Smithsonian Science for the Classroom

HOW CAN WE PROTECT ANIMALS WHEN THEIR HABITAT CHANGES?

Grade 3 - Engineering

TRAINER GUIDE

CURRICULUM PROFESSIONAL DEVELOPMENT

Smithsonian
Science Education Center

The **Smithsonian Science Education Center** (SSEC) is an education organization within the Smithsonian Institution. The SSEC's mission is to transform K–12 *Education Through Science*™ in collaboration with communities across the globe. The SSEC promotes authentic, interactive, inquiry-based K–12 STEM teaching and learning; ensures diversity, equity, accessibility, and inclusion in K–12 STEM education; and advances STEM education for sustainable development. The SSEC achieves its goals by developing exemplary curriculum materials and digital resources; supporting the professional growth of K–12 teachers and school leaders; and conducting outreach programs through LASER (Leadership and Assistance for Science Education Reform) to help schools, school districts, state education agencies, and ministries of education throughout the world implement inquiry-based science education programs.

The **Smithsonian Institution** was created by an Act of Congress in 1846 "for the increase and diffusion of knowledge . . ." This independent federal establishment is the world's largest museum, education, and research complex and is responsible for public and scholarly activities, exhibitions, and research projects nationwide and overseas. Among the objectives of the Smithsonian is the application of its unique resources to enhance elementary and secondary education.

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Thank You for Your Support

How Can We Protect Animals When Their Habitat Changes?
Grade 3—Engineering
Trainer Guide

INTRODUCTION

In 2019, the US Department of Education awarded the Smithsonian Science Education Center an early-phase Education Innovation and Research (EIR) grant to support the development, implementation, and initial evaluation of evidence-based innovations to improve student achievement. The project, called Smithsonian Science for North and South Carolina Classrooms (PR# U411C190055), took place between October 2019 and September 2024 in third-, fourth-, and fifth-grade classrooms in North and South Carolina.

Between 2020 and 2023, participating teachers in implementation schools received curriculum professional development tied to two Smithsonian Science for the Classroom curriculum modules and content and pedagogy professional development tied to the content of each module to implement in their classrooms. The Center for Research in Educational Policy (CREP) at the University of Memphis evaluated the impact of these modules and professional development on student achievement using standardized assessments, classroom observations, and teacher focus groups.

This guide was developed as a support for trainers leading curriculum professional development for third grade teachers implementing the Smithsonian Science for the Classroom Engineering module *How Can We Protect Animals When Their Habitat Changes?*

RESOURCES

- Teacher Guide (TG)
- Student Activity Guide (SAG)
- Smithsonian Science Stories Literacy Series: *Changing Habitats* (Reader)
- Carolina Science Online (CSO): Carolinascienceonline.com

HOW TO USE THIS TRAINER GUIDE

This guide shares important ideas and strategies for effectively introducing a Smithsonian Science for the Classroom (SSftC) module with educators, when used in conjunction with the corresponding Teacher Guide (TG). The Teacher Guide contains essential details needed to implement the module in the classroom, while this Trainer Guide outlines how to conduct professional development for that module; therefore, the two guides should be used in tandem.

The professional development plan for each section is outlined in a table at the start of each session. Within each section, there is another table. The first column shows the part of the lesson being addressed, and corresponding page numbers within the Teacher Guide, Student Activity Guide, and Reader. The second column provides the trainer with additional direction in concise bullet points.

ROOM SETUP

To set up a classroom for this workshop:

1. Move tables or desks so groups of three or four participants can work together.
2. Set module materials out on side tables where they can be easily accessed.
3. Locate the nearest restrooms and evacuation routes.

WORKSHOP OVERVIEW

This trainer guide provides direction on facilitating the curriculum sessions highlighted in the table below.

Day 1		Day 2	
10 a.m.	Welcome Session	**10 a.m.** Curriculum Session 3	Focus Questions 3–4 (Lessons 8–12)*
11 a.m. Curriculum Session 1	Introduction and Lesson 1	**12 p.m.**	Lunch
12 p.m.	Lunch	**12:45 p.m.** Curriculum Session 4	Focus Question 4–5 (Lessons 13–15)
12:45 p.m. Curriculum Session 2	Focus Questions 1–2 (Lessons 2–7)	**3 p.m.**	Closing Session
3:30 p.m.	Adjourn	**3:30 p.m.**	Adjourn

Depending on the workshop design, this section may be led by participants if they have adequate time to prepare.

Note: Italicized statements are intended to provide supporting information to facilitators.

SESSION 1:

Introduction and Lesson 1

In this session, the trainer leads lessons as a facilitator (wearing their "teacher hat") while teachers act as learners (wearing their "student hats").

Goal: The trainer facilitates the first lesson as an exemplar and introduces the concept storyline of the G3 Engineering module. Participants experience Lesson 1 as learners and debrief the lesson as teachers.

AGENDA AND TIMING

Sections	Minutes	Materials/Notes
Housekeeping and Introductions	10 minutes	
Lesson 1	30 minutes	
SSftC Features and CSO	15 minutes	
Concept Storyline	5 minutes	

Key Points	
Housekeeping and Introductions	**Introductions** Welcome participants to your session. Remind them that this professional learning workshop is meant to orient teachers to a new Smithsonian Science for the Classroom curriculum module. At times they will be asked to wear their "student hat" and experience lessons as their students will, and at others they'll reflect on the material wearing their "teacher hat." **Icebreaker Activity** Participants introduce themselves through an icebreaker activity. **Housekeeping** Preview the agenda. Verify the safety protocols in the classroom and locate the nearest restrooms, fire exit, tornado shelter.

	Key Points
	Establish the Tone for the Day Divide participants into small groups and ask them to think about what they want to achieve today. What norms do they think will encourage a positive learning environment? Introduce group norm ideas: • Be brave • Be present • Ask questions • Be respectful Have each small group discuss the suggested norms and add to the big group list of norms. Once everyone has added their ideas, ask if there are any changes, additions, or modifications that need to be made. When the discussion is finished, this will be the social contract the group abides by for the next two days.
	General Safety While the risk of injury is low, there should be clear safety guidelines and expectations. These guidelines will vary depending on the situation, but some useful examples can be found in the Stay Safe! contract included in the curriculum, chemistry lab rules, and general classroom safety expectations. Safety guidelines should be discussed before every lesson. Examples of safety guidelines: • Pull hair back • No tasting anything • Wear protective eyewear from start to finish • If something spills, report it immediately to get help cleaning it up • Listen closely to instructions • No running in the classroom

Lesson 1: Animal Survivor
Animals need food, water, and shelter to survive.

30 minutes

Students identify the problem of changes to habitat causing animal populations to decline and take part in a video investigation to find out what animals need to survive.

Group discussion among participants is very important for these lessons. Strategies for supporting group discussions can be found in Appendix 1. Strategies for furthering discussion through guiding thought/questioning can be found in Appendix 2.

On CSO, navigate to Lesson 1 using the numbers at the top of the screen.

Resource/Page #	Lesson 1
Overview TG: p. 79	Objectives: • Define the problem of animal population decline caused by habitat change. • Carry out an investigation to answer the question, What do animals need to survive? Lesson Background Information: • Animals require food, water, shelter, air, and space to survive. This unit will focus on water, food, and shelter. Class Periods: 1 (1 class period = about 35 minutes)
Materials & Preparation TG: p. 80	Materials: • Sticky notes • Chart paper or whiteboard for group discussion Printed Materials: • Lesson 1 Notebook Sheet A Digital Materials: • Tiger Range file • Animal Needs video *The materials listed here are a minimum list. Please visit CSO or the TG for more detailed information.* This lesson does not require any additional setup.

