LESSON 13: How does changing an ecosystem affect what lives there?

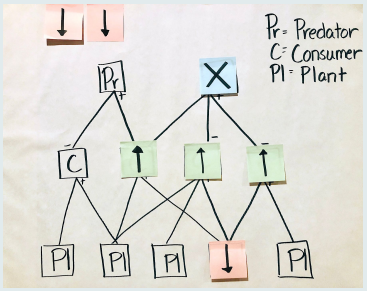
PREVIOUS LESSON

We wondered why more kinds of plants is beneficial. We investigated how ecosystems and farmers in diversified and monoculture farms fare in three disruption scenarios: disease, drought, and price drop. We figured out that the diversified farm is resilient for farmers and ecosystems because it has more components and links. We wonder how these ideas apply in other farm ecosystems.

THIS LESSON

PUTTING PIECES TOGETHER

2 days



In this lesson, we co-construct different explanations to the unit driving question. We represent our explanations in words and pictures and do a gallery walk to see how other groups represented their thinking. We engage in a Consensus Discussion to decide how changes to ecosystems impact other populations in the system. We use a generalized model to make predictions about different kinds of changes to ecosystems. We demonstrate our learning on an assessment about land use change in a riparian ecosystem and how that has affected populations that depend on these systems.

NEXT LESSON

We will revise our criteria and constraints for the palm farm design. We will investigate crop options to diversify the palm farm to support farmers. We will investigate utilizing a 20% forest corridor with surrounding farms to maximize a local orangutan population. We will share and reflect on our best designs and write an individual explanation to support our palm farm design. We will close out the DQB and celebrate our learning in the unit.

BUILDING TOWARD NGSS

MS-LS2-1, MS-LS2-2, MS-LS2-4, MS-LS2-5

WHAT STUDENTS WILL DO

Use a general model to show how changing one component of an ecosystem has ripple effects on other living things in the ecosystem (system modeling).

Construct an explanation using models to show how changing part of an ecosystem (cause) affects the populations that live in the ecosystem (effects).

WHAT STUDENTS WILL FIGURE OUT

- When you change parts of the ecosystem, you change how the whole system functions.

Lesson 13 • Learning Plan Snapshot

Part	Duration	Summary	Slide	Materials
1	10 min	**REVISIT THE UNIT DRIVING QUESTION** Review the unit driving question. Generate a Gotta-Have-It Checklist to guide students' co-constructed group explanation to the question.	A	DQB, chart paper, markers
2	8 min	**GENERALIZE OUR IDEAS TO MANY ECOSYSTEMS** Brainstorm a list of specific populations learned about in the unit and sort them into general categories.	B-C	chart paper, markers
3	20 min	**CO-CONSTRUCT EXPLANATIONS IN SMALL GROUPS** Have students work in small groups to develop an explanation, supported by a model, for one change to an ecosystem that affects the things that live there.	D	Progress Tracker, chart paper, markers, tape, class's agreed-upon modeling conventions
4	7 min	**GATHER IDEAS FROM A GALLERY WALK** Give students time to walk around to view other groups' models and to document two things they want to bring to the Consensus Discussion in the following class period.	E	2 sticky notes
				End of day 1
5	18 min	**CONSENSUS DISCUSSION** Convene in a Scientists Circle to articulate a specific explanation about the palm oil problem and a more general model for how land use change impacts populations.	F-G	Basic Ecosystem Model (prepared prior to day 2)
6	24 min	**INDIVIDUAL ASSESSMENT: CHANGING POPULATIONS IN RIPARIAN ECOSYSTEMS** Have students individually complete an assessment to demonstrate their learning about resource availability, competition, and population size change.	H-I	*Changing Populations in Riparian Ecosystems Assessment*, *Changing Populations in Riparian Ecosystems Assessment Scoring Guidance*
7	3 min	**NAVIGATION** Have students turn and talk with each other about changes to the palm farm ecosystem in anticipation of the design task.	J	
				End of day 2

Lesson 13 • Materials List

	per student	per group	per class
Lesson materials	• science notebook • Progress Tracker • 2 sticky notes • *Changing Populations in Riparian Ecosystems Assessment*	• chart paper • markers • tape	• DQB • chart paper • markers • class's agreed-upon modeling conventions • Basic Ecosystem Model (prepared prior to day 2) • *Changing Populations in Riparian Ecosystems Assessment Scoring Guidance*

