SUCCESS ACADEMY EDUCATION INSTITUTE

Life Science:

Unit 4

Ecology - The Ebb and Flow of Natural Systems: Lessons

Lesson 1: Ticks on the Loose!

Lesson Objective: Scholars understand that ecology is the study of interactions between organisms and the environment and that there are many solutions to ecological problems. They learn how to weigh the advantages and disadvantages of different solutions. Materials Needed

- For the teacher: pictures of scholars on their camping trip last year

Prep

- Intellectual Prep:
  - **What Is ecology?** from Khan Academy
  - **What Does Ecology Have to Do with Me?**
  - Determine advantages and disadvantages for each solution before class to prepare questioning that will push scholars to consider all aspects of a solution when evaluating.

What are scholars doing in this lesson?

- Scholars consider four solutions to control an increase in the number of ticks in an upstate New York campsite. Scholars read about and discuss the solutions and weigh the advantages and disadvantages of each. They compile a list of questions for people familiar with the campsite. They end by deciding which solution they think will be most effective, knowing that they will return to the question at the end of the unit.

Do Now

- Follow the **Do Now plan**.

Launch

- Ask: What do you remember most about your camping trip last year?
- Tell scholars that the campsite has reached out with a huge ecological problem! The staff are worried that scholars will no longer be able to attend their camping trip due to a huge increase in the number of ticks on their campgrounds!
    - Show a picture of a tick.

Image credit: **Alan R Walker**, **CC BY-SA 3.0**, via Wikimedia Commons

- Explain that ticks are organisms that use their legs to attach to animals so they can feed on their blood to survive.
- Ask: Why is the campsite considering the tick increase as an ecological problem? Define **ecology**.
- Today scholars consider four solutions to the tick problem at the campsite while gathering questions they have about the campsite that will help to inform their decision.

Activity Adapted from Chapter 5: Designing Solutions in ***Disruptions in Ecosystems from NGSS Lead States***. 2013. Next Generation Science Standards: For States. Washington, DC: The National Academies Press.

- Scholars brainstorm a list of questions that they might ask the campsite staff to learn more about the tick problem.

- Scholars read about the four possible solutions to the ecological problem in their Lab Notebooks. Groups or partners discuss each solution and make a list of advantages and disadvantages of each.
- As scholars are working, circulate and ask questions to elicit what information they are using as a basis for evidence in each solution.
    - What factors did you consider when deciding which solution to recommend?
    - What other information would have been useful when you were examining solutions?

[**Engagement Tip:** Press scholars to think about how this problem will impact scholars who visit the camp in future years.]

Discourse Debrief activity:

- Ask: What questions do you have for the campsite staff, and how will the answers inform your decision?
- Ask: What factors did you consider when coming up with advantages and disadvantages to each solution? What factors are the most important to consider when deciding on a solution to recommend?
    - Show scholar work for each solution and discuss the advantages and disadvantages that scholars brainstormed.
        - Press scholars to consider the cause/effect of each advantage or disadvantage for each solution. This will allow them to start thinking about the interconnectedness of the different components of ecosystems, which they will discover more about in upcoming lessons.

Introduce the Essential Question:

- Ask: Should we remove <u>all</u> ticks from upstate New York ecosystems?
    - Tell scholars that throughout the unit they will learn enough about ecology to take a strong, science-based stance on the question.
        - Ask scholars what they currently think about the question and create a T-chart to record the reasons and evidence for why they think that all ticks should or should not be removed.

Accountability (Lab Notebook)

- Write a recommendation for the solution that you believe is best to solve the campsite problem. Explain why you chose this solution using specific evidence from the disadvantages and advantages in your notes. Justify and support your response with your knowledge of science.

Scholar responses will vary based on their ideas; assess scholar effort and general understanding that an argument should have a clear claim that identifies their stance on the problem, strong supportive evidence, and justification/reasoning that uses science content or ideas to make sense of their evidence.

Possible Full-Credit Exemplars:

I believe that chemical control will be the best way to solve the campsite problem. The pesticide will effectively kill all the ticks, and it will only take two months to complete. The campsite can complete this chemical control during the time of the year before scholars visit the campsite, and they won't have to worry about ticks causing problems for any visitors.

I think that physical removal is the best way to solve the campsite problem. It may take a few years to complete, but by burning the land and through a personal checking system, they will be certain no ticks survive. Plants can regrow over time, and then the campsite can be fully up and running.

I think they should relocate the campsite as the solution to their problem. The other options involve potential harm to the environment, and this solution will leave all organisms safe. It might be difficult to sell and move to another place, but there is a lot of space in New York for them to make a new campsite.

Biological control is the best solution because the ticks can be removed naturally. Also, by only bringing in 30 toads, it won't be that many to affect the environment there. This solution will allow scholars to come to the campsite soon, because toads are not harmful.

Possible Partial Credit Exemplars:

They should use chemical control because it will kill all of the insects, not just the ticks, and no one likes insects when they are camping.

I think the best solution is to relocate the campsite because it is the easiest and least harmful to the environment.

Scoring Award points as follows:

- Score scholars on a 1–4 scale (below expectations through exceeding expectations) based on classwork. Do not penalize scholars for initial misconceptions about content; rather, rate them on effort and writing.
    - Look for the following when scoring scholar responses:
        - A clear claim that identifies one potential solution to the ecological problem
        - Specific evidence collected from the activity that supports their claim
        - Justification/reasoning for why this solution will be the most effective at solving the problem
        - High effort shown in writing, with complete sentences and proper grammar/ punctuation seen throughout the response

---

Lesson 2: What Is an Ecosystem?

Lesson Objective: Scholars understand the difference between biotic and abiotic factors and can explain how parts of an ecosystem depend on each other for essential resources. Materials Needed

- For the teacher: a copy of the **Ecosystem Box Teacher Key**, colored beads
- For each group: ecosystem boxes for 2000 and 2015, plastic tray, a copy of the **Ecosystem Box Scholar Key**

Prep

- Materials Prep:
    - Create an ecosystem box for 2000 and 2015 for each group of scholars by following the **Ecosystem Box Teacher Key**.
- Intellectual Prep:
    - **Ecosystem Ecology**

What are scholars doing in this lesson?

- Scholars analyze the campsite ecosystem boxes from 2000 and 2015 to determine what components make up the campsite ecosystem and what has changed in recent years. They use these observations to hypothesize how the tick population has gotten so large.

Do Now

- Follow the **Do Now plan**.

Launch

- Ask: How would knowing the different organisms of the campsite help us answer the Essential Question?
- Show scholars a **picture** of an **ecosystem** and define the term.
    - Explain that both terrestrial and aquatic ecosystems consist of **abiotic** and **biotic** factors.
    - What can scientists learn by studying ecosystems?
- If you traveled to upstate New York and arrived in the middle of the forest ecosystem, what would you need in order to survive the month? Where would you find these items?
    - Make sure you guide the conversation toward what scholars would need to survive, not what they would want to survive. Scholars have prior knowledge of what organisms need to survive.
- Today scholars analyze the campsite ecosystem boxes from 2000 and 2015 to determine what components make up the campsite ecosystem and what has changed in recent years. They use these observations to hypothesize how the tick population has gotten so large.

Activity

- Scholars analyze and record data on the ecosystem boxes from upstate New York.
    - Scholars classify whether the bead represents an abiotic or biotic factor and then record the bead color and number in the correct space in the table.

    - Groups or partners discuss how the data from the ecosystem boxes can help them determine a cause of the increased tick population. Scholars construct a hypothesis on what has caused the tick population to increase in their Lab Notebooks.

- As scholars are working, circulate and press them to question what the data reveals about the campsite ecosystem.

    - How can you tell which factor is biotic or abiotic?
    - What do you notice about the numbers of abiotic and biotic factors in the ecosystem? What does this tell you about how an ecosystem functions?
    - What happened from 2000 to 2015? What do you think caused this? Could this be related to the increase in the tick population?

Discourse Debrief activity:

- Ask: What happened to the ecosystem over the last 15 years?

    - What could be the cause of each of these changes?

- Ask: How did the data help you construct your hypothesis on the cause of the increase in the tick population?

    - Have scholars share their hypotheses and give peer feedback on the inclusion of evidence and the clarity of their justification/reasoning. Give scholars an opportunity to revise their hypotheses after discourse.