Resource/Page #	Lesson 1
Procedure: Getting Started TG: p. 80–81	*Getting Started* • Open the Tiger Range file. • Use guiding questions to discuss what information can be gathered from the map. • Hand out Lesson 1 Notebook Sheet A. Have students complete the questions.
Procedure: Activity TG: p. 81–82	*Activity* • Students will observe video clips to identify evidence of animal needs. • Record class observations on a table. • Introduce the problem, What do animals need to survive? • Introduce observations as a form of evidence. • Play the Animal Needs video and have participants record observations about what they see in their notebooks. • Play the video again, and have participants make notes about what the animals are doing and why they are doing it.
Procedure: Bringing It All Together TG: p. 82–85	*Bringing It All Together* • Collect evidence from participants to create a group chart of evidence. • Based on the evidence, have participants suggest a claim that answers the question, What do animals need to survive? • Create a visual organizer (e.g., Venn diagram, T chart, etc.) to organize evidence on animal needs (food, water, shelter). • Have participants write a final claim in their notebook in their own words.
Assessment, Enrichment & Extension TG: p. 85–87	Briefly review as time allows: • Assessment Rubrics: Pre-Assessment • Extension: My Animal Is . . . (Literacy)

Resource/Page #	Lesson 1
Reflection	After experiencing the lesson, ask participants to put on their "teacher hat" to consider and discuss: • What student learning can you expect from this lesson? • Any potential challenges you might have in this lesson? • Any potential difficulties or misconceptions that students may struggle with in this lesson? • What strategies or supports can be applied?

Smithsonian Science for the Classroom Features and Carolina Science Online

15 minutes

Key Points	
TG	Hand out TGs. Briefly review the physical items that accompany a module: • Teacher Guide (1) • Student Activity Guide (8) • Smithsonian Science Stories (16) • Materials (for 32 students)
CSO	Carolina Science Online (CSO) is the virtual platform that hosts the teacher guide, digital copies of the student readers, digital readers in Spanish, and other digital resources for the module. **Set Up a Carolina Science Online Account** Before training, you should receive an email directing you to create your teacher login on CSO (www.carolinascienceonline.com). On the main page, hover over the "Teacher Login" button. "Create a Teacher account" will appear as an option. Enter the required information. Make sure you choose a password you can remember. Return to the main page and log in. At the top of the page, click "redeem code." Enter the code that was emailed to you. The account is now ready to use. next page →

Key Points

	On the main page, all the titles available to you will be in bright colors. Click on the module you need. The module will open in the "Module Overview" tab.
	The "Home" button in the top left of the screen will take you back to the main screen with all of the available titles.
	"Bookmarks" will open your bookmarks folder. You can bookmark any of the digital resources on CSO by clicking on the star underneath the resource.
	"Assignments" shows all assignments you have created using CSO digital resources. You can add a digital resource to assignments by clicking "add to assignment" on any CSO digital resource.
TG and CSO TG: p. 1–17	Navigate to the "Curriculum Overview" section in the TG, which is also found under the "Module Overview" tab in CSO. This section provides an introduction to the curriculum and the research-based methods integrated into Smithsonian Science for the Classroom.
TG: p. 20–21	**Concepts and Practices Storyline** Modules are broken down into areas that revolve around a single focus question. The focus questions build a storyline that provides a coherent experience that builds toward solving a problem. The storylines are carefully integrated with the 5E model and each lesson is identified as to where it fits in the model. This module has five focus questions, with the final focus question being the Engineering Design Challenge.
TG: p. 22–24	**Prerequisite Concepts and Practices** The listed items are the skills and knowledge students will lean on to incorporate new skills and content learning. Each set of concepts and practices identifies where the prerequisites should have been taught. next page →

Key Points	
TG: p. 24–29	**Module Background Information** This section provides background information for the teacher. It covers content that is not directly discussed in the module but may prove useful in understanding where content or practices are headed. It also provides information that is a fundamental building block for content and practices used in the module.
TG: p. 30–33	**Common Misconceptions** Students may express misconceptions throughout the lesson. This section provides a list of common misconceptions identified in research for both content and practices, an explanation of the misconception, and a possible example of how it may come up. The number after the misconception refers to which reference the misconception is described in. Throughout the module, misconception callouts will be highlighted using the Good Thinking! bubble. Good Thinking! is a YouTube video series created by the Smithsonian Science Education Center focused on misconceptions and learning.
TG: p. 33–39	**Materials Management and Safety** This section provides information on materials that will be provided with the module kit, needed but not supplied materials, safety concerns, and a safety contract for students. Under the "Materials Lists" section you will need to click on the hyperlink to download the materials lists. These lists show you everything that will be included in the module kit and items teachers will need to supply. The lists also show how much of each material is needed and in which lesson. In the "Safety" section, there are callouts for specific concerns for this module and a link to a Stay Safe! contract. The contract lists expectations for students to keep themselves and others safe during science investigations. It has lines for both students and guardians to sign.

Key Points	
TG and CSO	Navigate to the "NGSS Alignment and Planner" tab in CSO.
TG: p. 42–43	**Module Alignment to NGSS** These modules are aligned to the Next Generation Science Standards, which teachers can use as an additional tool to identify student objectives and goals for learning.
TG: p. 44–73	**Lesson Planners** The lesson planners highlight everything that will happen in a lesson, such as: • Focus Question • Step of 5E model • Number of class periods needed • Vocabulary that will be introduced • Student objectives • Misconceptions: more information can be found in the "Module Overview" tab or TG p. 30–33 • Disciplinary core ideas: content focus • Science and engineering practices • Crosscutting concepts: ideas that are multidisciplinary • ELA and math connections: numbers reference the Common Core Standards • Extensions: additional lessons that are not necessary to move forward in the module
TG: p. 76–77	In the TG, review the callout icons itemized in the Guide to Module Investigations: • NGSS • Common Core • Misconceptions • Digital Resource • ELL Strategy • Teacher Tips and Tech Tips • Guiding Questions • Safety Notes • Class Period Break

Key Points	
Readers and CSO	All the written materials (Readers, Student Activity Guides, Notebook Sheets) are available digitally on CSO. Navigate to the student readers under the "Digital Resources" tab in CSO. There are multiple versions. The on-grade reader cover has a matchstick with the round end pointing up. The below-grade reader cover has a matchstick with the round end pointing down. The Spanish reader is only available on grade. The on-grade reader exists in two forms on CSO. One is an interactive book and the other is an e-book. The other readers are only available in the e-book format. Both formats have tools for students. In the interactive book, students can highlight and make notes using the tools in the toolbar. In the e-book format, students can use the text-to-talk feature by highlighting the text and selecting the speaking icon.
Support and CSO	Carolina Science Online provides a number of supports to teachers, including: • Teacher Resource videos: These videos provide an overview of the focus questions and show any lessons with a potentially tricky setup. They're available under the "Digital Resources" tab. • Tutorial videos: For help using CSO's features, choose "Support" from the vertical toolbar on the left side of the homepage. • Get Ready! Professional Learning: These short videos offer information on-demand and teacher tips about the program. They can be found at: https://www.smithsonianstc.com/ssftc-get-ready-campaign-172N7-44857Z.html

Concept Storyline
Grade 3 Engineering: *How Can We Protect Animals When Their Habitat Changes?*

5 minutes

Concept Storyline	
TG and CSO TG: p. 20-21	**Concepts and Practices Storyline** Return to the "Concepts and Practices Storyline" tab and walk through the module's structure. This module has five focus questions, with the final focus question being the Engineering Design Challenge. Explain each focus question with its objectives, as below: FQ#1: What do animals need to survive? (Lessons 1-4) *Students collect evidence from videos to make a claim that animals need air, food, water, and shelter to survive. They use this knowledge to design and test different classroom habitats where live roly polys can survive.* FQ#2: Why do animals live in different habitats? (Lessons 5-7) *Students analyze data from camera traps on animals living in different habitats. They read about marine habitats and make a claim about how well a marine animal would survive in a different habitat.* FQ#3: What can fossils tell us about animals and habitats? (Lessons 8-10) *Students compare fossils with modern-day animals to make a claim about the type of habitat the animals lived in. They compare and contrast an extinct animal with a living animal using information from a reading.* FQ#4: What happens to animals when their habitats change? (Lessons 11-13) *Students use games to simulate change in habitats and to make a claim that when habitats change, animal populations can go down. They learn through a reading that wildlife corridors can help protect animals when their habitat changes.* next page →

Concept Storyline	
	FQ#5: How can we reduce salamander deaths on roads? (Lessons 14–15) *Students engage in a two-part summative assessment. In the written assessment, students analyze data and construct explanations about how well different animals survive in a city, and what fossils can tell us about habitat change. Students are then challenged to apply what they have learned about science and engineering to build and test a tunnel that can stop salamanders from being killed when crossing roads.*

Assessment	There are four types of assessment throughout the module.
	
