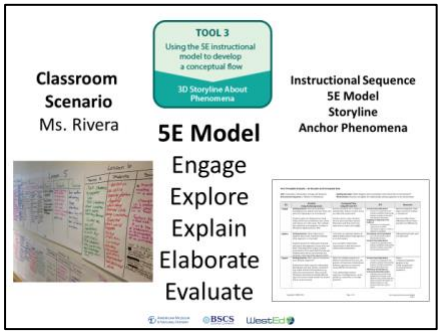
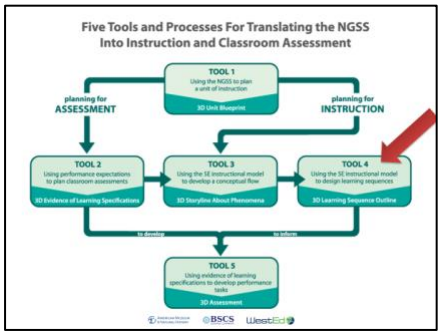
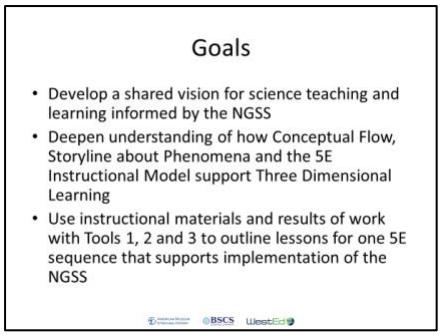
- Communicate with participants prior to the session. Suggest that they bring a computer, so they can access their Tool 1 Unit Blueprint, Tool 2 EoLS, and Tool 3 Storyline and Conceptual Flow. They should also bring their marked up copies of the Teacher B Scenario from Tool 3 and the instructional materials and resources referenced in their Tool 3 templates.

- Print and copy handouts.
- During Tool 1, participants were told to set aside their Connections to Common Core cards (for ELA/Literacy and Mathematics). In this session, the cards to work with are from the MS-LS2 card deck. If participants used another card deck for Tool 1, they should bring the additional Common Core cards to this session as well.
- Hang the Teacher B Scenario charts and sentence strips from Tool 3.

Part 1 Introduction (15 minutes)

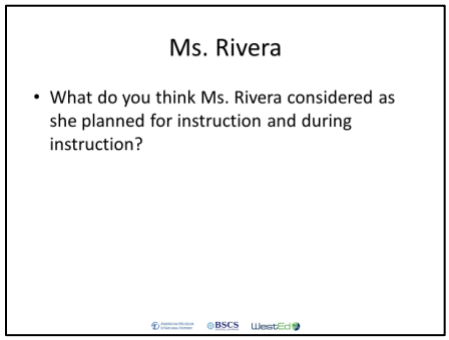
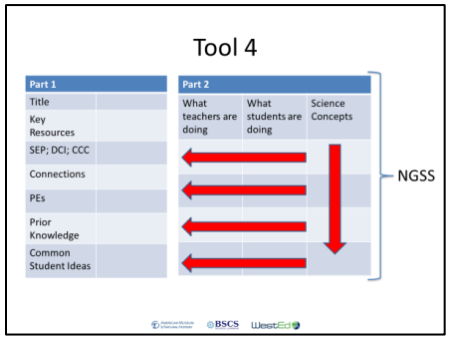
PD leader note: Begin the session with participants in their expert groups from Parts 1-4 of the Tool 3 session.