Materials preparation (20 minutes)

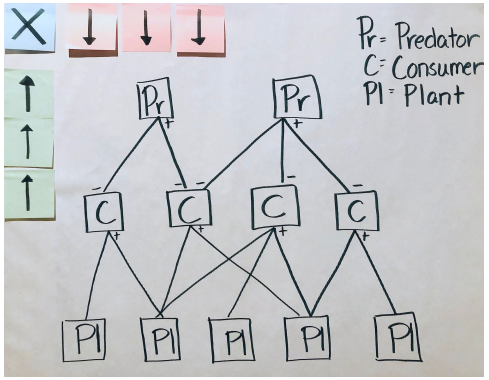
Review teacher guide, slides, and teacher references or keys (if applicable).

Make copies of handouts and ensure sufficient copies of student references, readings, and procedures are available.

Prior to day 1, make a Gotta-Have-It Checklist on chart paper with the unit driving question as the title, "How does changing an ecosystem affect what lives there?"

Prior to day 2, make a generalized food web model using your agreed-upon class modeling conventions. This model can support the Consensus Discussion on day 2. Prepare one sticky note with an "X" on it and several other sticky notes with up and down arrows on them. Title the chart "Basic Ecosystem Model."

Consider printing page 1 of students' *Changing Populations in Riparian Ecosystems Assessment* separately from the rest of the assessment for students to use as a reference page on all of the assessment items.



Lesson 13 • Where We Are Going and NOT Going

In previous lessons, students have developed models for different kinds of natural and agricultural ecosystems. They figured out that more components to a system means that the system has more biodiversity. They figured out that more interactions between components makes the system more resilient to disruptions. This lesson has students apply these ideas to explain how changes to one component of an ecosystem affects other populations in the system. Students extend these ideas to a related phenomenon of changes to riparian ecosystems in Colorado with the introduction of new plant populations.

By the end of this lesson, students should solidify their understanding about the following:

- "Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations."
- "Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health."

This lesson builds on 3rd and 5th grade DCIs: "Populations live in a variety of habitats, and change in those habitats affects the organisms living there" (grade 3) and "A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life" (grade 5). Students extend their understanding to realize that disruptions can not only affect individual organisms, but affect entire populations of organisms.

LEARNING PLAN for LESSON 13

1 · REVISIT THE UNIT DRIVING QUESTION

10 min

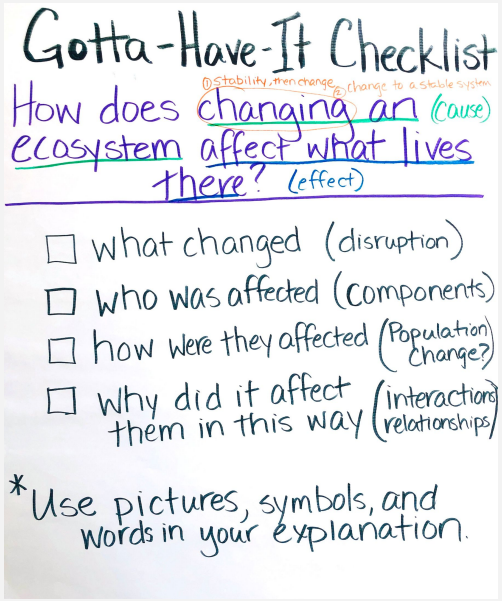
MATERIALS: DQB, chart paper, markers

Revisit the DQB and the unit driving question. Have the DQB visible to students. Say, *We've been up to a lot these past few weeks. We know a lot more about this palm oil problem and how the candy bars we eat could be connected. But this problem seems a lot bigger than just palm oil and orangutans. When we set out to learn about the problem, we decided that our unit question was: "How does changing an ecosystem affect what lives there?" We've done a lot of work to answer this question, and we're ready to explain it for the orangutans and probably for a lot of other places, too.*

Create an abbreviated Gotta-Have-It Checklist to guide explanations. Tell students that they will co-construct an explanation to the unit driving question in small groups, but first the class needs to agree on what needs to be represented and communicated in the explanation. Display **slide A**. Use the three prompts on the slide to guide this brainstorm for the Gotta-Have-It Checklist:

- What is the question asking us to explain?
- What ideas have we developed that will help us?
- What do we need to include in our explanations?