	• Pre-Assessment (Lesson 1)
	• Formative Assessment (Lessons 2–13)
	• Summative Assessment (Lessons 14–15)
	    • Written Summative Assessment
	    • Performance Summative Assessment
	• Self-Assessment (SAG): Stop & Check

SESSION 2:

Lessons 2–7

The trainer introduces Lessons 2–4 (Focus Question 1) and Lessons 5–7 (Focus Question 2).

Goal: The trainer facilitates Lessons 2–7, with participants experiencing the lessons as learners and debriefing each focus question as teachers.

At various points in the training, there may be differing ideas presented by participants, especially when introducing claims and evidence. For strategies on handling differing opinions, please see Appendix 4.

AGENDA AND TIMING

Sections	Minutes	Materials/Notes
Group Roles	5 minutes	Make sure Group Roles poster is visible
Lesson 2	25 minutes	Hand out Readers
Lesson 3	20 minutes	It will take time for roly polys to move from Lesson 2; explain the lesson and check back later for results
Short break	10 minutes	
Lesson 4	25 minutes	
Lesson 5	20 minutes	
Short break	10 minutes	
Lesson 6	25 minutes	
Lesson 7	25 minutes	Requires making comic strips; providing stencils and/or cutouts or using digital apps may reduce anxiety about drawing

Many of the lessons use group roles to assign specific jobs. For strategies on using group roles effectively, please see Appendix 3.

Group Roles

5 minutes

Starting in Lesson 2, students will be assigned group roles. The assignments and a possible rotation system can be found in Appendix 3. Group roles are a common tool to build teamwork skills such as turn taking, communication, and responsibility for individual and group needs. Additionally, having a specific role can increase student involvement and confidence by ensuring they know what is expected of them in a given situation. You can learn more about collaborative groups and group roles in the Zero Barriers in STEM Education Accessibility and Inclusion Workbook found at https://ssec.si.edu/zero-barriers.

Lesson 2: Roly Poly Hotel Part 1
A habitat needs to provide a source of food, water, and shelter.

25 minutes

Students design two classroom habitats where roly polys can survive and plan a fair test to determine the effect of changing one material and to decide which habitat is the best solution to the problem.

On CSO, navigate to Lesson 2 using the numbers at the top of the screen.

Resource/Page #	Lesson 2
Overview TG: p. 89	Objectives: • Work as a group to design two solutions to solve the problem of providing a classroom habitat where roly polys can survive. • Plan a fair test to determine in which habitat roly polys would survive best. Lesson Background Information: • Roly polys are crustaceans that live on land and breathe with gills. • They need water to breathe. • A fair test requires changing only one variable. Class Periods: 1 (1 class period = about 35 minutes)
Materials & Preparation TG: p. 90-93	Materials: • Roly poly habitat materials • SAG • Reader Printed Materials: • Lesson 2 Notebook Sheet A • Lesson 2 Notebook Sheet B Digital Materials: • N/A *The materials listed here are a minimum list. Please visit CSO or the TG for more detailed information.* next page →

Resource/Page #	Lesson 2
	To help participants better familiarize themselves with the lesson setup for implementation, the group will do some materials preparation during the workshop. For this lesson, the group should: • Collect leaves and rocks for groups to use in their habitat design. • Have roly polys ready to use.

Procedure: Getting Started
TG: p. 93–94
Reader: p. 1–8
	Getting Started
	• Introduce the roly polys to the class using guiding questions.
	• The Reader *Changing Habitats* has multiple versions. They all have the same readings but in multiple forms:
	  • On-Grade Readers: 16 physical copies shipped with your supplies, with Lexile scores for third grade
	  • CSO Readers: All CSO readers can be assigned to students using the CSO system
	    1. Spanish reader: on-grade reader in Spanish has notes and text-to-speech
	    2. Student reader: Digital copy of on-grade reader with note-taking and text-to-speech
	    3. Below-grade reader: the same information but simpler sentence structure, to decrease the Lexile score by about 100 points
	    4. Smithsonian Science Stories: *Motion and Magnets* Student Reader: e-book version of the on-grade reader with annotation toolbar
	• Hand out Readers and read the Roly Poly Life History section of reading 1, "A Roly Poly's World" in the Reader.
	
	next page →

Resource/Page #	Lesson 2
	Reading Summary This reading is about roly polys, or pill bugs. Roly polys are invertebrates, which means they don't have a backbone. Instead, they have a thin shell to support their body and jointed legs, which also makes them arthropods. Roly polys like to live on land where it is wet so they can breathe through their gills. They eat organic matter like dead plants.
Procedure: Activity TG: p. 94-98 SAG: p. 1-2	*Activity* • Introduce the engineering challenge of building a roly poly habitat. • Set criteria that there can be only three elements in the habitat. • Assign groups and group roles: Materials Manager, Speaker, Builder, and Zookeeper. • Hand out SAGs to each group and have them complete steps 1-2. • Hand out Lesson 2 Notebook Sheet A. • Introduce a fair test and have groups choose one material that will be different in the two habitats. • Hand out Lesson 2 Notebook Sheet B and have groups complete steps 3-5 in the SAG.
Procedure: Bringing It All Together TG: p. 99	*Bringing It All Together* • Use guiding questions to review what students have created and how it is an engineering problem.
Assessment, Enrichment & Extension TG: p. 99-102	Briefly review, as time allows: • Assessment Rubrics: Formative Assessment • Extension: Arthropods (Literacy), Gallery Walk (Literacy), Roly Poly Walk (Community and Home)

Resource/Page #	Lesson 2
Reflection	After experiencing the lesson, ask participants to put on their "teacher hat" to consider and discuss: • What student learning can you expect from this lesson? • Any potential challenges you might have in this lesson? • Any potential difficulties or misconceptions that students may struggle with in this lesson? • What strategies or supports can be applied?

Lesson 3: Roly Poly Hotel Part 2
Different solutions need to be tested to see which one best solves the problem.

20 minutes

Students collect data from testing two habitats to make a claim about the effect of the material that was changed and the habitat that best meets the needs of the roly polys.

On CSO, navigate to Lesson 3 using the numbers at the top of the screen.

Resource/Page #	Lesson 3
Overview TG: p. 103	Objectives: • Collaboratively plan and carry out an investigation to test two classroom habitats. • Argue from evidence for which habitat best meets the needs of the roly polys. Lesson Background Information: • Roly polys are not dangerous. • Some roly polys may die during testing. Class Periods: 2 (1 class period = about 35 minutes)
Materials & Preparation TG: p. 104–106	Materials: • Roly poly habitat materials • SAG Printed Materials: • Lesson 2 Notebook Sheet B Digital Materials: • Panda Enclosure file *The materials listed here are a minimum list. Please visit CSO or the TG for more detailed information.* This lesson does not require any additional setup.
Procedure: Getting Started TG: p. 106–107	***Getting Started*** • Project the Panda Enclosure file and discuss where the food, water, and shelter is for the pandas.

Resource/Page #	Lesson 3
Procedure: Activity TG: p. 107–110 SAG: p. 3–6	*Activity* • Participants will stay in the same groups as in Lesson 2 to create the habitats they designed. Reassign group roles: Materials Manager, Speaker, Builder, and Zookeeper. Then review how they are going to set up their fair test. • Hand out the SAGs and have participants complete steps 1–3. • Have participants complete steps 4–5 in the SAG. • Once habitats are built, have the Zookeeper collect 12 roly polys to add to their habitat. • Have participants complete steps 6–8 in the SAG. • When implementing this lesson in the classroom, the roly polys will need to be left overnight to move between the two setups. For training purposes, give the roly polys a few minutes or the length of a participant bathroom break to move, and then continue with the lesson. • Have participants complete steps 9–11 in the SAG.
Procedure: Bringing It All Together TG: p. 111–112	*Bringing It All Together* • Have the Speaker of each group share which of their habitats was better, using evidence from observations. • Have participants build a group claim for which materials roly polys prefer and support the claim with evidence from observations and discussions.
Assessment, Enrichment & Extension TG: p. 112–113	Briefly review, as time allows: • Assessment Rubrics: Formative Assessment • Extension: Roly Poly Bar Graph (Math)

Resource/Page #	Lesson 3
Reflection	After experiencing the lesson, ask participants to put on their "teacher hat" to consider and discuss: • What student learning can you expect from this lesson? • Any potential challenges you might have in this lesson? • Any potential difficulties or misconceptions that students may struggle with in this lesson? • What strategies or supports can be applied?