Make broader connections:

- Ask: Why do ecosystems contain both abiotic and biotic factors?

    - What might happen if the abiotic factors did not exist in the ecosystem?

- Define **interdependent**.

    - Press scholars to give examples of how biotic factors depend on abiotic factors and vice versa.

Make connections to the Essential Question:

- Ask: If we get rid of all ticks in upstate New York ecosystems, would it change other components of the ecosystem?

Accountability (Lab Notebook)

- Construct a hypothesis to explain why the tick population has increased in the last few years.

Scholar responses will vary based on their ideas. Assess scholar effort and general understanding that a hypothesis should have a clear claim that answers the question and strong supportive evidence from data and their prior scientific knowledge.

Possible Full-Credit Exemplars:

The campsite tick population has increased because over the last 15 years, the amount of sunlight and the temperature have both doubled. Maybe the ticks survive better in warmer climates, and that is why they have increased so much.

The campsite tick population has increased because the number of voles and deer has increased. The deer population is twice as big as it was in 2000. Because ticks eat blood, maybe if they have more animals to eat, they will grow and reproduce more quickly.

Possible Partial Credit Exemplars:

The campsite tick population has increased because the animals changed. Because ticks eat blood, maybe if they have more animals to eat, they will get bigger.

The campsite tick population has increased in the last few years because there are fewer birds around. Birds might eat ticks.

Scoring Award points as follows:

- Score scholars on a 1–4 scale (below expectations through exceeding expectations) based on classwork. Do not penalize scholars for initial misconceptions about content; rather, rate them on effort and writing.
    - Look for the following when scoring scholar responses:
        - A clear claim that identifies one clear reason for why the tick population has increased
        - Inclusion of evidence from their ecosystem box data that supports their claim
        - Justification/reasoning as to why the evidence supports their claim using their knowledge of science
        - High effort shown in writing, with complete sentences and proper grammar/ punctuation seen throughout the response

---

Lesson 3: What's for Dinner?

Lesson Objective: Scholars understand that food webs model the flow of energy in an ecosystem and that organisms can be classified based on their diet. Materials Needed

- For the teacher: a copy of the **Ecosystem Food Web Puzzle Key**
- For each group: a copy of the **Ecosystem Food Web Puzzle**, a copy of the **Organism Feeding Patterns Data**

Prep

- Materials Prep:
    - Print an **Ecosystem Food Web Puzzle** for each group on 11″ × 17″ paper. (You could laminate and have scholars use dry/wet erase markers for ease of writing and

erasing as they use the feeding patterns data. They can also be reused from class to class.)

- Print an **Organism Feeding Patterns Data** for each group.

- Intellectual Prep:
  - **Food Chains and Food Webs** from Khan Academy
  - **Food Webs**

What are scholars doing in this lesson?

- Scholars analyze a food web puzzle to determine how organisms in the campsite ecosystem depend on each other for energy! They then use their completed food web puzzles and prior knowledge to classify organisms based on feeding relationships.

Do Now

- Follow the **Do Now plan**.

Launch

- Ask: How do organisms get energy to survive?
  - How do scientists represent interactions of feeding relationships in an ecosystem?
    - Once scholars mention their previous knowledge of food chains and webs, define **food chain**. Explain that food chains only represent one flow of **energy** from a few organisms in an ecosystem, but that a **food web** represents the many food chains that tie an ecosystem together.
  - Is it possible for an organism to exist in an ecosystem and not provide any energy benefit to other organisms?
    - How do you think the tick fits into a food web of the campsite ecosystem?
- Today scholars use data to determine how the organisms of the campsite are dependent on each other for energy by solving a food web puzzle! They then use their completed food web puzzles and prior knowledge to determine how organisms are classified based on their feeding relationships.

Activity

- Scholars use the Organism Feeding Patterns Data sheet to determine where the organisms fall in the ecosystem web.
  - Once scholars have completed their food web, they copy it into their Lab Notebooks and determine how the sun can be added to their food webs.
  - They answer discussion questions that prompt them to describe different aspects of the food web model and to give the definitions of terminology used to describe organisms in a food web.

- As scholars are working, circulate and press them to explain how they are interpreting the data of feeding relationships to solve the food web.
    - What do the arrows in the food web tell you about what the organism eats? How do you know?
    - Some organisms eat more than one type of food. How would this be represented in a food web?
    - Why do some organisms not have an energy source in this food web? How do they survive?

Discourse Debrief activity:

- Ask: How did you know where the sun fits into your food web?
- Ask: What role do decomposers play in an ecosystem? Why were all the arrows connected back to decomposers?
- Ask: Are decomposers producers? Why or why not?
- Ask: What are the strengths and weaknesses of using food chains and webs to model interactions between different organisms?
- Ask: How do food webs show the interdependence between organisms in an ecosystem?

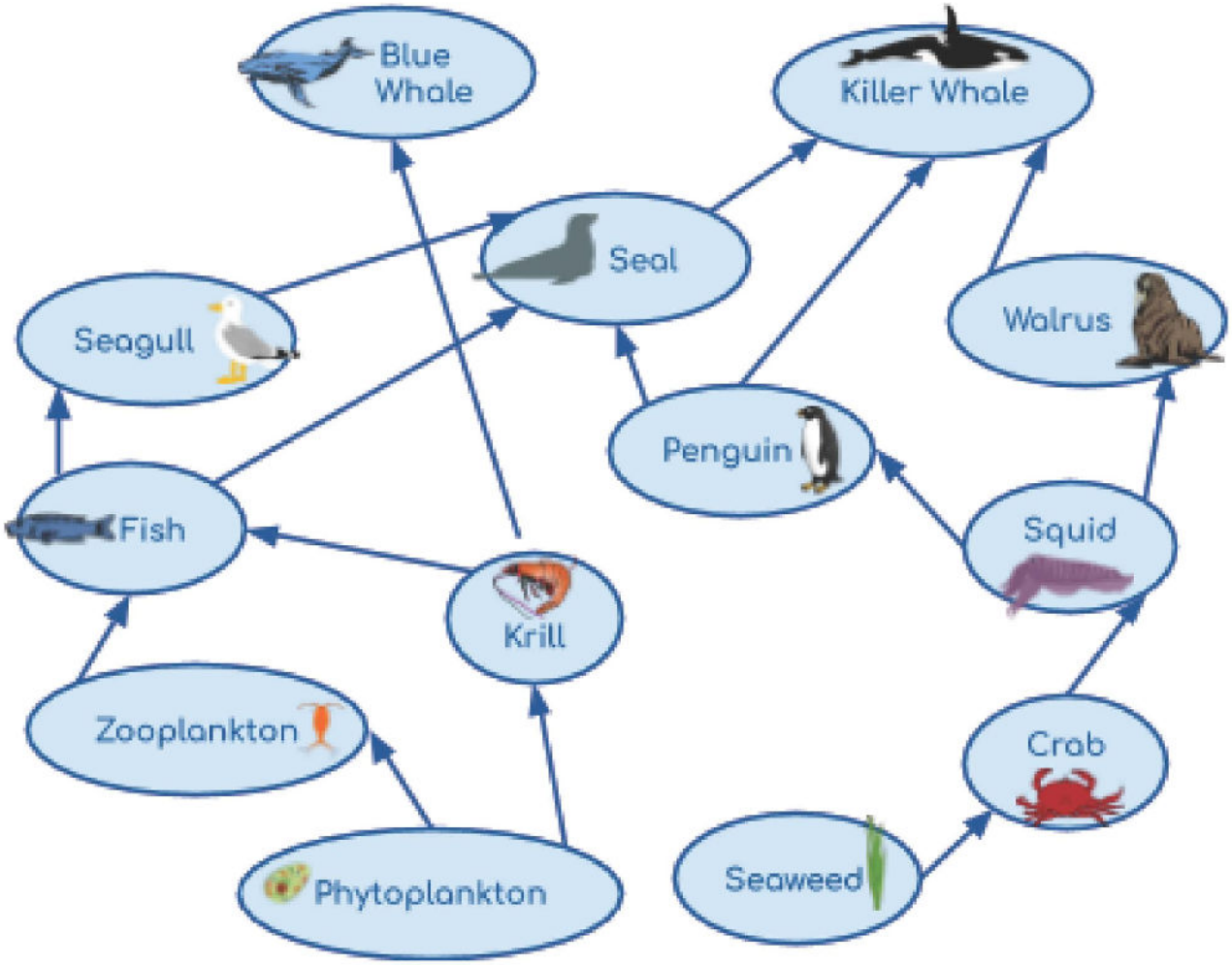
Make broader connections:

- Ask: What is the difference between producers and consumers?
    - Once scholars discuss both terms, define **producers** and **consumers**.
    - Do all consumers eat the same type of food? How can we differentiate them based on their diet?
        - Define **herbivore**, **omnivore**, and **carnivore**.
- Ask: Do you think food webs stay the same over time in an ecosystem? Why or why not?