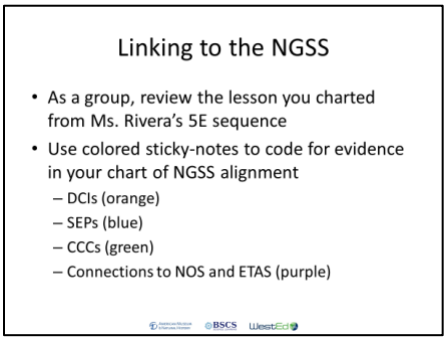
Slide and Time	Facilitation Notes
 Slide 1 (0 minutes)	**Display Slide 1 Five Tools and Processes…** a. Welcome participants to the session. **PD leader note**: Slides 2-4 reviews Tools 1-3 work in the previous sessions and provides context for their work in Tool 4.
 Slide 2 (3 minutes)	**Display Slide 2 Tool 1 Summary** **PD leader note:** This slide is animated. a. Invite participants to use the animated slide to tell the story of their learning (or work) so far. Alternatively, share a summary of the work participants did in Tool 1. Possible narrative: *The purpose of Tool 1 is to develop an understanding of the three dimensions of the NGSS—disciplinary core ideas in science and engineering, science and engineering practices, and the crosscutting—and to use these dimensions to develop a blueprint for designing an instructional unit.* [CLICK] *We began with our ideas about what MS students need to understand about Ecosystems: Interactions, Energy, and Dynamics.* [CLICK] *We then grounded our ideas in the Framework* [CLICK] *and NGSS.* [CLICK] *Using a card set with text from the standards,* [CLICK] *we developed a coherent conceptual flow through the grouping of the cards.* [CLICK] *The final product of this work was a Unit Blueprint.*
 Slide 3 (2 minutes)	**Display Slide 3 Tool 2 Summary** a. Invite participants to use the animated slide to tell the story of their learning (or work) so far. Alternatively, share a summary of the work participants did in Tool 2. Possible narrative: *The purpose of Tool 2 is to develop Evidence of Learning Specifications that will inform the planning of classroom assessments.* *Using a backwards design approach, we examined the NGSS performance expectations from the first instructional sequence of*

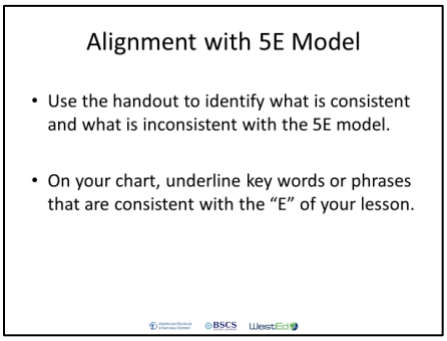
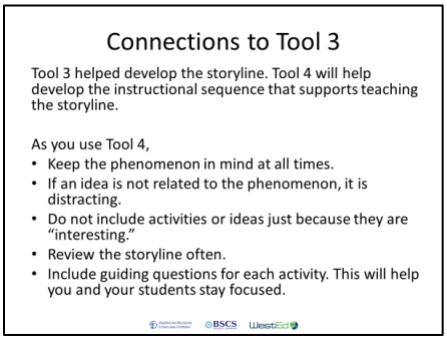
Slide and Time	Facilitation Notes
	the Unit Blueprint Template Example and developed Evidence of Learning Specifications (EoLS). These EoLS are aligned with the SEPs, DCIs, CCCs, and Connections of the instructional sequence and describe what constitutes evidence of student proficiency.
 Slide 4 (2 minutes)	**Display Slide 4 Tool 3 Summary** a. Invite participants to use the animated slide to tell the story of their learning (or work) so far. Alternatively, share a summary of the work participants did in Tool 3. Possible narrative: *The purpose of Tool 3 is to use the research-based 5E Instructional Model to develop a coherent storyline that focused on anchor phenomena and a conceptual flow of science content.* *We analyzed two teacher scenarios and examined how Ms. Rivera's lessons were aligned with the 5E Instructional Model and the research on how students learn. We used a phenomenon card sort activity to deepen our understanding of phenomena and developed a storyline that focused on anchor phenomena and conceptual flow of science content for an instructional sequence from the Unit Blueprint Template Example. We then developed a conceptual flow for an instructional sequence from the Unit Blueprint Template Example.*
 Slide 5 (1 minute)	**Display Slide 5 Five Tools and Processes Graphic** a. Briefly reorient participants to the Five Tools and Processes. Introduce Tool 4 as the focus of the session today. b. Mark that the product of our work from Tool 3 will be used in Tool 4 to design integrated three-dimensional, phenomena focused lessons and instructional activities.
 Slide 6 (2 min)	**Display Slide 6 Goals** a. Review the goals of the session with participants.