Lesson 4: Teamwork
Living in groups helps some animals survive.

25 minutes

Students collect evidence from a text to construct a claim that being in a group can have many effects that may help an animal survive.

On CSO, navigate to Lesson 4 using the numbers at the top of the screen.

Resource/Page #	Lesson 4
Overview TG: p. 115	Objectives: • Obtain, evaluate, and communicate information from a text on animals living in groups. • Argue using evidence that some animals form groups that help members survive. Lesson Background Information: • Living in a group can help animals survive when their habitat changes and/or protect them from predators. • Living in a group can be dangerous for an animal because it increases competition and the chance for disease. Class Periods: 1 (1 class period = about 35 minutes)
Materials & Preparation TG: p. 116	Materials: • Sticky notes • Reader Printed Materials: • Lesson 4 Notebook Sheet Digital Materials: • Animal Needs video *The materials listed here are a minimum list. Please visit CSO or the TG for more detailed information.* This lesson does not require any additional setup.
Procedure: Getting Started TG: p. 116–117	***Getting Started*** • Replay the Animal Needs video from Lesson 1 and use guiding questions to facilitate a discussion on animals living in groups.

Resource/Page #	Lesson 4
Procedure: Activity TG: p. 117–118 Reader: p. 9–14	*Activity* • Hand out the Reader to pairs of participants or have them access the digital readers. Read reading 2, "Social Survival." • Have participants complete the Lesson 4 Notebook Sheet with effects of animals living in groups. **Reading Summary** This reading is about animals who live in groups and others who live alone. Ants live in colonies where each ant has a specific job to help the group survive. Some predators, like lions, hunt other animals by working together in groups. The animals being hunted, or prey, stay together for protection, as with schools of fish and flocks of birds. Animals who live alone, like big cats and polar bears, are solitary and don't have to share food or shelter.
Procedure: Bringing It All Together TG: p. 119–120	*Bringing It All Together* • Collect cause-and-effect data from groups to create a claim about whether or not being in a group helps animals.
Assessment, Enrichment & Extension TG: p. 120–122	Briefly review, as time allows: • Assessment Rubrics: Formative Assessment • Extension: My Group (Literacy, Community and Home), A Closer Look (Literacy)
Reflection	After experiencing the lesson, ask participants to put on their "teacher hat" to consider and discuss: • What student learning can you expect from this lesson? • Any potential challenges you might have in this lesson? • Any potential difficulties or misconceptions that students may struggle with in this lesson? • What strategies or supports can be applied?

Lesson 5: Camera Trap
Different numbers and types of animals are found in different habitats.

20 minutes

Students look for patterns in camera trap data to identify mammals living in a woodland habitat.

On CSO, navigate to Lesson 5 using the numbers at the top of the screen.

Resource/Page #	Lesson 5
Overview TG: p. 123	Objectives: • Obtain information from a text on how scientists use camera traps to collect data. • Analyze camera trap photos and record the number and kinds of animals in a table. Lesson Background Information: • Motion-sensitive cameras are used to collect images and video of animals in different areas to provide data about animals in the area. • Tracking animal data over time can show important patterns in habitat change. Class Periods: 1 (1 class period = about 35 minutes)
Materials & Preparation TG: p. 124	Materials: • Reader • Field Guide booklet Printed Materials: • Lesson 5 Notebook Sheet Digital Materials: • Virginia Woodland file • Woodland Animals file *The materials listed here are a minimum list. Please visit CSO or the TG for more detailed information.* This lesson does not require any additional setup.

Resource/Page #	Lesson 5
Procedure: Getting Started TG: p. 125–126 Reader: p. 19–22	*Getting Started* • Lead a discussion about why animals live in the habitats they live in using the Virginia Woodland file. • Read the eMammal section of reading 3, "Anyone Can Be a Scientist" in the Reader. • Discuss how camera traps help scientists collect data. **Reading Summary** This reading describes eMammal, a citizen science camera trap project where students and scientists upload their camera trap pictures to a website. Anyone can then visit the website and identify the animals caught on camera, especially the mammals. Mammals are vertebrates (have backbones) with fur or hair and live young that they feed with milk.
Procedure: Activity TG: p. 126–128	*Activity* • Provide groups of three with a Field Guide and access to the Woodland Animals file. Groups will use the Lesson 5 Notebook Sheet to collect data. • Demonstrate how to use the Field Guide and Notebook Sheet to identify and tally the animals they identify.
Procedure: Bringing It All Together TG: p. 129–130	*Bringing It All Together* • Debrief what groups noticed and how this data could help scientists.
Assessment, Enrichment & Extension TG: p. 130–133	Briefly review, as time allows: • Assessment Rubrics: Formative Assessment • Extension: Grumeti (Community and Home), Citizen Scientists (Literacy), Woodland Animals Graph (Math)

Resource/Page #	Lesson 5
Reflection	After experiencing the lesson, ask participants to put on their "teacher hat" to consider and discuss: • What student learning can you expect from this lesson? • Any potential challenges you might have in this lesson? • Any potential difficulties or misconceptions that students may struggle with in this lesson? • What strategies or supports can be applied?

Lesson 6: Town and Country
Some habitats meet the needs of particular animals better than other habitats

25 minutes

Students use graphs to analyze camera trap data from three different habitats and use evidence from a field guide to explain the patterns in the kind and number of animals seen in each habitat.

On CSO, navigate to Lesson 6 using the numbers at the top of the screen.

Resource/Page #	Lesson 6
Overview TG: p. 135	Objectives: • Analyze and interpret camera trap data from three different habitats. • Use data to construct an explanation for why different animals are seen in different habitats. Lesson Background Information: • Groups will look at camera trap information from three sites: oak woodlands, pine woodlands, and an urban area. • Different habitats provide different things that enable different types of animals to thrive. Class Periods: 1 (1 class period = about 35 minutes)
Materials & Preparation TG: p. 136–137	Materials: • Set of Habitat Cards • Field Guide booklet • SAG Printed Materials: • Lesson 6 Activity Sheet • Lesson 6 Notebook Sheet A • Lesson 6 Notebook Sheet B Digital Materials: • N/A *The materials listed here are a minimum list. Please visit CSO or the TG for more detailed information.* This lesson does not require any additional setup.

Resource/Page #	Lesson 6
Procedure: Getting Started TG: p. 137–138	*Getting Started* • Ask groups about what animals they identified in Lesson 5. • In this lesson, groups will be conducting similar research in new areas.
Procedure: Activity TG: p. 138–141 SAG: p. 7–8	*Activity* • Pass out the Habitat Cards sets to each group of three. Assign group roles: Artist, Speaker, Questioner. • Ask groups to divide the cards and share their observations with one another. • Introduce the Venn diagram on the Lesson 6 Activity Sheet and provide guidance on how to complete it. • Have groups follow steps 1–3 in the SAG to complete the Venn diagram. • Have participants complete steps 4–7 in the SAG to graph the number of animals seen in different habitats. • Participants will use the Field Guide booklet to help them identify animals.
Procedure: Bringing It All Together TG: p. 142	*Bringing It All Together* • Ask groups for their observations about where animals live and why they live there.
Assessment, Enrichment & Extension TG: p. 142–145	Briefly review, as time allows: • Assessment Rubrics: Formative Assessment • Extension: Red Fox, Gray Fox (Math), Our Habitat (Community and Home)
Reflection	After experiencing the lesson, ask participants to put on their "teacher hat" to consider and discuss: • What student learning can you expect from this lesson? • Any potential challenges you might have in this lesson? • Any potential difficulties or misconceptions that students may struggle with in this lesson? • What strategies or supports can be applied?