Make connections to the Essential Question:

- Show one scholar's food web. Ask: How does knowing the tick's role in the campsite food web help us answer the Essential Question?

Accountability (Exit Ticket) Below is a food web that represents the feeding relationships in an aquatic ecosystem.



1. Based on your knowledge of science and the food web above, fill out the table below based on what type of organism is listed (producer or consumer) and what their source(s) of energy are. [4]

Organism	Type of Organism	Source(s) of Energy
Seal	Consumer	Penguin, Seagull, Fish
Seaweed	Producer	Sun

2. Marine worms are one type of decomposer that exists in aquatic ecosystems. If the marine worm was added to the food web above, what would be its source of energy? Explain using your knowledge of science to support your response. [2]

All of the organisms would be the energy source for the marine worm. Decomposers break down decaying material to get energy, so when any of the organisms in the aquatic ecosystem die, the decomposer can use them for energy.

Scoring Award points as follows:

1. Award one point for each of the following:
    - Listing the correct sources of energy for each organism (up to two points)
    - Listing the correct type of organism for each organism (up to two points)
2. Award one point for each of the following:
    - Identifying that the marine worm receives energy from all organisms in the ecosystem
    - Explaining the tie between the role of decomposers and the food web

---

Lesson 4: The Great Pyramids: Energy and Matter Flow

Lesson Objective: Scholars understand that energy flow in an ecosystem can be modeled with an ecological pyramid. They can explain that energy is conserved in an ecosystem through the work of decomposers. Materials Needed

- For each group: 10 plastic cups, 1,000 mL of tap water, graduated cylinders (100 mL and 10 mL), plastic pipette
- For each scholar: ruler

Prep

- Materials Prep:
    - Set up materials for each group. It is important to give each group more than four cups in order to not give away the answer to part one of the investigation.

[**Tip:** Have paper towels handy in case of any spills.]

- Intellectual Prep:
    - **Energy Flow in Ecosystems**
    - **Trophic Levels Review** from Khan Academy

What are scholars doing in this lesson?

- Scholars use a model to determine how many levels of energy can exist in an ecological pyramid and use their data from the campsite food web to determine which organisms fall into each level to create their own ecological pyramid.

Do Now

- Follow the **Do Now plan**.

Launch

- Ask: When organisms eat food, how do they get energy?
    - How does this energy move throughout an ecosystem?
        - Explain that scientists use an **ecological pyramid** to represent how much energy moves throughout an ecosystem. Each ecological pyramid has different levels that represent different groups of organisms that share a similar function in the food web and relationship to the primary source of energy.
        - Show a **picture** of a pyramid. If we split this pyramid into different layers, which part of the pyramid would have the greatest area? Why?
            - Explain that the bottom of an ecological layer usually represents the group of organisms that hold the most energy for the ecosystem.
                - As you get closer to the top of the pyramid, what happens to the amount of area?
                    - Explain that the organisms at the top of the pyramid usually represent the group of organisms that hold the least amount of energy for the ecosystem.
    - How much energy do you think a tick contributes to an ecosystem?
        - Will knowing this value help answer the Essential Question?
- Today scholars use a model to determine how many levels of energy can exist in an ecological pyramid and use their data from the campsite food web to determine which organisms fall into each level to create their own ecological pyramid!

Activity

- Scholars complete the procedure to determine how many energy levels can exist in their ecological pyramid.
    - Explain the 10 percent rule of ecological pyramids. Because most energy is used during activity and cellular respiration, only 10 percent of energy from food consumption is converted and stored into biomass.
    - For each level of energy, scholars must calculate and transfer 10 percent of the preceding cup. Scholars complete this process to determine how many cups or levels of energy can exist in their ecological pyramid.
        - Scholars place 1,000 mL of water into the first cup and label it “Level 1.”
        - Scholars calculate 10 percent of 1,000 mL and then transfer that amount from the first cup into a second cup and label it “Level 2.”

        - Scholars complete this process with additional cups until they do not have the tools to transfer any more water or energy into a new cup (they will only be able to create four levels).

- Scholars draw in the amount of levels in their pyramids in their Lab Notebooks.
    - Scholars then use the organisms found in the campsite ecosystem food web from Lesson 3 and use logical reasoning to determine which organisms to place in each level.
        - Scholars may not know the correct organisms that fall in each level. Push them to use the food web to determine the order in which energy flows to help them use logical reasoning to create their ecological pyramids.
- As scholars are working, circulate and press them to think about why the energy passed from each level gets smaller each time and what that means for organisms in the first level versus the fourth level.
    - What kind of organisms carry the most energy for the entire ecosystem? Why do you think this?
    - Why do the organisms in the last level carry the least amount of energy for the entire ecosystem?
        - Does this mean they do not get enough energy from the food they eat?
    - What happens to the energy after the last level?

Discourse Debrief activity:

- Ask: What did you notice about how energy flows in an ecosystem?
    - Why does the amount of energy in each level decrease as you get closer to the top of the ecological pyramid? Why couldn't you make more than four levels of energy?
        - Scholars should be able to conclude that if there were more levels in an ecological pyramid, the organisms would be receiving minimal amounts of energy and it would eventually cost them more energy than they gain.
        - What are the implications of this limit for the type of organisms in an ecosystem?
            - The number of consumers at the top of the ecological pyramid must be kept to a minimum because there won't be enough energy to give them.
            - What happens to the energy after it reaches the top of the ecological pyramid?
                - Push scholars to connect to the decomposers defined in the previous lesson.
                - Is energy conserved in an ecosystem?

        - If organisms are composed of matter, is matter conserved in an ecosystem?

- Show scholar work or use a blank ecological pyramid to work through as a whole class.
    - Ask: How did you determine which organisms are in each level of your ecological pyramid?
        - Explain that the bottom layer is called Trophic Level 1 and define **trophic**. All organisms in this layer are producers and are known as **autotrophs** because they make their own energy using sunlight.
            - Why do autotrophs carry the most energy for the entire ecosystem?
        - Which organisms did you place in Trophic Level 2?
            - Explain that each consecutive trophic level is composed of consumers or **heterotrophs**â€" organisms that cannot make their own food. These trophic levels are divided into **primary**, **secondary**, and **tertiary consumers**. Define these terms and give an example of each using the campsite food web.

Make connections to the Essential Question:

- Ask: Which trophic level would ticks fall in?
    - Would the removal of ticks from this trophic level affect the campsite ecosystem?

Accountability (Exit Ticket) Directions: Revise your ecological pyramid of the campsite ecosystem using your Lab Notebook and your knowledge of science. Be sure to include the following in your model:

- Labels for each part of the pyramid

 The type of trophic level (1–4) [1]

- The type of organisms make up that level:

 Autotrophs [1]

 Heterotrophs [1]

- Primary consumers
- Secondary consumers
- Tertiary consumers

 Organisms from the campsite ecosystem that make up each level [1]

 An arrow that represents the direction of energy flow [1]

Scoring Award points as follows:

- Award one point for each of the following:
    - Trophic Levels 1–4 are correctly labeled on the ecological pyramid
    - Trophic Level 1 is labeled “autotrophs”
    - Trophic Levels 2–4 are correctly labeled as the following heterotrophs:
        - Trophic Level 2 is labeled “primary consumers”
        - Trophic Level 3 is labeled “secondary consumers”
        - Trophic Level 4 is labeled “tertiary consumers”
    - Each trophic level has the correct organisms from the campsite food web labeled inside:
        - Trophic Level 1: White Oak Trees, Wildflowers, Ferns
        - Trophic Level 2: Slugs, Voles, Butterflies, Beetles, Deer
        - Trophic Level 3: Newt, Bullfrog, Mantis, Tick, Black Bear
        - Trophic Level 4: Cardinal, Hawk, Gray Fox
    - An arrow representing energy flow is drawn, pointing from the bottom of the pyramid to the top

---

Lesson 5: Feast or Famine?