Slide and Time	Facilitation Notes
 Slide 7 (5 minutes)	**Display Slide 7 How Will We Accomplish These Goals?** **PD leader note:** This slide is animated. a. Provide a frame for the session by linking to the session goals and Tools 1-3. Possible narrative: The goal for our work with Tool 4 is to outline lessons for one 5E instructional sequence that supports implementation of the NGSS. [CLICK] We will use our storyline about phenomena with a coherent conceptual flow [CLICK] and the 5E Instructional Model [CLICK] *to design lessons in an instructional sequence aligned to the NGSS DCIs, SEPs, CCCs, and Connections.* **Transition**: *As we work today, we'll begin by revisiting Ms. Rivera's classroom. Keep in mind that our intention is to analyze the alignment and coherence of her sequence, so we can apply that thinking to our own work later in the session.*

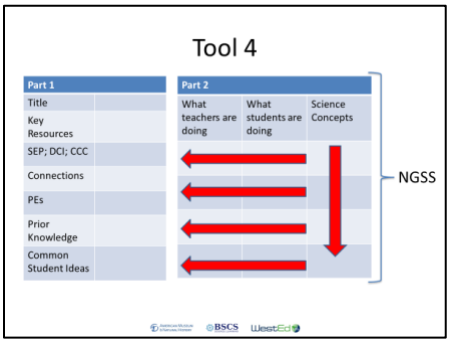
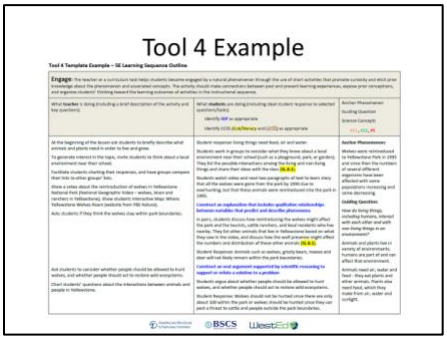
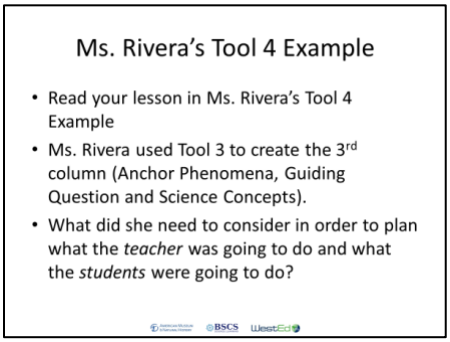
Part 2 Revisit Ms. Rivera and her Instructional Sequence (135 minutes)

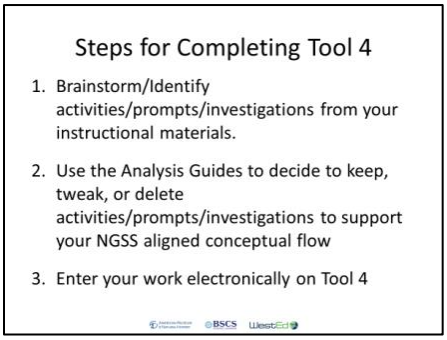
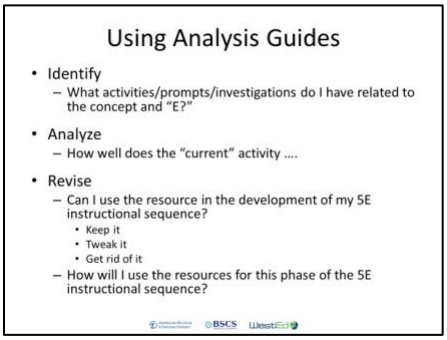
Slide and Time	Facilitation Notes
 Slide 8 (optional)	**Display Slide 8 Ms. Rivera (hidden)** a. In a Think-Pair-Share, ask participants to recall Ms. Rivera's scenario (provide Tool 3 HO2 to anyone who doesn't have theirs) and the charts they created in the last session and discuss the prompt on the slide. b. Chart the group's ideas and use their ideas in to build on in the next slide.
 Slide 9 (5 minutes)	**Display Slide 9 Tool 4** a. Share that we have seen the product of Ms. Rivera's planning and we will retrace her steps so that we can better create our own instructional sequences to support our students. b. Mark that, from the product of her work from the Tool 3 Example, we know she thought carefully about the science concepts using the Tool 1 blueprint, what she will do as the classroom teacher, and what her students will do throughout the lesson. These ideas are captured on our charts and represented as Part 2 on the slide.