Lesson 7: Under the Sea

In a given habitat, some animals can survive well, some survive less well, and others cannot survive at all.

25 minutes

Students communicate information obtained from a text by creating a comic strip showing how a marine animal would be affected by visiting a new type of habitat.

On CSO, navigate to Lesson 7 using the numbers at the top of the screen.

Resource/Page #	Lesson 7
Overview TG: p. 147	Objectives: • Obtain information from a text on marine habitats and organisms. • Communicate information in a comic strip story based on evidence showing that in a particular marine habitat, some animals survive well, some survive less well, and others don't survive at all. Lesson Background Information: • The ocean has different habitats that are home to different animals. • Different animals live in different habitats: open ocean, coral reef, and sandy beach. Class Periods: 1 (1 class period = about 35 minutes)
Materials & Preparation TG: p. 148	Materials: • Colored pencils • Reader Printed Materials: • Lesson 7 Activity Sheet Digital Materials: • Open Ocean video • Coral Reef video • Sandy Beach video • Ocean Animals file *The materials listed here are a minimum list. Please visit CSO or the TG for more detailed information.* This lesson does not require any additional setup.

Resource/Page #	Lesson 7
Procedure: Getting Started TG: p. 148–149	***Getting Started*** • Show the videos of the different ocean habitats and lead a discussion about the differences in the habitats.
Procedure: Activity TG: p. 149–152 Reader: p. 23–31	***Activity*** • Have pairs read reading 4, "Exploring Marine Habitats" in the Reader. • Discuss which animals might live in each habitat and why. • Assign groups a scenario in which ocean animals go to a different habitat using the suggested scenarios on TG p. 151. • Explain the criteria for creating a comic strip to illustrate this scenario. **Reading Summary** This reading describes three ocean habitats: open ocean, coral reef, and sandy beach. The open ocean is far from land and is inhabited by mammals, birds, fish, and invertebrates. Coral reefs are built in shallower water by very small animals called polyps, and are inhabited by many animals, including fish, starfish, and sea turtles. Sandy beaches are constantly changing due to ocean waves and the tide. The crabs, crustaceans, and worms that live there can either bury themselves in the sand or move out of the way of the waves.
Procedure: Bringing It All Together TG: p. 153	***Bringing It All Together*** • Have individuals present their comic strips and explain what is happening in them.
Assessment, Enrichment & Extension TG: p. 153–155	Briefly review, as time allows: • Assessment Rubrics: Formative Assessment • Extension: Ocean Explorers (Literacy), Conservation Comics (Literacy)

Resource/Page #	Lesson 7
Reflection	After experiencing the lesson, ask participants to put on their "teacher hat" to consider and discuss: • What student learning can you expect from this lesson? • Any potential challenges you might have in this lesson? • Any potential difficulties or misconceptions that students may struggle with in this lesson? • What strategies or supports can be applied?

SESSION 3:

Lessons 8–12

The trainer introduces Lessons 8–12 (Focus Questions 3 and 4).

Goal: The trainer facilitates Lessons 8–12, with participants experiencing the lessons as learners and debriefing each focus question as teachers.

At various points in the training, there may be differing ideas presented by participants, especially when introducing claims and evidence. For strategies on handling differing opinions, please see Appendix 4.

AGENDA AND TIMING

Sections	Minutes	Materials/Notes
Lesson 8	20 minutes	
Lesson 9	25 minutes	Hand out Readers
Short break	10 minutes	
Lesson 10	25 minutes	
Lesson 11	20 minutes	Pre-play the game to be prepared
Lesson 12	20 minutes	Watch Teacher Resource video to prepare for the Tiger, Tiger demo

Lesson 8: She Sorts Seashells
There are similarities and differences between fossil organisms and modern organisms.

20 minutes

Students analyze patterns in seashells and compare and contrast them with a fossil.

On CSO, navigate to Lesson 8 using the numbers at the top of the screen.

Resource/Page #	Lesson 8
Overview TG: p. 157	Objectives: • Analyze data on seashells to identify the number of different types of animals. • Compare data on seashells and fossils to show patterns of similarities and differences. Lesson Background Information: • Fossils show what animals were alive a long time ago. • Fossils are generally made in watery areas, but can also be made when an animal is frozen or encased in a hard substance. Class Periods: 1 (1 class period = about 35 minutes)
Materials & Preparation TG: p. 158	Materials: • Seashells • Hand lenses • SAG Printed Materials: • Lesson 8 Notebook Sheet Digital Materials: • N/A *The materials listed here are a minimum list. Please visit CSO or the TG for more detailed information.* To help participants better familiarize themselves with the lesson setup for implementation, the group will do some materials preparation during the workshop. For this lesson, the group should: • Sort seashells for each group so they have a mixture of types.

Resource/Page #	Lesson 8
Procedure: Getting Started TG: p. 159	*Getting Started* • Have groups share what they know about fossils. • Have partners think-pair-share about how a fossil of a seashell could be found in a desert.
Procedure: Activity TG: p. 159–161 SAG: p. 9–10	*Activity* • Assign group roles: Materials Manager, Speaker, Organizer, Messenger. • Have groups complete steps 1–3 in the SAG to sort seashells. • Have groups complete steps 4–11 in the SAG to compare their fossil to a seashell using a box and a T chart on the Lesson 8 Notebook Sheet.
Procedure: Bringing It All Together TG: p. 162–163	*Bringing It All Together* • Share T charts of fossils vs. seashells. • Discuss what part of animals become fossils.
Assessment, Enrichment & Extension TG: p. 163–166	Briefly review, as time allows: • Assessment Rubrics: Formative Assessment • Extension: Gallery Walk (Literacy), Timeline (Social Studies), Mold and Cast (Art)
Reflection	After experiencing the lesson, ask participants to put on their "teacher hat" to consider and discuss: • What student learning can you expect from this lesson? • Any potential challenges you might have in this lesson? • Any potential difficulties or misconceptions that students may struggle with in this lesson? • What strategies or supports can be applied?

Lesson 9: Fossil CSI
Evidence from fossils shows that some habitats have changed dramatically over long periods of time.

25 minutes

Students analyze and interpret data on fossils and make a claim about whether the habitat where the fossil organisms lived has changed over a long period of time.

On CSO, navigate to Lesson 9 using the numbers at the top of the screen.

Resource/Page #	Lesson 9
Overview TG: p. 167	Objectives: • Represent data on fossils to show the relationship to modern organisms. • Use data to construct an explanation that some habitats on Earth have changed. Lesson Background Information: • Comparing fossils to modern organisms can provide information about how a habitat has changed over time. • Finding similarities in fossils and modern organisms can help scientists understand how ancient animals lived. Class Periods: 1 (1 class period = about 35 minutes)
Materials & Preparation TG: p. 168	Materials: • Bag of assorted fossils • Fossil Sorting Guide • Reader Printed Materials: • Lesson 9 Notebook Sheet Digital Materials: • Paleozoic Ocean file *The materials listed here are a minimum list. Please visit CSO or the TG for more detailed information.* next page →

Resource/Page #	Lesson 9
	To help participants better familiarize themselves with the lesson setup for implementation, the group will do some materials preparation during the workshop. For this lesson, the group should: • Prepare a set of three fossils for each group and make sure they each receive three different kinds of fossils.
Procedure: Getting Started TG: p. 169 Reader: p. 32–38	*Getting Started* • Ask groups what they remember about fossils from Lesson 8. • Have pairs read reading 5, "Fossil Finders" in the Reader. **Reading Summary** The science of studying ancient life and nature is called "paleontology" and is done by paleontologists. Sedimentary rock is a great place to find fossils, which show paleontologists the structure of long-gone animals. Getting fossils out of the ground is delicate work. Paleontologists collect the fossil and the material around it to bring back to a lab, where they look for patterns in the fossil and the rocks around it to determine what type of animal it might have been and what its habitat was like.
Procedure: Activity TG: p. 169–171 SAG: p. 11–12	*Activity* • Let groups know they will be investigating fossils to help paleontologists determine what a particular habitat was like long ago. • Assign groups of three to group roles: Speaker, Organizer, Messenger. • Have groups complete steps 1–3 in the SAG to plan how they will investigate the fossils. • Have groups complete steps 4–7 in the SAG and complete the Lesson 9 Notebook Sheet.
Procedure: Bringing It All Together TG: p. 171–173	*Bringing It All Together* • Have groups share their Notebook Sheets and observations. • Show the Paleozoic Ocean file, which is an artist's rendition of what the habitat might have looked like.