To answer part of the first question prompt, reread the unit driving question again and brainstorm crosscutting concepts to help our thinking. Point out to students (or elicit from students if they are ready) that the unit driving question is written using language similar to cause and effect. Have students identify which part of the question indicates that there is a cause and which part indicates that there is an effect. Students may also want to think about stability and change as they co-construct their explanation. Both crosscutting concepts can be beneficial lenses to guide thinking on this activity.



To answer the rest of the first prompt and the second prompt, have students review their Progress Trackers in their science notebooks and offer up science ideas that they believe are critical to answering our question.

Record a Gotta-Have-It Checklist. As you elicit ideas from students, start to record a list that will serve as the class's Gotta-Have-It Checklist. This should reflect the class's response mostly to the third prompt. As students share and agree on ideas, record the agreed-upon ideas on chart paper. Students will likely share ideas as complete thoughts or complete science ideas from their Progress Trackers, and you will need to shorten for ease in quickly capturing the gist of what is shared.

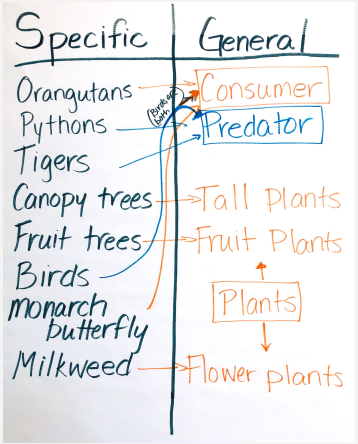
2 · GENERALIZE OUR IDEAS TO MANY ECOSYSTEMS

8 min

MATERIALS: chart paper, markers

Set the purpose for the explanation work in small groups. Display **slide B**. Explain to students that they will construct an explanation to the unit driving question that could help them explain how a change to *any* ecosystem could affect populations. This means that students can think about what they know about the rainforest and palm farm systems but that their models should be useful for explaining a lot of related phenomena that we know about when ecosystems are changed.

To help students think more generally, create a T-chart to map specific populations to general types of organisms. Have students generate a list of specific populations that they have encountered throughout the unit. Then sort the specific populations into a category or group, such as plant, consumer, and predator.



ADDITIONAL GUIDANCE

As students generalize populations into different categories, they will do so primarily using what they know about feeding relationships. Leverage what students know from the OpenSciEd Unit 7.4 Maple Syrup unit about producers and consumers. Add predators as a specific kind of consumer.

Lastly, brainstorm different ways that the system could be changed. Display **slide C**. Allow students to consider explaining how a change to part of the system, beyond plants, could affect other living things in the system.

Suggested prompts	Sample student responses
What are different kinds of changes to ecosystems that we could use in our explanations?	*Disease, drought, cutting down trees.*
What are some changes that happen to the nonliving, or abiotic, components of an ecosystem?	*Drought, flood, too much heat, too cold.*
What are some changes that happen to the living, or biotic, components of an ecosystem?	*Cutting down trees, killing animals, killing tigers, a consumer dying because it can't get food.*

3 · CO-CONSTRUCT EXPLANATIONS IN SMALL GROUPS

20 min

MATERIALS: science notebook, Progress Tracker, chart paper, markers, tape, class's agreed-upon modeling conventions

Preview the task. Display **slide D** and go over the guiding statements on the slide:

- Construct an explanation to answer the question.
- Support your explanation with a model. Use pictures, symbols, and words.
- Use our agreed-upon modeling symbols.
- Draw and write large enough to share your thinking with others.

Have the class's agreed-upon modeling conventions (or symbols) displayed for everyone to reference.

Form groups to begin their work. Arrange students in groups of 3, with one large piece of chart paper and markers. Keep **slide D** displayed to guide their work. Circulate among groups as they work. Remind students to use the CCC (cause and effect and/or stability and change) to help them articulate and represent their thinking, along with other important science ideas that they want to include.

After about 15 minutes, have students make final additions to their explanation. Then have groups post their explanations around the room to prepare for the gallery walk.