Lesson Objective: Scholars learn that patterns of predator–prey and competition occur at every level of the ecosystem and are essential for survival. They also learn about the negative effects of invasive species on resource availability, increased competition, and population fluctuation.
Materials Needed

- For the teacher: 6 Hula-Hoops, **Ecological Scenarios**, timer
- For each group: a copy of the **Feast or Famine? Rules**
- For each scholar: 1 **Role Card**

Prep

- Materials Prep:
    - Spread the Hula-Hoops out on the floor.
    - Label two hoops “food,” two “water,” and the last two “shelter.”
    - Print out **Role Cards** and give half of your class predator cards and the other half prey cards. Keep another set of cards for the different scenarios.

[**Tip:** This game can be played in the classroom but it might be better if it’s played hallway, gym, or outside space to allow for more movement.]

- Intellectual Prep:
    - **Predator–Prey Cycles** from Khan Academy
    - **Niches and Competition** from Khan Academy
    - **Invasive Species**

What are scholars doing in this lesson?

- Scholars play an interactive game, becoming organisms in an ecosystem as they model predator–prey relationships and competition under different ecological conditions to determine more evidence of how the tick might impact the campsite ecosystem.

Do Now

- Follow the **Do Now plan**.

Launch

- Ask scholars to think about a time when they were in a competition.
    - What did it mean to compete?
    - What do you think competition is like in an ecosystem?
    - What might cause competition in an ecosystem?
        - Which organisms in the ecosystem would be involved in competition?
            - When scholars describe organisms competing for food, define **predator** and **prey**.
                - Scholars may think only animals are involved in competition. Press scholars to think how plants might be involved in competition too and why.
            - Show the campsite ecosystem food web. Which organisms are predators and prey?
                - Define **apex predator**.

- Ask: How might the tick be involved in the ecosystem competition?
- Today scholars become organisms in an ecosystem as they model predator–prey relationships and competition under different ecological conditions to determine more evidence of how the tick might impact the campsite ecosystem.

Activity

- Scholars are assigned a **Role Card** and record the information on the card in their Lab Notebooks.
    - Groups or partners read the rules of the game at their tables to understand their objectives and classroom safety.
    - Teacher reads every scenario before each game begins and prompts scholars to make predictions in their Lab Notebooks on what might happen to the ecosystem during the game.
    - After each game (when there are no prey left), groups should discuss and record notes on the impact of each scenario on the ecosystem.
- As scholars are working, circulate and ask questions about the causes and effects of each scenario on the ecosystem.
    - What happened to the prey or predator during the scenario?
        - What helped or harmed their chances of survival during the round?

Discourse Debrief activity:

- Ask: How do predator–prey relationships affect the size of populations in an ecosystem?
    - What happened when there were more predators than prey?
    - What happened when there were more prey than predators?
    - What happened to the ecosystem when the outside predator entered?
- Define **invasive species**. Show scholars this TED-Ed **video** to further explain the harm invasive species cause ecosystems around the world.
    - Ask: How did the invasive species in the game today affect the ecosystem?

Make connections to the Essential Question:

- Show the campsite ecosystem food web. Where does the tick in the campsite ecosystem fall in the predator–prey relationship?
    - Ask: Does the tick population increase or decrease competition in the campsite ecosystem?
        - How does this information help you take a stance on the Essential Question?

Make broader connections:

- Ask: Why does competition occur in an ecosystem?
    - Define ecological **competition**.
    - How does competition affect the size of different organism **populations** in an ecosystem?
    - What can reduce competition between populations in an ecosystem?

Accountability (Exit Ticket) A group of ecologists were studying the different predator–prey relationships of a desert ecosystem over a 15-year period.

1. Using the prediction of predator populations over the 15-year period, complete the graph by finishing the "Prey" curve through year 15. [1]

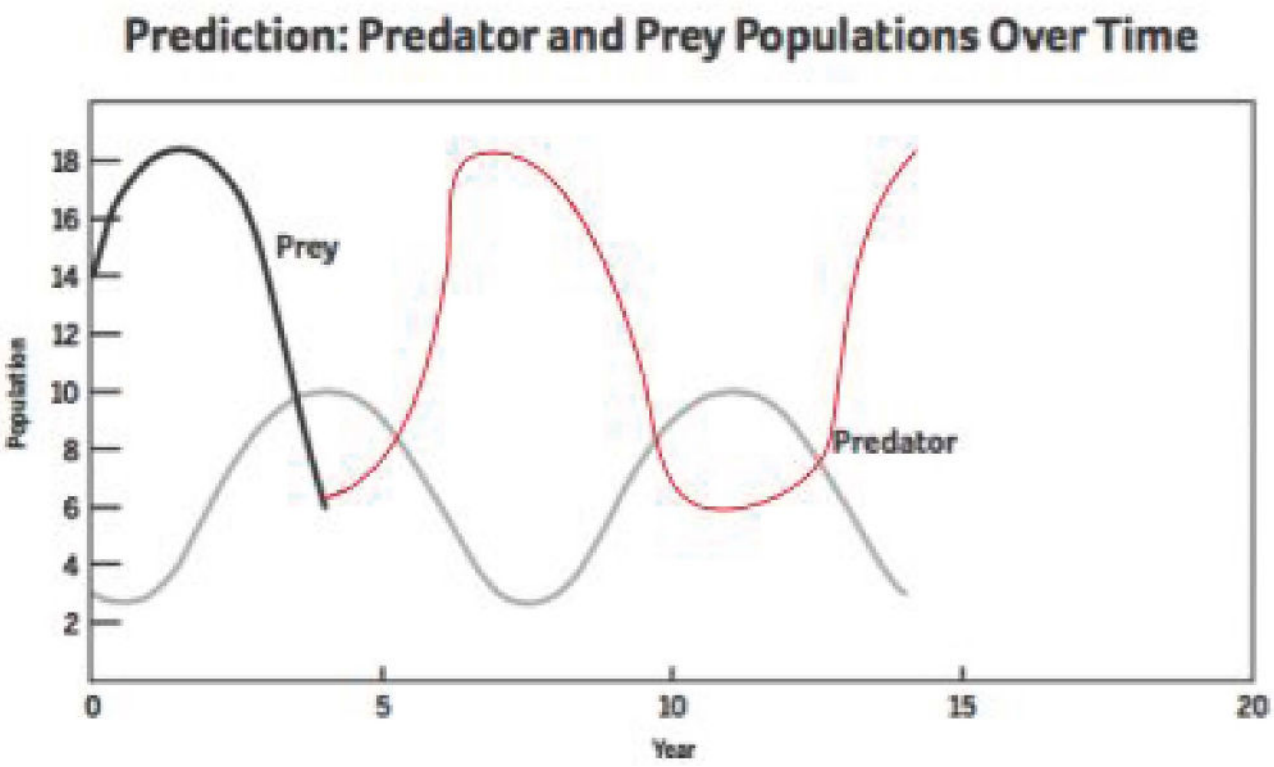


Image and question adapted from Chapter 1: Wolves in Yellowstone in ***Disruptions in Ecosystems from NGSS Lead States***. 2013. Next Generation Science Standards: For States. Washington, DC: The National Academies Press.

The ecologists had different ideas of what would happen if another predator entered the ecosystem:

Dr. Eco Logyrocks: "*The addition of another predator would decrease the amount of resources available for other organisms.*"

Dr. Fauna Matters: "*More predators means more competition among the predators!*"

Dr. Herb Ivorous: "*If we add more predators, the populations in the ecosystem will decrease significantly!*"

2. Which ecologist is the most scientifically accurate? Explain using your knowledge of science to support and justify your response. [3]

Possible Exemplars:

Dr. Eco Logyrocks's statement is the most accurate, because if predators have the same food source, they will compete for the same prey. If both organisms are eating the same type of food, there will be less of that resource available for them or other organisms that rely on them.

Dr. Fauna Matters is correct, because if another predator is added and eats the same prey, they will compete for the same resource. When there is a shared resource among organisms, they compete with each other to get the resource in order to survive.