Resource/Page #	Lesson 9
Assessment, Enrichment & Extension TG: p. 173–174	Briefly review, as time allows: • Assessment Rubrics: Formative Assessment • Extension: Fossil Hunters (Community and Home)
Reflection	After experiencing the lesson, ask participants to put on their "teacher hat" to consider and discuss: • What student learning can you expect from this lesson? • Any potential challenges you might have in this lesson? • Any potential difficulties or misconceptions that students may struggle with in this lesson? • What strategies or supports can be applied?

Lesson 10: Dinosaur Dig Site
Some types of organisms that once lived are now extinct.

25 minutes

Students collect information from a text on patterns of similarities and differences between an extinct animal and a modern animal. They use information in the text to make a claim about the kind of habitat the extinct animal lived in.

On CSO, navigate to Lesson 10 using the numbers at the top of the screen.

Resource/Page #	Lesson 10
Overview TG: p. 175	Objectives: • Obtain, evaluate, and communicate information from a text on fossils. • Analyze data on an extinct and non-extinct animal to show similarities and differences. Lesson Background Information: • The modern cassowary is similar to the prehistoric Anzu but has some distinct differences. Class Periods: 1 (1 class period = about 35 minutes)
Materials & Preparation TG: p. 176	Materials: • Reader Printed Materials: • Lesson 10 Notebook Sheet Digital Materials: • Arthropods file • Cassowary video *The materials listed here are a minimum list. Please visit CSO or the TG for more detailed information.* This lesson does not require any additional setup.
Procedure: Getting Started TG: p. 176–177	***Getting Started*** • Show the Arthropods file and ask the group what modern animal is most similar to the trilobite.

Resource/Page #	Lesson 10
Procedure: Activity TG: p. 177–179 Reader: p. 39–46	*Activity* • Have pairs read reading 6, "Digging for Dinosaurs" in the Reader. • Discuss the reading as a whole group. • Have individuals compare the cassowary and the Anzu using a box and a T chart on the Lesson 10 Notebook Sheet. **Reading Summary** This reading describes the Hell Creek Formations, which are rock layers in Montana, North Dakota, South Dakota, and Wyoming where more dinosaur fossils have been found than anywhere else in North America. These areas are warm and dry now, but used to be lakes and rivers—indicated by the many plant fossils that have been found there dating back 66 million years. A new bird-like dinosaur was recently discovered there and named *Anzu wyliei.* Scientists are still debating what caused dinosaurs to go extinct at the time when no more dinosaur fossils can be found in newer rock layers.
Procedure: Bringing It All Together TG: p. 180	*Bringing It All Together* • Play the Cassowary video and have students suggest what this might tell them about how the Anzu lived.
Assessment, Enrichment & Extension TG: p. 180–182	Briefly review, as time allows: • Assessment Rubrics: Formative Assessment • Extension: A New Dinosaur (Literacy), Dinosaur Lengths (Math)
Reflection	After experiencing the lesson, ask participants to put on their "teacher hat" to consider and discuss: • What student learning can you expect from this lesson? • Any potential challenges you might have in this lesson? • Any potential difficulties or misconceptions that students may struggle with in this lesson? • What strategies or supports can be applied?

Lesson 11: Move, Survive, or Die!
When their environment changes, some organisms thrive, some must move, and others die.

20 minutes

Students use a board game as a model to collect evidence to make a claim that a change in habitat can cause animal populations to go up or down.

On CSO, navigate to Lesson 11 using the numbers at the top of the screen.

Resource/Page #	Lesson 11
Overview TG: p. 183	Objectives: • Carry out an investigation using a model to collect evidence to answer the question, What happens to animals when their habitat changes? • Construct an explanation about the effect of habitat changes on different animal populations. Lesson Background Information: • Some animals are greatly affected by habitat changes, while others are able to withstand larger changes. Class Periods: 1 (1 class period = about 35 minutes)
Materials & Preparation TG: p. 184–185	Materials: • Move, Survive, or Die! Game • SAG Printed Materials: • Lesson 11 Notebook Sheet Digital Materials: • N/A *The materials listed here are a minimum list. Please visit CSO or the TG for more detailed information.* To help participants better familiarize themselves with the lesson setup for implementation, the group will do some materials preparation during the workshop. For this lesson, the group should: • Cut apart game cards. • Count out pop-it counters.

Resource/Page #	Lesson 11
Procedure: Getting Started TG: p. 185–186	*Getting Started* • Ask the group questions about why the dinosaurs went extinct.
Procedure: Activity TG: p. 186–188 SAG: p. 13–16	*Activity* • Have groups follow steps 1–9 in the SAG to set up the Move, Survive, or Die! game. • Review the rules, then have students play the game while keeping track of their population change.
Procedure: Bringing It All Together TG: p. 188–189	*Bringing It All Together* • Have groups share what happened to their animal population. • Have individuals share ideas to make a group claim about what happens to animals when their habitat changes.
Assessment, Enrichment & Extension TG: p. 189–190	Briefly review, as time allows: • Assessment Rubrics: Formative Assessment • Extension: Hundreds and Thousands (Math)
Reflection	After experiencing the lesson, ask participants to put on their "teacher hat" to consider and discuss: • What student learning can you expect from this lesson? • Any potential challenges you might have in this lesson? • Any potential difficulties or misconceptions that students may struggle with in this lesson? • What strategies or supports can be applied?

Lesson 12: Tiger, Tiger
Land development can make it harder for animals to access resources and their population can decrease.

20 minutes

Students use a movement game as a model to construct an explanation for why land development causes tiger populations to decline.

On CSO, navigate to Lesson 12 using the numbers at the top of the screen.

Resource/Page #	Lesson 12
Overview TG: p. 191	Objectives: • Use a game as a model to understand the causes of tiger population decline. • Construct an explanation for why land development is causing tigers to become endangered. Lesson Background Information: • Tigers have lost 93% of their historic range and now live largely where there are no humans or crops. • In this lesson, students use a model of a tiger habitat to explain why tiger populations are declining. Class Periods: 1 (1 class period = about 35 minutes)
Materials & Preparation TG: p. 192–194	Materials: • 17 pieces of chart paper or poster paper • Food cards • Sheet of blue paper Printed Materials: • N/A Digital Materials: • Tiger Background file *The materials listed here are a minimum list. Please visit CSO or the TG for more detailed information.* This lesson does not require any additional setup.

Resource/Page #	Lesson 12
Procedure: Getting Started TG: p. 194–195	*Getting Started* • Use the Tiger Background file to introduce the tiger habitat and the nearby villages.
Procedure: Activity TG: p. 195–198	*Activity* • Assign each participant a role as a plant, tiger, or villager. Have them stand on the appropriate spot on the chart paper as described in the TG. • In each round of the game, expand the village, have tigers find food cards or water, and have the tigers and villagers play rock-paper-scissors to determine who wins the square. • Record the tiger population for each round.
Procedure: Bringing It All Together TG: p. 199–200	*Bringing It All Together* • Ask the group what they noticed during the game. • Ask individuals to write a few sentences in their notebook about why the Bengal tiger is now endangered.
Assessment, Enrichment & Extension TG: p. 200–202	Briefly review, as time allows: • Assessment Rubrics: Formative Assessment • Extension: Plotting Tigers (Math)
Reflection	After experiencing the lesson, ask participants to put on their "teacher hat" to consider and discuss: • What student learning can you expect from this lesson? • Any potential challenges you might have in this lesson? • Any potential difficulties or misconceptions that students may struggle with in this lesson? • What strategies or supports can be applied?

SESSION 4:

Lessons 13–15

The trainer finishes Focus Question 4 with Lesson 13 and introduces the final Engineering Design Challenge (Lessons 14–15/Focus Question 5).

Goal: The trainer facilitates Lessons 13–15, with participants experiencing the lessons as learners and debriefing each focus question as teachers.

