SUCCESS ACADEMY EDUCATION INSTITUTE

Life Science:

Unit 4

Ecology - The Ebb and Flow of Natural Systems: Introduction

Purpose: The Why, What, and How of This Unit

Essential Question: Should we remove *all* ticks from upstate New York ecosystems?

Unit Storyline Synopsis: Scholars engage with the Essential Question by recalling their experiences on Grade 5 camping trips. They use this as a jump-off point to examine what it means to be an ecological system. Each lesson builds on their understanding that interactions between biotic and abiotic factors create a stable, healthy ecosystem.

They then consider how feeding relationships help maintain the balance between trophic levels and flow of energy and matter. From the producers that harness the energy from the Sun, to the consumers that rely on resources from other organisms, to the decomposers that help to cycle the energy and matter back to the soil, an ecosystem is truly a system functioning through the work of many essential parts.

Scholars continue to learn about different types of ecological relationships that significantly impact the ecosystem. While predator–prey relationships help organisms meet basic energy needs, the addition of competition can seriously impact the resource availability. They expand their thinking of what it means to be interdependent by studying new symbiotic relationships that allow for survival in unique ways. Scholars revisit the idea of microbes by learning the different symbiotic relationships that ticks partake in: They question the ethics behind the Essential Question as they determine how to equate the life of a tick to that of other organisms, even bacteria!

Scholars are asked to consider how human activity impacts ecosystems. Scholars consider whether it is ethical or necessary for humans to interfere with natural ecosystems. It pushes them to think beyond the human as an organism and to consider the broader impact of disruptions on the world. They consider whether natural disruptions will eventually rid the campsite of its tick problem or if human interference is needed.

They end the unit by engaging in a debate about how to manage the tick population at the campsite. They combine their knowledge of competition, feeding relationships, and human impact to advocate for their solution.

Why This Unit? We continue the yearlong journey from micro to macro by examining individual and population interactions. Scholars build on their understanding of how matter and energy flow within individual organisms to examine how these interactions occur between both living and nonliving things in ecosystems.

This unit reveals the connections and reliance of different living and nonliving factors throughout the ecosystem to provide resources and stability to sustain life. The Essential Question allows scholars to think deeply about the interdependence of an ecosystem while considering the ethics of a real-world problem.

What Is the Bottom Line?

Big Idea 1: Interdependent relationships help organisms survive in their ecosystem. Organisms and nonliving factors interact in many ways to provide essential resources by repeatedly cycling energy and matter.

- Genetic variation creates unique structural and behavioral adaptations in organisms that increase their odds of survival by allowing them to interact successfully with different parts of an ecosystem.
- Predator–prey, competitive, and symbiotic relationships are common across ecosystems all over the world.
- Abiotic factors are resources like air, water, shelter, energy, and essential minerals that promote organismal survival and reproduction.
- Food chains, webs, and pyramids are used to represent the many relationships between producers, consumers, and decomposers that allow for energy flow and matter conservation.

Big Idea 2: Ecosystems are dynamic in nature, and their characteristics vary over time. The ecosystem functions as a delicate balance of organisms and nonliving factors and can be majorly impacted through physical or biological disruptions.

- The variety of species found in both terrestrial and aquatic components of the ecosystem describe its biodiversity, which is used by scientists as a measure of its health.
- Growth of organisms and population increases are limited by access to resources and local conditions.
- Invasive species can drastically change the structure of an ecosystem, affecting resource availability.
- Severe weather and catastrophic events can interrupt ecosystem balance by causing primary or secondary succession.
- Humans often interfere with ecosystem balance, influencing biodiversity and environmental health.

How do Next Generation Science Standards practices and crosscutting concepts support mastery of the Big Ideas? Science and Engineering Practices highlighted in this unit:

- **Developing and Using Models**
    - Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena.
    - Develop and/or use a model to predict and/or describe phenomena.
- **Engaging in Argument from Evidence**
    - Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.
    - Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts.

Crosscutting Concepts highlighted in this unit:

- **Cause and Effect**
    - Cause and effect relationships may be used to predict phenomena in natural or designed systems.
- **Systems and System Models**
    - Models can be used to represent systems and their interactionsâ€” such as inputs, processes, and outputsâ€” and energy and matter flows within systems.
    - Systems may interact with other systems; they may have subsystems and be part of larger complex systems.