I agree with Dr. Herb Ivorous, because if another predator is added, they will take energy away from other organisms. When there is less energy for organisms in an ecosystem, they start to die off and their population will decrease.

Scoring Award points as follows:

1. Award one point for correctly predicting the change in the prey population through year 15.
2. Award one point for each of the following:
    - A clear claim that identifies which of the statements is the most accurate
    - A clear scientific reason for why they agree with that specific ecologist that connects to their knowledge of competition in ecosystems
    - Further supporting information for why their ecologist's statement is correct based on scientific information learned in class

---

Lesson 6: The Crittercam Files: Ecological Relationships

Lesson Objective: Scholars understand that organisms engage in symbiotic relationships (parasitism, mutualism, and commensalism) that further support the idea of interdependence in ecosystems. Materials Needed

- For each scholar: computer/device, **Ecological Relationships Activity**, headphones

Prep

- Materials Prep:
    - Ensure that scholars have the link to **Ecological Relationships Activity**.
- Intellectual Prep:
    - **Five Types of Ecological Relationships**

What are scholars doing in this lesson?

- Scholars study different types of relationships between organisms in a marine environment to determine how else organisms depend on each other in an ecosystem.

Do Now

- Follow the **Do Now plan**.

Launch

- Tell scholars to brainstorm what they depend on to survive on a daily basis. Have scholars share out.
    - Are all of these based on predator–prey or competitive relationships?
        - Besides feeding relationships, how do organisms in an ecosystem depend on each other?
        - Do you think other organisms depend on the tick for their survival?
- Introduce and define the terms **symbiosis**, **mutualism**, **parasitism**, and **commensalism**.
    - Chart these on an anchor chart or have scholars record them in their Lab Notebooks to use throughout the investigation.
- Today scholars study different types of relationships between organisms in a marine environment to determine how else organisms depend on each other in an ecosystem.
    - Explain that Crittercam is a National Geographic project that is used by scientists to understand the day-to-day lives of different organisms in the marine environment and to study their ecological interactions.

Activity

- Scholars use the Crittercam footage and images to identify which symbiotic relationship is being represented in the marine ecosystem (mutualism, commensalism, or parasitism).
    - Scholars navigate to and watch the following Crittercam footage: “Caribbean Cleaners,” “Giving Fish a Bath,” and “Clownfish and Sea Anemone Partnership.”
    - Scholars then navigate to and observe the image of the “lemon shark.”

[**Tip:** If scholars are still struggling to grasp other ecological relationships, like predator–prey relationships or competition, have them watch the first Crittercam footage “Fish Thieves Take Rare Seals’ Prey.”]

- Scholars choose one interaction between two organisms from the Crittercam footage to construct an explanation on what type of symbiotic relationship they have.

- As scholars are working, circulate and ask them what they are inferring from the Crittercam footage.
    - What are the two organisms in this relationship?
        - Who in the relationship is benefiting? Who is being harmed? Who is not being affected at all?
            - Which symbiotic relationship does this represent?

Discourse Debrief activity:

- Share scholar work of each identified symbiotic relationship.
    - Discuss the strength of the explanation based on the evidence provided and the scientific knowledge that justifies/supports their response.

Make connections to the Essential Question:

- Ask: Based on what you know about ticks, what kind of symbiotic relationship do they share with the campsite ecosystem?
    - Share and read the “Home and Transmission page” on Lyme disease from the **CDC website**.
        - Explain that the bacteria use the tick as a vector, but ticks never experience Lyme disease because this particular bacterium needs a human host in order to reproduce. Ask:
            - What other symbiotic relationship is the tick involved in?
            - Does this change your stance on the Essential Question?

Accountability (Exit Ticket) A species of sea slugs called *Melibe engeli* feed on hard and soft corals. Some algae, photosynthetic organisms, live on hard and soft corals. When the sea slugs ingest their food, they keep the algae alive and move them to special parts of their bodies. When the algae undergo photosynthesis, the sea slugs receive the products, and in return the algae receive protection and nitrogen (an essential nutrient that promotes growth in organisms). Additionally, the chlorophyll found in the chloroplasts of the algae give the sea slugs a green color, which helps to camouflage them in their environment.

Image Credit: **Rickard Zerpe**, **CC BY-SA 2.0**, via Wikimedia Commons

1. What type of symbiotic relationship do sea slugs and algae share? [1]
    1. Parasitism
    2. Mutualism
    3. Commensalism
2. Explain and justify your response. Include evidence to explain both organisms in the relationship. [2]

Both organisms benefit by helping the other survive. In the text, the sea slugs give protection to the algae by ingesting the algae and moving them to special parts of their body. The algae help sea slugs by producing oxygen and sugar during photosynthesis that the sea slugs can use for cellular respiration.

Scoring Award points as follows:

1. Award one point for selecting answer B.
2. Award one point for each of the following:

    - Evidence from the text that supports how both organisms benefit each other
    - Justification/reasoning that further explains how organisms interact during a mutualistic relationship

---

Lesson 7: Time for a Checkup: Ecosystem Health

Lesson Objective: Scholars understand that the health of an ecosystem depends on biodiversity. They can explain the impact of genetic variation and adaptations on the biodiversity of an ecosystem. Materials Needed

- For the teacher: a copy of the **Biodiversity Musical Chairs Teacher Guide**, a copy of the **Energy Sources**

- For each group: a copy of the **Biodiversity Musical Chairs Rules**
- For each scholar: 1 **Musical Chair Role Card**

Prep

- Materials Prep:
    - Read through the **Biodiversity Musical Chairs Teacher Guide** to understand the steps you will need to take during each round.
    - Set up the chairs (similar to this **model**).
    - Print and tape the energy sources to the chairs.
    - Print and cut out role cards to give to scholars.

[**Tip:** This game can be played in the classroom, but it might be better if it's played in the hallway, gym, or outside space to allow for more movement by scholars.]

- Intellectual Prep:
    - **What is biodiversity?**

What are scholars doing in this lesson?

- Scholars represent different organisms in an ecosystem and play a game of musical chairs to determine what affects the health of an ecosystem.

Do Now

- Follow the **Do Now plan**.

Launch

- Ask: When you go to the doctor for a checkup, what determines whether or not you are healthy?
    - What do you think makes an ecosystem healthy?
- Ask: Does the increase of the tick population make the campsite ecosystem unhealthy?
- Today scholars represent different organisms in an ecosystem and play a game of musical chairs to determine what affects the health of an ecosystem.

Activity Adapted from **Ecosystem Musical Chairs by Peace Corps**

- Scholars each receive a role card and record their information in their Lab Notebooks. Then groups review the rules of the game to better understand how they will play.
    - Once scholars understand their role and the rules of the game, teachers play Round Zero, where every organism has a chair and survives. Scholars record whether or not the ecosystem is healthy.

        - Teacher continues playing each sequential round of the game by removing a chair and the energy source outlined in the teacher guide.

- As scholars finish each round and record their results, circulate and ask them how the latest removal from the ecosystem affects its health.

        - What caused this organism to become eliminated?

            - How does its elimination impact the rest of the ecosystem?
            - Does its removal change the health of the ecosystem?

Discourse Debrief activity:

- Ask: What happened to the health of the ecosystem after we finished playing four rounds of the game? Why?

        - What causes an ecosystem to be considered healthy?

            - Define **biodiversity** and explain that scientists measure the health of an ecosystem by assessing its overall biodiversity.

- Have scholars share and read their role cards with their groups. Ask: What made organisms different or unique in the ecosystem?