At various points in the training, there may be differing ideas presented by participants, especially when introducing claims and evidence. For strategies on handling differing opinions, please see Appendix 4.

AGENDA AND TIMING

Sections	Minutes	Materials/Notes
Lesson 13	30 minutes	Hand out Readers
Lesson 14	30 minutes	
Lesson 15	30 minutes	Test the designs with the roly polys
Wrap Up	15 minutes	

Lesson 13: Wildlife Corridors
Wildlife corridors are one solution that can help protect animals from the negative effects of land development.

30 minutes

Students argue using information from texts that wildlife corridors can be effective in helping protect animals when their habitat changes.

On CSO, navigate to Lesson 13 using the numbers at the top of the screen.

Resource/Page #	Lesson 13
Overview TG: p. 203	Objectives: • Obtain, evaluate, and communicate information from a text on wildlife corridors. • Make a claim using evidence that a wildlife corridor can solve the problem of animals not being able to move between or within habitats. Lesson Background Information: • Wildlife corridors are safe paths animals can use to travel. • Some are overpasses, while others go underground, depending on which animals they are meant to help. Class Periods: 1 (1 class period = about 35 minutes)
Materials & Preparation TG: p. 204	Materials: • Reader Printed Materials: • Lesson 13 Notebook Sheet Digital Materials: • Animal Crossing video *The materials listed here are a minimum list. Please visit CSO or the TG for more detailed information.* This lesson does not require any additional setup.
Procedure: Getting Started TG: p. 204-205	***Getting Started*** • Show the Animal Crossing video and ask the group what purpose they serve for animals.

Resource/Page #	Lesson 13
Procedure: Activity TG: p. 205–206 Reader: p. 47–54	*Activity* • Have partners read reading 7, "Park Pathways" in the Reader. • Have partners identify the problem and possible solutions mentioned in the reading. • Have individuals complete the Lesson 13 Notebook Sheet to make a claim with evidence about what solved the problem of animals being killed on the road. **Reading Summary** This reading describes how Banff National Park in Canada has protected wildlife by building six overpasses and 38 underpasses on the Trans-Canada Highway. These corridors help animals to cross over and under the road safely to find food, mates, and places to raise their young. Some animals move with the seasons, which is called "migration."
Procedure: Bringing It All Together TG: p. 207	*Bringing It All Together* • Ask individuals to share their thoughts to create a class claim about what solved the problem of animals being killed on the road.
Assessment, Enrichment & Extension TG: p. 207–209	Briefly review, as time allows: • Assessment Rubrics: Performance Summative Assessment • Extension: Fund My Corridor (Literacy), Close to Home (Literacy, Community and Home)
Reflection	After experiencing the lesson, ask participants to put on their "teacher hat" to consider and discuss: • What student learning can you expect from this lesson? • Any potential challenges you might have in this lesson? • Any potential difficulties or misconceptions that students may struggle with in this lesson? • What strategies or supports can be applied?

Lesson 14: Salamander Tunnel Part 1
Problems are defined in terms of their criteria and constraints.

30 minutes

Students define the problem of salamanders being killed on roads and work together to design a prototype that, as a complete system, meets the constraints and criteria of the problem.

On CSO, navigate to Lesson 14 using the numbers at the top of the screen.

Resource/Page #	Lesson 14
Overview TG: p. 211	Objectives: • Define the problem of salamanders being killed on roads as they try to reach their breeding pools. • Work as a group to design a prototype of a salamander tunnel that meets the constraints and criteria. Lesson Background Information: • Since 1980, more than 100 types of amphibians have disappeared and 427 more are endangered. • Using an under-road tunnel can help amphibians move to breeding grounds, search for food, and move to safer areas without injury. Class Periods: 2 (1 class period = about 35 minutes)
Materials & Preparation TG: p. 212–215	Materials: • Road model • Tunnel materials • SAG Printed Materials: • Lesson 14 Notebook Sheet A • Lesson 14 Notebook Sheet B Digital Materials: • SPLAT Design Challenge file *The materials listed here are a minimum list. Please visit CSO or the TG for more detailed information.* next page →

Resource/Page #	Lesson 14
	To help participants better familiarize themselves with the lesson setup for implementation, the group will do some materials preparation during the workshop. For this lesson, the group should: • Set up the road models.
Procedure: Getting Started TG: p. 215–216	*Getting Started* • This is the beginning of the summative assessment. • The written summative assessment is Lesson 14 Notebook Sheet A, and should be completed at the beginning of the lesson.
Procedure: Activity TG: p. 216–219 SAG: p. 17–20	*Activity* • The Engineering Design Challenge is the summative performance assessment. Introduce the Design Challenge using the SPLAT Design Challenge file. • Hand out SAGs and have groups of four discuss the criteria and constraints listed. Assign group roles: Builder, Materials Manager, Speaker, Zookeeper. • Introduce the testing setup and the building materials. • Have groups use Lesson 14 Notebook Sheet B to start developing designs for their solution.
Procedure: Bringing It All Together TG: p. 220	*Bringing It All Together* • Discuss how the design process went and what thought processes groups went through. • Tell groups they will build their designs in Lesson 15.
Assessment, Enrichment & Extension TG: p. 220–225	Briefly review, as time allows: • Assessment Rubrics: Performance Summative Assessment • Extension: A Deadly Disease (Literacy)

Resource/Page #	Lesson 14
Reflection	After experiencing the lesson, ask participants to put on their "teacher hat" to consider and discuss: • What student learning can you expect from this lesson? • Any potential challenges you might have in this lesson? • Any potential difficulties or misconceptions that students may struggle with in this lesson? • What strategies or supports can be applied?

Lesson 15: Salamander Tunnel Part 2
Different solutions need to be tested to see which one best solves the problem.

30 minutes

Students build their prototype and test it using roly polys as a model for salamanders. They use data from their test to argue for how well their prototype solved the problem, and which parts of their design may have caused successes and failures.

On CSO, navigate to Lesson 15 using the numbers at the top of the screen.

Resource/Page #	Lesson 15
Overview TG: p. 227	Objectives: • Work as a group to build a prototype of a salamander tunnel that meets the constraints and criteria. • Carry out an investigation to test a prototype of a salamander tunnel. • Argue from evidence for how well a prototype of a salamander tunnel meets the constraints and criteria. Lesson Background Information: • A prototype is a type of model that is used to test ideas. • The learning goal is students' ability to apply what they have learned, regardless of how many roly polys use their tunnel. Class Periods: 2 (1 class period = about 35 minutes)
Materials & Preparation TG: p. 228–229	Materials: • Road model • Tunnel materials • Roly polys • SAG Printed Materials: • Lesson 15 Notebook Sheet Digital Materials: • SPLAT Design Challenge file *The materials listed here are a minimum list. Please visit CSO or the TG for more detailed information.* next page →

Resource/Page #	Lesson 15
	To help participants better familiarize themselves with the lesson setup for implementation, the group will do some materials preparation during the workshop. For this lesson, the group should: • Gather group materials based on the Notebook Sheets from Lesson 14.
Procedure: Getting Started TG: p. 230	*Getting Started* • This is the conclusion of the performance assessment. • Remind groups that they will be building their design and preparing a claim about how their design solves the problem.
Procedure: Activity TG: p. 230–232 SAG: p. 21–23	*Activity* • Have groups follow steps: 1–10 in the SAG to create their solution and final budget worksheet. • When the design is complete, have the Zookeeper carefully add roly polys to the test setup. • Have the Recorder mark where roly polys are in the setup. • After some time (preferably overnight in the actual classroom lesson), have groups record where the roly polys are.
Procedure: Bringing It All Together TG: p. 232–233	*Bringing It All Together* • Have groups present their solution, with a focus on meeting the criteria and solving the problem. • Have groups ask questions or share comments about the different designs. • Ask participants how what they learned in this module can help them protect animals in their community.
Assessment, Enrichment & Extension TG: p. 234–236	Briefly review, as time allows: • Assessment Rubrics: Performance Summative Assessment • Extension: Tunnel Graphs (Math), Letter to SPLAT (Literacy)

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Resource/Page #	Lesson 15
Reflection	After experiencing the lesson, ask participants to put on their "teacher hat" to consider and discuss: • What student learning can you expect from this lesson? • Any potential challenges you might have in this lesson? • Any potential difficulties or misconceptions that students may struggle with in this lesson? • What strategies or supports can be applied?