4 · GATHER IDEAS FROM A GALLERY WALK

7 min

MATERIALS: 2 sticky notes, science notebook

Set up for a gallery walk of the system models. Display **slide E** and pass out 2 sticky notes to each student. Preview the purpose and goals of the gallery walk. Ask students to visit at least 2 other groups' explanations and to spend at least 2-3 minutes reading and thinking about their work. They should record two ideas that they think are important to share and include in our Consensus Discussion in the next class. Have students attach the sticky notes to the next available page in the Progress Tracker section of their science notebook.

To end the class, say, *There is a lot of thoughtful work on display in our classroom. As I walked around, it was interesting to see the different ways in which your groups chose to answer the unit driving question. Next class, we're going to share our thinking with each other, so keep your sticky notes in your notebooks and be prepared to share them with us.*

End of day 1

5 · CONSENSUS DISCUSSION

18 min

MATERIALS: science notebook, Basic Ecosystem Model (prepared prior to day 2)

Form a Scientists Circle for a Consensus Discussion. Have students bring their individual models in their science notebooks to the discussion circle. Give students 1-2 minutes to reread their sticky notes from day 1.

Remind students of discussion norms for a Consensus Discussion. Display **slide F** if needed and show students the Communicating in Scientific Ways chart. Remind students of the discussion norms and sentence frames to use when having scientific discussions. Emphasize the importance of having a safe space in which students can share their ideas and push each other's thinking. Remind students:

- how to agree or disagree respectfully,

- how to push for justification,
- that it's OK to share an idea they're not sure about, and
- that it's OK to disagree with someone's or a group's idea but to back up their thinking with evidence.

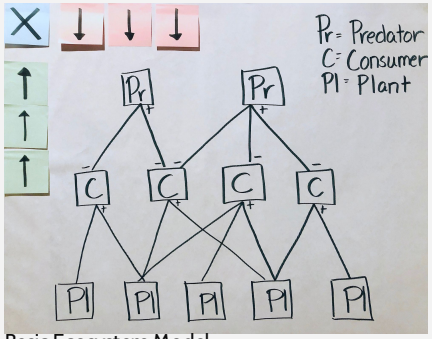
KEY IDEAS

Purpose of the discussion: to describe how changes to different parts of the ecosystem affect populations that live in the system.

Listen for student ideas:

- Every part of the system works just how it should until one part is changed. Then it affects a lot more parts of the system.
- Everything in the system is interconnected, so changing one thing changes other things in the system.
- When a part has a lot of interactions with other parts, this can be a good thing (e.g., more food choices) or a bad thing if it is the part that is changed.

Display **slide G**. Say, *We're going to take stock of the ideas in everyone's models and talk through how each of the changes to the ecosystem, or disruptions, that you explained impacted the things that lived in the system.*

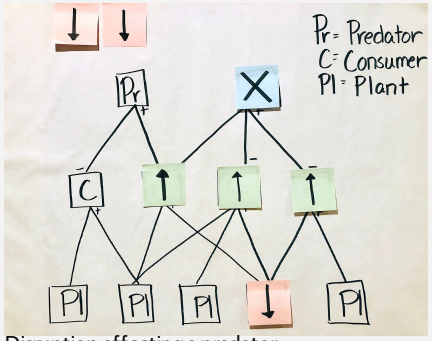


Basic Ecosystem Model

Facilitate the Consensus Discussion and model each impact. Have the Basic Ecosystem Model displayed near the Scientists Circle. Start by having students share the change to the ecosystem that their group explained in the small-group posters. Keep track of these changes on a list, which could include a change to a living or nonliving component. Organize the list by similar-type disruptions, which could include a disruption to plants, one that affected consumers directly, or one that affected predators directly. Start modeling with one type of disruption first.

Use the "X" sticky note to cover up the population that is immediately and most affected by the disruption or change, for example, a predator. Have the groups who explained this change to the ecosystem describe how the change to the predator population affected other populations. One student from the group(s) should post the "↑" and "↓" sticky notes onto the populations most affected.

As the groups share their thinking with the class, discuss why the change would affect other populations and encourage students to support or challenge each other's ideas based on evidence. Ask the other students to scan their sticky note comments from the gallery walk to see if they have comments that relate to this type of change to the ecosystem. Spend about 5 minutes on up to 3 kinds of disruptions.



Disruption affecting a predator

To close, ask students, *How is this alike or different from the palm oil problem or other farming and land use change problems we've learned about?* Listen for students to:

- point out that, in most of the cases we learned about, many components of the system were changed or replaced at once and
- describe how changing parts of the ecosystem affect how everything else works in the system.