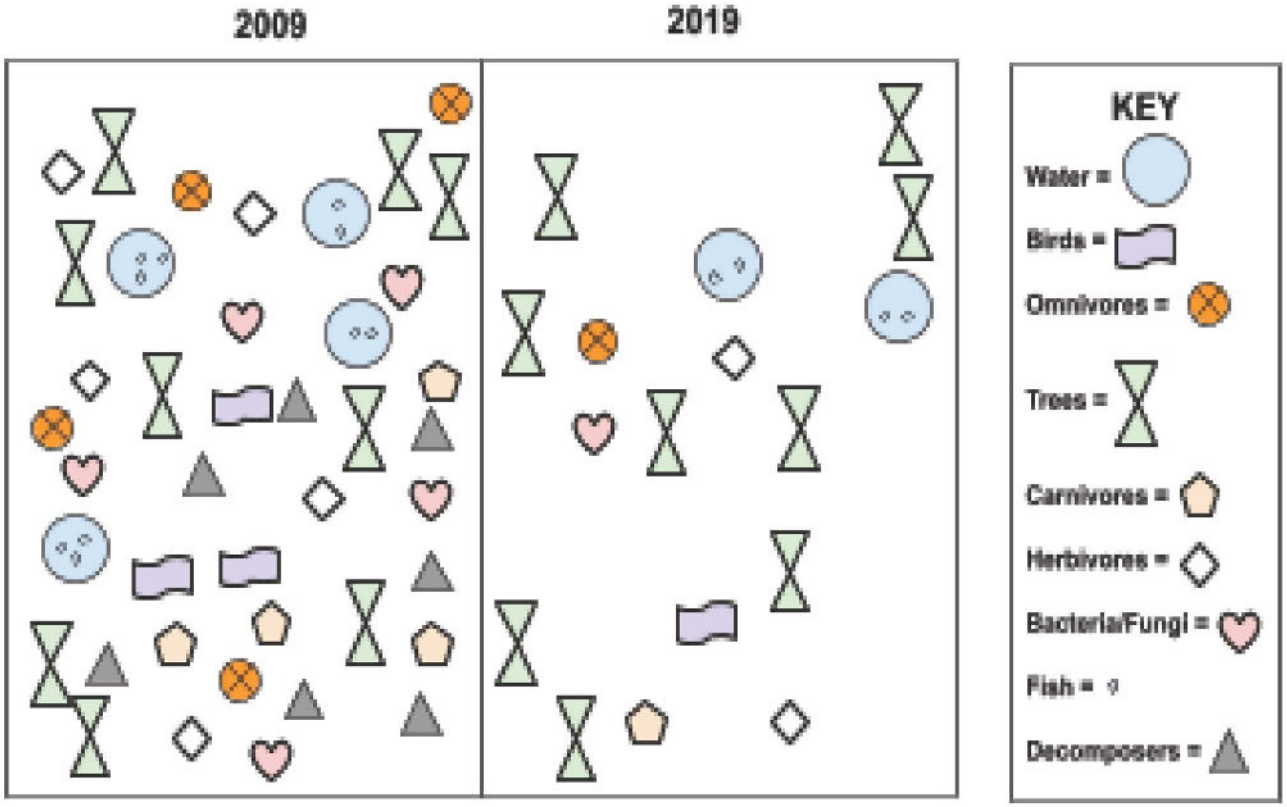
        - What caused each different organism to be eliminated from the game?

            - Define **adaptation**.
            - What causes organisms to have different adaptations? Push scholars to think back on their knowledge of sexual reproduction and genetic variation.

Make connections to the Essential Question:

- Ask: Will the removal of ticks from the campsite ecosystem affect the ecosystem’s health?

Accountability (Exit Ticket) The following model shows how a tropical rain forest ecosystem has changed in the last ten years.



Note: Each symbol represents a population of that type of organism found in the ecosystem.

A tourism company located near the rain forest released the following statement:

"*Unfortunately, the rain forest ecosystem is experiencing a decline in its health and cannot have any visitors.*"

1. Evaluate the accuracy of the company's statement. Explain using evidence from the model and your knowledge of biodiversity to support and justify your response. [3]

The tourism company's statement is accurate because an ecosystem's health is measured by its biodiversity. In the model, over time, the ecosystem has fewer types of organisms present. When an ecosystem has fewer varieties of species, the amount of resources for different organisms change. If an organism has a certain adaptation and the resource they are adapted for is no longer present, they will not be able to survive.

2. Which is the correct sequence that leads to biodiversity in an ecosystem? [1]
    1. Biodiversity → genetic variation → unique adaptations
    2. Genetic variation → unique adaptations → biodiversity
    3. Unique adaptations → genetic variation → biodiversity
    4. Genetic variation → biodiversity → unique adaptations

Scoring Award points as follows:

1. Award one point for each of the following:

    - A claim that identifies the company's statement as accurate
    - Evidence from the model that supports the company's statement
    - Justification/reasoning that further explains why a decrease in variety of species can be harmful for an ecosystem's health

2. Award one point for selecting answer B.

Lesson 8: Succeeding in Succession

Lesson Objective: Scholars understand that different physical and biological disruptions can lead to population decline and an imbalance in biodiversity that can take many years to recover from. Scholars also learn that different natural disruptions can cause primary or secondary succession and result in the survival of specific species over others. Materials Needed

- For the teacher: a set of JENGAâ“‡ blocks for each group, red stickers, an opaque bag for each group
- For each group: dice, a copy of the **Succeeding in Succession Cards**, a copy of the **Succeeding in Succession Game Rules**, a bag of JENGAâ“‡ blocks, a ruler

Prep

- Materials Prep:
    - Print out the **Succeeding in Succession Game Rules** for each group on cardstock.
    - Print and cut out the **Succeeding in Succession Cards** for each group.
    - Add a red sticker to 18 JENGAâ“‡ blocks of each set and place one complete set in an opaque bag for each group.
- Intellectual Prep:
    - **Ecological Succession**

What are scholars doing in this lesson?

- Scholars play a game that represents the challenges that populations face when succession occurs in an ecosystem. To win the game, all players must work together to create a stable tower that reaches 1 foot tall.

Do Now

- Follow the **Do Now plan**.

Launch

- Ask scholars what they know about natural disasters and severe weather.
- Ask: Do natural disasters or severe weather affect ecosystems?
    - Are certain natural disruptions worse for ecosystems than others?
        - Explain that scientists study how natural disruptions change the structure of ecosystems to better understand how ecosystems can maintain their biodiversity and health. Define **ecological succession**.

- Ask: Could a natural disruption solve the campsite tick problem?
    - Would knowing this information change your stance on the Essential Question?
- Today scholars play a game that represents the challenges that populations face in an ecosystem when ecological succession occurs. To win the game, all players must work together to create a stable tower that reaches 1 foot tall.

Activity

- Scholars follow the **Succeeding in Succession Rules** to determine their game role and turn order. They follow the directions to play and to win the game with their group.
    - Scholars roll the dice to determine their game role and turn order. They record information on their species in their Lab Notebooks.
    - Groups read through the game rules and create a tower with nine blocks before beginning.
    - Scholars take turns rolling the dice and adding the corresponding number of blocks to their tower from the bag. When scholars pull a block with a red sticker, they draw a card from the pile and read the directions to the rest of the group. Scholars record the effect the card had on the tower and the reason for the change in their Lab Notebooks.
    - Scholars continue playing the game until they win.
- As scholars are working, circulate and ask what is causing them to change the blocks on their tower.
    - How do the cards affect the building of your JENGAâ“‡ tower?
        - Why do some players move blocks differently than others?
    - What is the difference between primary or secondary succession cards?
    - Why do you think all players must work together to create a 1-foot-tall tower to win the game?
        - What does the tower represent?

Discourse Debrief activity:

- Ask: What type of natural disruptions did you encounter in the game?
    - How did they affect your tower?
- Ask: What was the difference between cards labeled primary or secondary succession?
    - Define **primary** and **secondary succession**.

        - Which players were able to add blocks when you pulled a primary succession card?
            - What allowed these species to survive over others?
                - Explain that during primary succession, the soil becomes uninhabitable by plants and that the first species to colonize an ecosystem are called **pioneer species**. Examples include bacteria, fungi, and lichens. Their role is to promote soil health so that smaller plants can begin to grow.

- Ask: Which players were able to add blocks when you pulled a secondary succession card?
    - What allowed these species to survive over others?
- Ask: Why did all players need to work together to create a 1-foot-tall tower to win the succession game?
- Ask: How long did it take you to build the tower?
    - How is this connected to the way an ecosystem rebounds from ecological succession?
        - What would you expect to happen to the biodiversity of an ecosystem as it recovers from an ecological succession?

Make connections to the Essential Question:

- Ask: Do humans need to be involved in tick removal, or could natural disruptions impact their population growth?
    - How does this change your stance on the Essential Question?