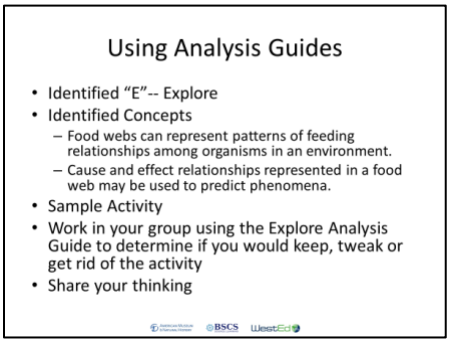
Slide and Time	Facilitation Notes
	c. Share with participants that in Part 1 of Tool 4, Ms. Rivera examined the NGSS addressed in the sequence and considered potential resources, student prior knowledge and common student ideas. d. Note that, in Part 2, she used her conceptual flow from Tool 3 to serve as the "backbone" for instruction, considering what students are doing and what the teacher is doing for her lessons. e. Share that Ms. Rivera used the anchor phenomena and conceptual flow to select appropriate activities from her resources (including her instructional materials) in the 5E sequence to develop a coherent storyline for learning. **Transition**: *To trace Ms. Rivera's steps in Part 1, we will identify where she incorporated the NGSS into her instructional sequence.*
 Slide 10 (30 minutes)	**Display Slide 10 Linking to the NGSS** a. Share that each expert group will revisit the lesson they charted to look for evidence of the three dimensions and connections. b. Using the prompts on the slide, share that they will code their evidence using the appropriate colored sticky note with the code and one-two words written in marker on the sticky note. c. Encourage participants to use the Tool 1 Blueprint Template Example, the Teacher Scenario B lesson descriptions, and the Tool 3 Template Example as sources for their evidence. d. Once groups have added their sticky notes to the charts, invite the whole group to stand at the charts. Invite elbow partners to share what they notice as they observe the sticky notes across the instructional sequence. e. Invite pairs to share their observations with the whole group. Highlight key ideas such as: i. The three dimensions are present across the instructional sequence ii. Science concepts (DCIs) are scaffolded from more concrete to more abstract iii. Students need scaffolding to support their growth in the elements of the practices. For example, students were asked to explain if wolves should be reintroduced to an ecosystem in lesson 1 and again in lessons 6 and

Slide and Time	Facilitation Notes
	7. However, in lesson 1 their explanation was based on prior knowledge while in lessons 6 and 7 their explanations are based on evidence. iv. Note that students engage in the practice of explanation in lessons that are not the Explain lesson of the 5E sequence. Depending on the purpose of engaging in explanation as an SEP, students may engage in this practice in multiple lessons within the 5E sequence.
 Slide 11 (30 minutes)	**Display Slide 11 Alignment with the 5E Model** a. Distribute **HO1: 5E Teacher/Student**. Give participants a several minutes to look over both sides of the handout. b. Share that we will look for key language that helps identify alignment with the purpose of each phase of the 5Es. c. Using their Teacher Scenario B handout, groups should revisit their chart again, underlining words or phrases that are consistent with the "E" of that lesson. If needed, they can add language to their chart. d. After all groups have finished underlining on their charts, invite the whole group to look across the lessons and compare the underlining on the charts with HO1. Invite participants to ask clarifying questions to other lesson groups.
 Slide 12 (8 minutes)	**Display Slide 12 Connections to Tool 3** a. Note that Tool 3 resulted in an outline with a phenomena focused storyline with a coherent conceptual flow. Tool 4 will use that outline to create an instructional sequence teaching guide to enact that storyline. b. Review the Tool 4 reminders on the slide, noting that they will help participant select and adapt activities as they complete Tool 4 for their instructional sequence.