Safety

Plan carefully for safety in all lessons. The top safety risks in this unit include:

- In Lesson 7, scholars will be out of their seats playing a musical chairs game. Set expectations with scholars on how to move around the room during the game to avoid injuries or issues among players.

Important Note: These lesson plans highlight some of the safety risks you should be aware of while teaching these lessons. These safety suggestions are not meant to take the place of a formal science safety training. Please be sure to follow all safety rules from your district, as well as all local, state, and federal science safety guidelines.

Unit Storyline

Engage: Scholars are brought back to their camping experience at the beginning of middle school only to discover that a ravaging, blood-sucking organism has taken overâ€" the small but mighty tick! Scholars begin to ponder their stance toward the Essential Question: Should we remove *all* ticks from upstate New York ecosystems?

- **Lesson 1: Ticks on the Loose!** Scholars are introduced to the storyline and the Essential Question. They know that to save the camping trip, the tick problem must be solved, and quickly! Scholars examine four proposed solutions and record their initial evaluations of each plan.
- **Lesson 2: What Is an Ecosystem?** Scholars observe the campsite ecosystem and identify different abiotic and biotic components. Scholars learn how the different parts of the ecosystem depend on each other for essential resources and hypothesize about what happened at the campsite by considering these interactions.

Explore: While some may think the answer to the Essential Question is obvious (save the campsite!), scholars learn that the flow of energy and matter in an ecosystem may complicate the situation. Scholars explore different feeding relationships to learn how energy and matter are conserved within and between populations.

- **Lesson 3: What's for Dinner?** Scholars explore the different feeding relationships in an ecosystem by using data to create a food web that connects organisms to their energy sources. They unveil the ultimate source of energy that drives most ecosystems and learn how to classify organisms based on their diet.
- **Lesson 4: The Great Pyramids: Energy and Matter Flow** Scholars elevate their knowledge of feeding relationships by using an ecological pyramid to explore how energy and matter are cycled and conserved in the ecosystem.

Explain: Scholars take a closer look at the campsite to learn the various interactions within an ecosystem, complicating the Essential Questionâ€" is it possible that the tick helps maintain the balance of the ecosystem? They learn how interdependency relies on adaptations of different organisms, which creates interesting fluctuations when biodiversity is threatened.

- **Lesson 5: Feast or Famine?** Scholars learn about the delicate predator–prey relationship and how competition can greatly impact the flow of energy and matter throughout the ecosystem. By modeling the interactions of organisms in different scenarios, scholars have a rich discussion of the effects that invasive species and population fluctuation have on an ecosystem.
- **Lesson 6: The Crittercam Files: Ecological Relationships** Scholars strengthen their understanding of the interdependence of organisms in an ecosystem by learning that there is more to ecological relationships than feeding and competition. They investigate the different types of symbiotic relationships.
- **Lesson 7: Time for a Checkup: Ecosystem Health** Through participation in a modification of musical chairs, scholars use their knowledge of ecological relationships to explain that the health of an ecosystem depends on its biodiversity. With connection to prior knowledge, scholars learn that a variety of organisms across an ecosystem is connected to genetic variation, giving way to different adaptations.

Elaborate: Scholars apply their knowledge of ecosystem interactions and interdependency to determine how extreme environmental conditions and human impact can disrupt the balance of

the ecosystem and organismal growth. They will weigh human interference against natural interference as evidence toward answering the Essential Question.

- **Lesson 8: Succeeding in Succession** Scholars learn that physical and biological disruptions can influence the potential growth of specific populations in an ecosystem.
- **Lesson 9: Chaotic Campsite** Scholars work on solving the presence of mysterious ecological events by reading through campsite policy changes and eyewitness accounts.

Evaluate: Scholars experience the real-life challenges scientists face as they evaluate potential solutions to maintain the biodiversity of an ecosystem. Scholars harness their knowledge from the entire unit to take a strong stance and develop a compelling argument to answer the Essential Question.

- **Lesson 10: Smart Solutions** Scholars revisit the solutions they considered in the beginning of the unit to determine which is the best. They weigh the economic, social, and environmental impacts of the solutions and work to construct an argument to present in a whole-class debate!

Extra Resources

In addition to the resources linked throughout the guide, use the following materials to help you prepare to launch this unit with scholars:

- **Printable Exit Tickets**
- **Printable Lab Notebook**