Accountability (Exit Ticket) There was a large volcanic eruption, and a thick cloud of ash blocked most sunlight from reaching the ecosystem for several months. Below are three statements on what will happen to the ecosystem:

1. The producer population will increase.

---

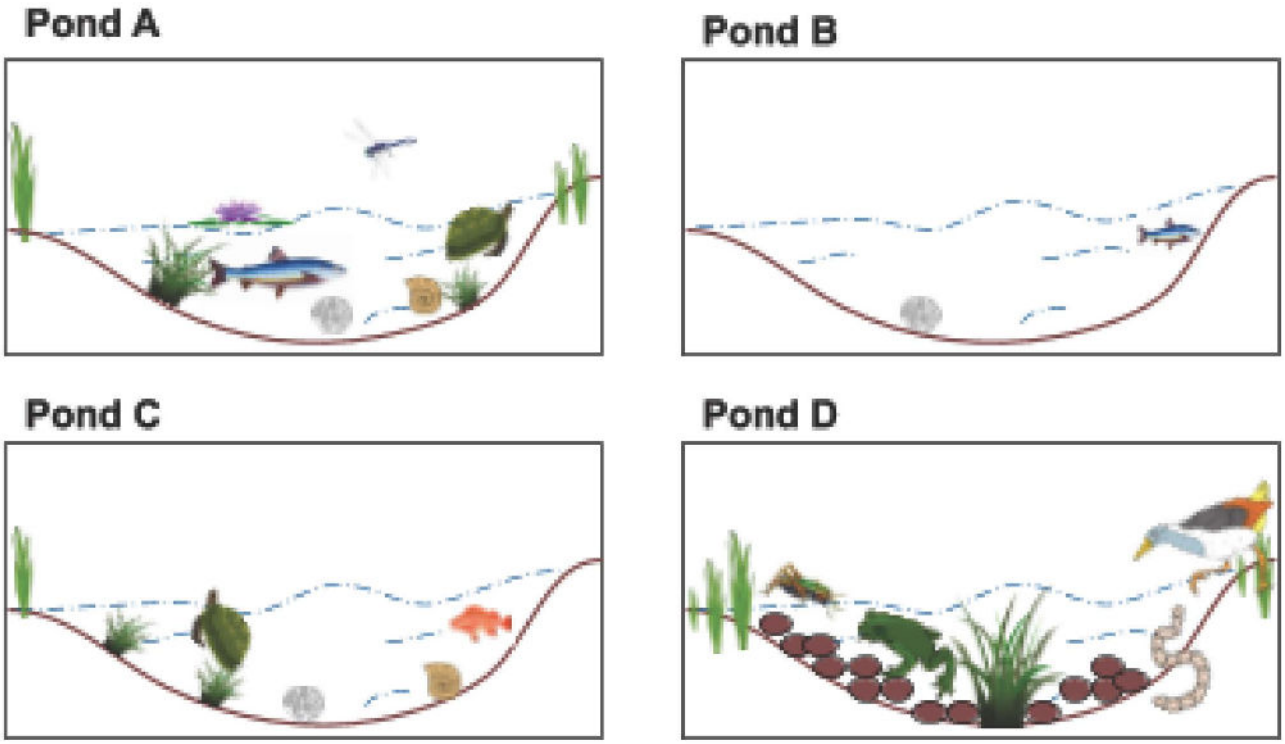
2. All trophic levels will be negatively affected but not completely eliminated.

---

3. The ecosystem will experience primary succession.

1. Which statements above are true? Circle the best answer below. [1]
    1. I
    2. II
    3. III
    4. Only I and II
    5. Only II and III

As the ecosystem recovered from the volcanic eruption, ecologists studied the organisms in the same pond. Each pond represents a year following the eruption.



2. Order the pond pictures from oldest (closest to volcanic eruption) to youngest (closest to present day) by writing their letter on lines below. [2]

B	→	C	→	A	→	D
Oldest	→	Second Oldest	→	Second Youngest	→	Youngest

Scoring Award points as follows:

1. Award one point for selecting answer C.
2. Award two points for identifying the correct order of pond pictures.

    - Award partial credit for one error
    - Award no credit for two or more errors

Lesson 9: Chaotic Campsite

Lesson Objective: Scholars learn that human interference in an ecosystem can be detrimental to biodiversity. Materials Needed

- For each group: a copy of the **Campsite Policy Changes**, a copy of the **Eyewitness Accounts**, a copy of the **Campsite Staff Letter**

Prep

- Materials Prep:
    - Print out materials for each group (**Campsite Policy Changes**, **Eyewitness Accounts**, **Campsite Staff Letter**).
- Intellectual Prep:
    - **5 Human Impacts on the Environment**
    - **Human Impact on Ecosystems Review** from Khan Academy

What are scholars doing in this lesson?

- Scholars investigate the ecological chaos at the campsite to determine the root cause of the ecological issues, focusing on how human activity impacts ecosystems.

Do Now

- Follow the **Do Now plan**.

Launch

- Tell scholars that you have received more information from the campsite staff about some strange changes in the ecosystem they are noticing.
    - Show and read the **Campsite Staff Letter** to the class.
        - What could cause the problems they are experiencing?
- Today scholars investigate the ecological chaos at the campsite to determine the root cause of their ecological issues.

Activity

- Scholars read and analyze the **Campsite Policy Changes** and **Eyewitness Accounts** of the staff to determine the cause of their ecological problems.
    - Groups or partners read the **Campsite Policy Changes** and take notes on possible reasons for ecological problems.
    - Groups or partners read the **Eyewitness Accounts** and take notes on possible evidence for reasons they outlined for the ecological problems.
    - Scholars discuss with their groups the cause of the problem and possible solutions for the campsite.
    - Scholars independently write a letter back to the campsite with their ideas.

- As scholars are working, circulate and ask them to explain how they are interpreting the presented data.
    - What policy changes impact the ecosystem?
    - How do the **Eyewitness Accounts** help you to determine the root cause of the ecological problems?
    - What should the campsite do to solve their ecological problems?

Discourse Debrief activity:

- Have scholars share their letters with the class and ask them to evaluate their ideas and evidence for the campsite's ecological problems.
- Ask: What was the ultimate cause of the campsite ecological problems?
    - Discuss human impact.
        - How can human impact change the balance of the ecosystem?
        - How does human impact affect humans?
    - What must humans do to ensure that they do not impact ecosystems?

Make connections to the Essential Question:

- Ask: If humans remove the tick population by spraying chemicals around the campsite, what do you predict might happen to the ecosystem?
    - How does this change your stance toward the Essential Question?

Accountability (Exit Ticket) The table below shows the population of deer in a grassland ecosystem over a period of eight years. Use the information below and the table to help you answer the questions that follow.

- At the end of year 3, 80 percent of the grassland is converted to farmland and fenced to keep the deer out.

Year	Deer Population	Average Mass (kg)	Number of Deer Births	% Malnourished (Severely Underweight) Deer
1	100	30	30	5
2	97	29	25	4
3	105	31	15	3
4	83	29	5	46

5	57	27	7	32
6	56	23	6	25
7	58	20	8	18
8	58	20	5	10

Question adapted from Chapter 3: Interactions Between Populations and Resources in ***Disruptions in Ecosystems from NGSS Lead States***. 2013. Next Generation Science Standards: For States. Washington, DC: The National Academies Press.

When asked about the impact of the farmland and fencing, farmers stated the following:

"This change will be beneficial for the deer population."

1. Do you agree with this statement? (Circle one) **Yes** or **No** [1]
2. Use two pieces of evidence from the data table to write two different statements that each include both evidence and justification that scientists could use to refute the farmers' claim. [2]

Evidence & Justification 1: According to the table above, deer are not reproducing at as high of a rate as before the fences were put up, showing that the population is decreasing.

Evidence & Justification 2: After the fences were put up, the percentage of deer that are malnourished went up by over 40 percent, meaning there is not enough food to feed the population.

Scoring Award points as follows:

1. Award one point for circling "No."
2. Award one point for each piece of evidence provided from the table that supports that the change was not beneficial for the deer population.

Lesson 10: Smart Solutions (Two Days)

Lesson Objective: Scholars understand that ecologists consider economic and social impacts in addition to environmental ones when proposing solutions to ecological problems. Materials Needed

- For each scholar: a copy of the **Designing Solutions Article**

Prep

- Materials Prep:
  - Print the **Designing Solutions Article** for each scholar or pair of scholars.