ADDITIONAL GUIDANCE	Students will not have final models in their Progress Trackers. One strategy you can use so that students can get a final model is to take photos of students' explanation posters from day 1 and print them for students to paste into their science notebooks. That way they have a record in their Progress Tracker of their group's model and explanation.

6 · INDIVIDUAL ASSESSMENT: CHANGING POPULATIONS IN RIPARIAN ECOSYSTEMS

24 min

MATERIALS: *Changing Populations in Riparian Ecosystems Assessment*, science notebook, *Changing Populations in Riparian Ecosystems Assessment Scoring Guidance*

Introduce the individual assessment. Display **slide H**. Pass out 1 copy of *Changing Populations in Riparian Ecosystems Assessment* to each student. Say, *There is a type of ecosystem that is found all over the world and even here close to home. It's called a riparian ecosystem. These ecosystems are threatened by a lot of different changes, and you're going to read about some of those changes today.* Use **slide H** to introduce students to the riparian ecosystem, the kind in which they are located, and the model that depicts a few of the components and interactions in the system. Read through page 1 of the assessment together.

Before letting students begin the assessment, preview any specialized vocabulary words with them, such as "invasive" on question 4. Encourage students to use pictures and words, or other modalities, to communicate their understanding.✱ Display **slide I** so that students do not need to continue to flip to page 1 in order to use the model.

Ask students to complete the assessment.✱ Have students individually complete *Changing Populations in Riparian Ecosystems Assessment*.

✱ ATTENDING TO EQUITY

This assessment encourages students to demonstrate their understanding of key skills and concepts from the unit so far through multiple modalities, including writing to explain and drawing models. Some students may benefit from using multiple modalities to show their thinking for any or all of the questions on this assessment. In each case, encouraging students to use multiple modalities to show their thinking creates a clear, accessible, equitable pathway for all students to demonstrate proficiency.

✱ ATTENDING TO EQUITY

For some students, particularly students with learning differences, below grade-level reading, or students who are emergent multilingual learners, this assessment may require more time than that which is provided for this lesson because there is a heavy reading component. Consider allowing students to finish this assessment as home learning or providing extra time for these students to demonstrate their full understanding. These students would benefit from reading the introductory text and item prompts together and asking clarifying questions.

7 · NAVIGATION

3 min

MATERIALS: None

Have students perform a Turn and Talk in anticipation of the design task. Display **slide J**. Have students find a partner for a Turn and Talk. Ask students to start thinking about the design task ahead. Use the prompt on the slide to have them brainstorm how to approach the task:

- We want to make changes to the palm farm ecosystem to support the orangutans. Pick 1 change you would make and explain how it will affect the orangutans.

Say, *We've done some excellent work around our original unit driving question. But remember that we added a second driving question to our DQB after we learned more, "How can we use land in ways that work for people and other living things?" Let's see if we can use some of the ideas we've figured out to answer this question next.*

Additional Lesson 13 Teacher Guidance

SUPPORTING STUDENTS IN MAKING CONNECTIONS IN ELA

In this unit, students will frequently engage in speaking, listening, and responding to others as part of their participation in scientific and engineering practices. In this instance, students engage in peer-to-peer discussion to share, express, and refine their thinking. As they do this, they must develop, present, and defend their ideas to one another verbally in a focused, coherent manner with relevant evidence; sound, valid reasoning; and well-chosen details (CCSS.ELA-Literacy.SL.8.1). Using the Communicating in Scientific Ways sentence starters can help facilitate the discussion between and among students.

As students work on their individual assessments on day 2, they are working toward the following:

- CCSS.ELA-LITERACY.W.7.2. Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
- CCSS.ELA-LITERACY.W.7.2.A. Introduce a topic; organize ideas, concepts, and information, using strategies, such as definition, classification, comparison/contrast, and cause/effect; include formatting (e.g., headings), graphics (e.g., charts, tables), and multimedia when useful to aiding comprehension.
- CCSS.ELA-LITERACY.W.7.2.B. Develop the topic with relevant facts, definitions, concrete details, quotations, or other information and examples.
- CCSS.ELA-LITERACY.W.7.2.D. Use precise language and domain-specific vocabulary to inform about or explain the topic.