Part 3. Tool 4 Example (60 minutes)

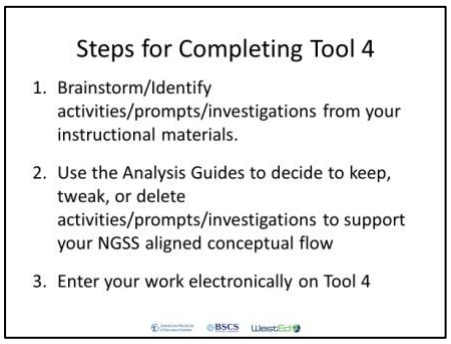
Slide and Time	Facilitation Notes
 Slide 13 (3 min)	**Display Slide 13 Tool 4** a. Distribute **HO2: Tool 4 Template Example**. Invite participants to individually look over the front matter. b. Ask participants to share where they think Ms. Rivera found the information to complete each section of Part 1. Ensure that participants know the sources of each piece of information in the Part 1 front matter.
 Slide 14 (2 minutes)	**Display Slide 14 Tool 4 Example** a. Direct groups to their lesson in the Tool 4 Template Example. **PD leader note:** Because there are two cycles of Explore-Explain in this instructional sequence, make sure the Explore and Explain lesson groups are in the correct place in the document (L2: page 6, L3: page 8, L4: page 10, and L5: page 11). b. Orient participants to the structure of the outline, noting the alignment to the lesson's "E", and the three columns describing what the teacher is doing, what the students are doing, and the science concepts. Mark that these columns are the same as those on their lesson charts.
 Slide 16 (15 minutes)	**Display Slide 15 Ms. Rivera's Tool 4 Example** a. Review the directions on the slide with participants. Provide time for participants to individually read their lesson. b. Distribute the Connections to Common Core cards for ELA/Literacy and Mathematics that were first shared during Tool 1 and set aside until now. Have groups identify the ELA/Literacy and Mathematics connections cards that align with the PEs for this instructional sequence. **PD leader note**: Participants should look for Common Core cards aligned with MS-LS2-2. There are five ELA/Literacy cards and one Mathematics card that align. c. Using the Tool 4 example as a guide, invite participants to add the ELA/Literacy and Mathematics Connections cards to their charts as appropriate. d. Invite participants to discuss the question on the slide with an elbow partner.

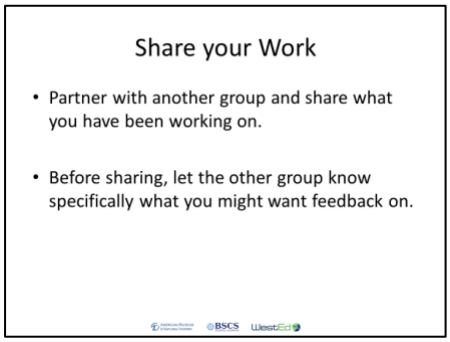
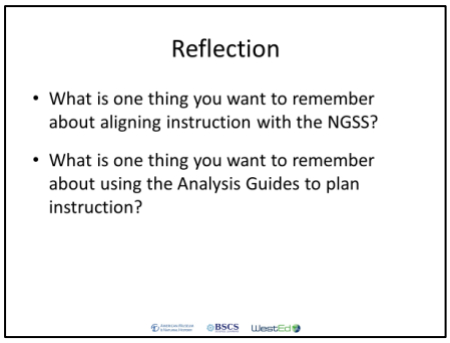
Slide and Time	Facilitation Notes
	Transition: Share that we will now examine the specific steps Ms. Rivera followed to determine the activities, prompts, and investigations for each lesson.
 Slide 17 (2 minutes)	**Display Slide 16 Steps for Completing Tool 4** a. Review the steps for completing Tool 4 with participants. Remind them that they need to keep in mind alignment with both NGSS and the 5E Instructional Model. b. Share with participants that BSCS has developed Analysis Guides for each "E" to help check for alignment. **Transition**: *To familiarize ourselves with the Analysis Guides, we will practice using the Explore Analysis Guide together.*
 Slide 18 (10 minutes)	**Display Slide 17 Using Analysis Guides** a. Provide an overview of the process used in each Analysis Guide represented by Identify, Analyze, and Revise: i. Identify: brainstorm or find activities and prompts that could be used in instruction; ii. Analyze: determine the worthiness of the activity or prompt for instruction and ideas/evidence to inform revisions to the activity; and iii. Revise: modify the activity or prompt as needed to better align with the NGSS learning. b. Remind participants that design is an iterative process and they will likely revise their concept statements, activities, and even conceptual flow as they continue to work. c. Distribute **HO3: Analysis Guides**. Orient participants to the structure of the guide for each E, using the Explore as an example. Share with participants that: i. All the guides follow the same format. ii. Note that the first page of each analysis guide provides a foundation for decision-making—the learning goals of the lesson and a description of the decision to be made. Remind participants that they may choose to "toss" an activity at any time in the analysis process. iii. Ensure that all participants know where to find the information required to complete the analysis guide. iv. There are two major analyses for each phase: page 2 has questions that determine the characteristics of the activity that would determine its worthiness of further analysis;