- Intellectual Prep:
    - Read and annotate the **Designing Solutions Article**.

What are scholars doing in this lesson?

- Scholars read an article about how ecologists devise solutions to problems. They then revisit the solutions they considered on Day One to determine which would be most effective at minimizing economic, social, and environmental impacts. Scholars wrap up the unit by constructing an argument to share during a whole-class debate on Day Two.

Day One

Do Now

- Follow the **Do Now plan**.

Launch

- Ask: What do ecologists consider when solving problems in an ecosystem?
    - How does this help them determine the best solution?
    - What is the goal of solving problems in an ecosystem?
- Today scholars read an article that explains how ecologists create smart solutions to ecological disruptions. They accumulate evidence for each solution to the tick problem and construct an argument to share during a whole-class debate on Day Two.

Research Activity adapted from Chapter 5: Designing Solutions in ***Disruptions in Ecosystems from NGSS Lead States***. 2013. Next Generation Science Standards: For States. Washington, DC: The National Academies Press.

- Scholars read the article and gather evidence from throughout the unit and online for the debate to support all three factors that impact the ecological solution.
    - Scholars read the **Designing Solutions Article** and discuss the purpose of each factor with their groups.
    - Independently or with a partner, scholars collect evidence for each solution from throughout the unit and online.
    - Scholars decide which solution will be the best for the campsite and construct an argument to share during the debate.
- As scholars are working, circulate and ask them how they are determining evidence for the social, economic, and environmental impact for each solution.

Discourse Debrief reading:

- Ask: Why do scientists determine economic, social, and environmental impacts when considering solutions for ecological problems?
    - Which is the most important factor to consider? Why?

Make connections to the Essential Question:

- Ask: Should humans interfere with the increasing tick population at the campsite, or should we not choose any of the control solutions?

Make broader connections:

- Ask: What might happen if scientists were not consulted to help solve an ecological problem?

Accountability (Lab Notebook)

- Construct an argument to persuade the campsite which is the best solution to use to solve their increasing tick population problem. Include at least two pieces of evidence to support and justify your response.

Scholar responses will vary based on their ideas. Assess scholar effort and general understanding that an argument should have a clear claim that identifies their stance on the problem, strong supportive evidence, and justification/reasoning that uses science content or ideas to make sense of their evidence.

Possible Full-Credit Exemplars:

I believe that chemical control will be the best to solve the campsite problem. The pesticide will effectively kill all of the ticks, and it will only take two months to complete. The campsite can complete this chemical control during the time of the year before scholars visit the campsite, and they won't have to worry about ticks causing problems for any visitors. The staff will only be out of work for two months and will not need to relocate in order to keep their jobs.

I think that physical removal is the best way to solve the campsite problem. It may take a few years to complete, but by burning the land and through a personal checking system, they will be certain no ticks survive. Plants can regrow over time, and then the campsite can be fully up and running. It does not cost much money to create a fire, and the campsite could use their own staff to check for ticks, which would allow them to keep their jobs during this time.

I think they should relocate the campsite as the solution to their problem. The other options involve potential harm to the environment, and this solution will leave all organisms safe. It might be difficult to sell and move to another place, but there is a lot of space in New York for them to make a new campsite. Additionally, if they buy a new and better campsite, they might attract more campers and be able to make more money over time.

Biological control is the best solution because the ticks can be removed naturally. Also, by only bringing in 30 toads, it won't be that many to affect the environment there, and it will not cost much to purchase or find toads from another environment to bring over. This solution will allow scholars to come to the campsite soon, because toads are not harmful.

Scoring Award points as follows:

- Score scholars on a 1–4 scale (below expectations through exceeding expectations) based on classwork.
    - Look for the following when scoring scholar responses:
        - A clear claim that identifies one potential solution to the ecological problem
        - Multiple pieces of specific evidence collected from the unit that supports their claim and addresses the social, economic, and environmental impacts of the solution
        - Justification/reasoning for why this solution will be the most effective at solving the problem

---

Day Two

Do Now

- Follow the **Do Now plan**.

Launch

- Ask: What makes an argument strong?
- Ask: How can you persuade someone to agree with your argument?
    - Chart scholar responses to reference during the activity.
- Today scholars break into minigroups with a member from each viewpoint to share their arguments and persuade others to join their side. Scholars rethink their stance, and representatives from each solution share their ideas during a whole-class debate!

[**Engagement Tip:** Make this a class-wide competition by incentivizing the group that convinces the most scholars to change their stance and join their group!]

Activity Activity adapted from Chapter 5: Designing Solutions in ***Disruptions in Ecosystems from NGSS Lead States***. 2013. Next Generation Science Standards: For States. Washington, DC: The National Academies Press.

- Divide your room into four spaces to represent each solution for the campsite ecosystem. Have scholars move to the solution that they agree with and have constructed an argument for.
- Create groups of four, with a representative from each solution in each mini group.
    - Scholars share their arguments and try to persuade each member of their mini group to change their stance on the solution they have chosen.
    - Scholars reflect on the information presented from members of their mini group and decide which solution will be the best for the campsite.

- As scholars are working, circulate and monitor which scholars stand out as convincing members for their solution.

Discourse Debrief activity:

- Divide your room into four spaces again to represent each solution for the campsite ecosystem. Have scholars move to the solution that they now agree with after the mini group discussions.
- Choose representatives from each solution to take turns stating their argument for each solution.
    - Have scholars who do not agree with that solution ask questions.
- Ask: Were you convinced to change your stance on the best solution for the campsite? Why?
- If there are big discrepancies in the number of scholars who favor each solution, ask why that is.
- Ask: Should humans interfere with the increasing tick population at the campsite, or should we not choose any of the control solutions?

Make connections to the Essential Question:

- Ask: Should humans interfere with the increasing tick population at the campsite, or should we not choose any of the control solutions?

Accountability (Exit Ticket)

1. Compose an answer to the Essential Question: Should we remove all ticks from upstate New York ecosystems? Include a detailed explanation with at least three pieces of evidence from the unit. [5]

I do not think that ticks should be removed from all ecosystems because they help to maintain the balance and biodiversity of an ecosystem. Ticks serve as both predators and prey for different organisms in the campsite ecosystem, so removing ticks would eliminate a food source for the praying mantis and the cardinals, limiting their ability to receive energy and survive.

While this might be a positive benefit for the organisms the ticks feed off, it may also create an increase in those organisms, like the deer, which may also disrupt the balance of energy flow. Additionally, the ecosystem needs to have a variety of species to maintain its biodiversity and stay healthy. If the tick is removed, we would see a decline in the overall ecosystem's health.

The tick also acts as a partner in a symbiotic relationship with bacteria, which helps the bacteria survive. If the tick was eliminated, we would also be eliminating the bacteria from the environment. While certain bacteria are harmful, other bacteria act as decomposers in the ecosystem, which help to cycle matter and energy back to the soil for producers.

Overall, the tick is needed by the ecosystem, and even though their population has increased, natural disruptions or changes to the ecosystem may help solve this problem. For example, changes to weather or a natural disaster could change the environment and the ability for the tick to survive, so the problem would be solved without human interference.

Scoring Award points as follows:

1. Award one point each for:

    - A clear claim that identifies a reason why we should or should not remove ticks from the ecosystem
    - Each piece of supporting evidence from the unit that explains how the tick plays a part in several ecological roles in maintaining ecosystem biodiversity (up to three points)
    - Justification/reasoning that further explains how the ecological interactions between the tick and the ecosystem can help or harm the overall stability of the ecosystem.

Unit Vocabulary

Vocabulary List

- **ecology**
- **ecosystem**
- **abiotic**
- **biotic**
- **interdependent**
- **food chain**
- **food web**
- **producer**
- **consumer**
- **herbivore**
- **omnivore**
- **carnivore**
- **decomposer**
- **ecological pyramid**
- **trophic level**
- **autotroph**
- **heterotroph**
- **primary consumer**
- **secondary consumer**
- **tertiary consumer**
- **competition**
- **predator**
- **prey**
- **apex predator**
- **invasive species**
- **population**
- **symbiosis**

- **mutualism**
- **parasitism**
- **commensalism**
- **biodiversity**
- **adaptation**
- **ecological succession**
- **primary succession**
- **secondary succession**
- **pioneer species**