Wrap Up

Take a few minutes to check in with the group before dismissing everyone.

15 minutes

Key Points	
Q&A	Invite participants to ask any final questions about materials, implementation, strategies, or anything else on their mind.
Continuing Support	If you are willing, provide your contact information for questions and concerns that the participants may have in the future.

APPENDIX 1: GROUP DISCUSSION

The goal of group discussions is to provide an opportunity for shared learning by asking multiple people to propose connections between their individual experience and the new content of focus.

The facilitator has three primary jobs during group discussions:

1. Support individuals sharing.
   It may be unnerving for individuals to share their thoughts in a group. When facilitating group discussions, use the following techniques to boost individuals' confidence and likelihood of sharing their thoughts:
   - Pay attention to speakers.
   - Smile and nod at appropriate moments to nonverbally communicate that you are engaged.
   - Provide anonymous sharing opportunities using chart paper or sticky notes.

2. Manage group participation.
   It is important to have active and balanced participation from the group to gain as many perspectives as possible. While it is important to hear from everyone, not every person needs to comment on every question. Here are some techniques to help you manage participation of individuals during a group discussion:
   - Use small groups with a designated sharer/speaker.
     - Assigning roles: Change roles for each lesson.
   - When no one wants to speak up:
     - Use the silence. Generally someone will speak up within 15 seconds.
     - Make eye contact with someone you would like to hear from.
   - How to stop a monopolizing speaker:
     - Do not make eye contact with them.
     - Redirect comments and questions from monopolizers to others.

3. Support group thinking.
   - Record individual member suggestions or points in a central location.
   - Ask guiding questions to have the group highlight connections.
   - Summarize.

If you would like to see group discussions in practice, please visit:
TERC Inquiry Project videos: https://inquiryproject.terc.edu/prof_dev/library.cfm.html

APPENDIX 2: QUESTIONING/GUIDING THOUGHT

Questioning is a useful tool with many applications. For this application we will focus on questioning as a way to discover what people are thinking, encourage further thought, and develop group understanding.

The best questions to use are open-ended questions, which do not have a set answer and often require a sentence or more to answer. Questions like:
- What do you know about . . . ?
- Does anyone have anything to add?
- Why do you agree/disagree?

Generally the first level will be eliciting new ideas by asking questions about what people already know or can observe during the lesson:
- What did you observe?
- Has anyone ever encountered . . . ?
- What are some ways to introduce students to . . . ?

The second level is encouraging further thought by asking people to reflect on what has been said, to identify connections to the current topic:
- What do you mean by . . . ?
- Can you tell me more about . . . ?
- What is the evidence for/against . . . ?

The final level we will look at is creating a group understanding by coming to consensus on what has been discussed:
- What idea do you think best connects what everyone is saying?
- Can someone summarize for me?
- Based on what the group is saying, how would this affect . . . ?

Further suggestions for questioning:
- Give thinking time of three to five seconds after posing a question.
- Avoid saying "correct/incorrect." Instead, let the group validate or clarify what someone is saying.
- Avoid the habit of only collecting one "correct" response and moving on. Always have at least two people answer a question, even if their answers are similar.
- Questioning can also be used to help keep time by letting people know how much longer the discussion can go on.
- Validate everyone's input by thanking them for speaking up.

APPENDIX 3: GROUP ROLES

Each person in a group having a role can provide many positive outcomes. Some benefits of using group roles include:

- Increases participant motivation by having a unique role
- Models positive classroom behaviors
- Decreases the amount of time spent waiting for a group to decide or discuss who will do what
- If a job is assigned, it pushes participants to participate in different ways

Here are some ideas for how to begin using group roles:

- Change roles regularly to maintain interest.
- Try to give everyone a chance at each role.
- Have a system in place for assigning roles. Possible systems include:
  - Colored dots and frames—Give each person in the group a colored dot. Place a matching color frame around their role for the day. Change the frame placement as needed.
  - Numbers—Assign each member of the group a number (1–4). Place a sticky note with the corresponding number on their role for the day.
  - Badges—Give each person in the group a badge or card with their role for the day listed.
  - Desk tents—Give each person in a group a desk tent with their role for the day.

More information about group roles can be found at: https://ctl.wustl.edu/resources/using-roles-in-group-work

The chart here shows which roles are used in each lesson. The roles and rotation are based on having four members in each group. The numbers in each column suggest how to rotate roles.

Group Role	Lesson #						
	2	3	6	8	9	14	15
Recorder							
Artist			3				
Builder	3	4				1	2
Tester							
Materials Manager	1	2		3		4	1
Speaker	2	3	1	4	2	3	4
Gardener/ Zookeeper	4	1				2	3
Questioner			2				
Organizer				2	1		
Messenger				1	3		

For these trainings, use the roles listed in each lesson, as described on the Group Roles poster.

Scientists and Engineers in Our Classroom: Group Roles

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Artist
Draws any sketches, diagrams, or graphs.

Builder
Takes the lead in putting together materials.

Gardener/Zookeeper
Makes sure live organisms are cared for and treated with respect.
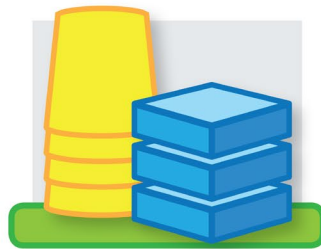
Materials Manager
Collects, cleans up, and puts away materials neatly.

Messenger
Asks questions of the teacher for the group.

Organizer
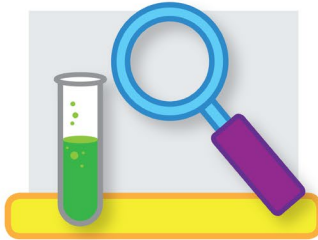Makes sure group members work together and complete work on time.

Recorder
Writes down data, observations, and explanations.

Speaker
Shares the group's final work or ideas with the whole class.

Tester
Takes the lead in carrying out investigations and testing designs.

Questioner
Asks questions of group members to make sure all points of view are considered.

APPENDIX 4:
MANAGING DIFFERING OPINIONS

At some point, it is highly likely that participants will have different opinions and thoughts. Working through these differences and coming to a point of mutual understanding is important to keep the group moving forward. This is also at the core of inquiry science and changing education practices.

Hearing different opinions and thoughts shows there is not always one "right" answer and there are multiple ways to interpret evidence. Often we are trying to come to consensus, which may require each participant to compromise or focus on where they agree and come back to the other areas.

To have meaningful conversations around different interpretations and ideas, it is important to build a culture of discussion and argumentation. At the beginning of the training, set group norms for how to interact when people do not agree, such as:
- Disagree with an idea, not the person.
- Use respectful language.
- Use phrases like "I disagree about . . ." or "I agree on . . ."
- Listen quietly to other people.
- Ask questions politely.
- Speak loudly and clearly.
- Always use evidence.

As with any other discussion, everyone needs to have the opportunity to be heard. Make sure you are allowing a variety of people to speak and that people are not cutting each other off.

Not every discussion of different opinions can come to a complete end every time. One way to table a discussion in order to move on is to take advantage of a parking lot or other idea repository. The chart on the next page lists a few ideas about when the parking lot should be used instead of having the discussion continue. Note: Every circumstance is different. These are suggested criteria, not hard rules.

Parking Lot	Keep Going
Requires input from people outside of training	Is specific to the current topic
Will be covered more in future lessons or sessions	Will likely be wrapped up in the session
Not related to the current topic	Multiple participants are highly engaged
Discussion becomes combative	Group has good evidence to come to consensus
Only one participant is speaking	

Sometimes the difference of opinions and ideas stems from a misconception. The Teacher Guide has a list of content and practice-based misconceptions that may come up in each module. Additionally, it is important to ask participants about what sources they are using, why they believe this information, or other questions to get at the root of their misconception while avoiding an accusatory or negative tone of voice. You can also use their peers' input to help clarify. If you must correct misconceptions to support learning later in the module, try using a supportive phrase such as, "Many people think that is true but the evidence so far supports . . ."

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