Slide and Time	Facilitation Notes
	page 3 has questions to analyze the depth of student thinking required by the activity. v. The guides include prompts to revise the activity to align with the 5Es and the NGSS.
 Slide 19 (28 minutes)	**Display Slide 18 Using Analysis Guides** a. Distribute **HO4: Disruptions in Ecosystems Activity 1.2** to half of the members of each group, and **HO5: BSCS Activity 1.2** to the other half. b. Share with participants that these are the activities Ms. Rivera considered for her first Explore lesson in her 5E instructional sequence. c. Provide time for participants to work together to use the Explore Analysis Guide for their assigned activity. d. When they are ready, invite participants to share the analysis of their assigned activity with their expert group. e. Ask several groups to share their analyses with the whole group.

Part 4. Designing a Learning Sequence Using Tool 4 and the Analysis Guides (155 minutes)

PD leader note: For the remainder of the session, participants should work the groups from Part 5 of the Tool 3 session. This is an opportune time to take a break and move to their working groups.

Slide and Time	Facilitation Notes
 Slide 20 (120 minutes)	**Display Slide 19 Steps for Completing Tool 4** a. Remind participants that Ms. Rivera's activities and prompts were aligned with the "E" and the concept for that phase. She considered her storyline about phenomena and her conceptual flow aligned with the NGSS to think about what the students and what she would be doing for each lesson. She then identified/brainstormed activities, analyzed them, and then revise them for better alignment. b. Share that participants will have 2 hours to go through a similar process for the instructional sequence they worked on in Tool 3. c. Suggest that groups work on charts to keep their thinking public. When they have completed their thinking, if time allows, they can enter the information electronically into the Tool 4 template.

Slide and Time	Facilitation Notes
	d. Walk around and monitor table discussions. If necessary, remind participants to: • Review their PE, Evidence of Learning Specifications, and DCIs, CCCs, and SEPs from their Tool 1 Unit Blueprint. • Review their EoLS from Tool 2 and their Tool 3 work for their sequence. • Access their instructional materials. • Note that once they work through an Analysis Guide for each E, they should summarize their activities in the Tool 4 Template. For example, once participants have decided to use an activity from their instructional materials, they should capture common misconceptions identified in the top part of the Tool 4 Template. They should capture their ideal student responses in the "What students are doing" column in the appropriate Phase of the Tool 4 Template.
 Slide 21 (30 minutes)	**Display Slide 20 Share Your Work** a. Share with participants that they will now have an opportunity to check in with another group in the room. b. Pair up groups for sharing. If groups have struggled, an alternative option is to have one group present to everyone.
 Slide 22 (5 minutes)	**Display Slide 21 Reflection** a. Invite participants to reflect individually on the prompts. b. Invite them to share their ideas with their group.