Investigate environmental influence on evolution

Focus question
How can environmental conditions impact growth rate, behavior and reproduction?

Standards
- **8.LS.1 Diversity of species, a result of variation of traits, occurs through the process of evolution and extinction over many generations.** The fossil records provide evidence that changes have occurred in number and types of species.
- **8.LS. 3** The characteristics of an organism are a result of inherited traits received from parent(s). **Expression of all traits is determined by genes and environmental factors to varying degrees.** Many genes influence more than one trait, and many traits are influenced by more than one gene.

Introduction
What is the cause and effect relationship of trait inheritance and environmental influence? In this lesson, students will learn how the environment can influence the inherited traits of an organism. How did the prehistoric environment help the *Tyrannosaurus rex* to become one of the largest carnivores of all time? How does a modern poultry house help the flock to stay healthy, happy and productive? Students play a game to model environmental influence on trait expression and use data to explain the results.

Student prior knowledge
Familiarity with the concepts of inherited traits, natural selection and environmental services are helpful during this lesson. Students should have an understanding that individual survival is based on meeting the basic requirements for life: food, water, shelter, and air. Organisms must have access to these basic needs in order to reproduce, thereby passing inherited traits on to the next generation.

Suggested timeline
1 class period (45–60 minutes)

Materials
- *Research and compare* student data sheet
- *Hungry chicken game* cards
- *Hungry chicken game* tokens (alternative: game chips, pennies, etc.)
- *Hungry chicken game* student sheet
- 1 cup per student
- 1 paper bag per student group

Teacher preparation
- Print off enough *Research and compare* student sheets and *Hungry chicken game* student sheets for each member of the class.
- Print off the Hungry Chicken game cards ahead of time on cardstock, one set per group.
- Each group should have 1 cup per person and 1 bag to hold energy tokens (A group of 4 would require 4 cups and 1 bag). Place 10 tokens in each student cup before round 1 begins.

DIFFERENTIATION

Students can model this game in a commercial setting. For example, if a layer house provides ample food, water, and shelter, how will this impact the hungry chicken game cards? Students can create a new set of cards for a commercial layer house setting.

Procedure

1. In small groups, students will compare traits of both the *T. rex* and the modern day chicken to determine what similarities and differences they find between the two organisms.
    - Which traits are/could be influenced by their native environments?
    - How do heritable traits change over time?
    - Why?
2. Pass out the Hungry Chicken game cards, tokens, student sheets, cups, and bags. Have the students complete the modeling game.
   Lead this activity with a focus question: Does the environment have an impact on a chicken's weight? How do inherited traits play a part?
3. Place 10 tokens in each cup before beginning.
    - The cup represents the chicken and the bag represents the environment.
    - The tokens represent the food/energy available to the chicken.
    - The chicken will get energy from food and use that energy to survive by moving to find a mate, food, or shelter.
    - Each card provides a scenario about how the chicken interacts with its environment and explains how the animal uses energy. Place the cards in the environment bag.
    - If the chicken loses food, then the student will have to take tokens out of his/her cup. If the chicken gains food, then the student will place tokens in the cup.
    - In the second round of play, one student in the group will inherit an agility gene that will allow his/her chicken to move more quickly and capture more food (tokens). *This second trait should be used to emphasize that traits are influenced by inheritance as well as the environment.*
4. Reflect with the students how the environment influenced the chicken traits within each group during each round.
    - Did some chickens have more access to food than other chickens?
5. Next, have the students brainstorm how humans can alter a chicken's natural environment to increase safety, improve health, and consequently increase egg production and/or growth.
    - What would the perfect chicken environment look like?

SUGGESTED WRAP-UP ACTIVITY

Compare the *T. rex* to the Hungry Chicken game that models a natural environment. What characteristics of the *T. rex* are similar to that of a chicken? The *T. rex* has been shown to grow faster in an environment with more food availability, and grow less quickly in an environment with less food availability. What other characteristics could some species demonstrate when food availability is scarce? What characteristics are farmers looking to capitalize on by providing ample food, water and protection from disease and predation in a commercial poultry environment?

More challenges

- Have the students brainstorm ways that the *Tyrannosaurus rex* as well as other dinosaurs (both carnivores and herbivores) became so large. What types of large animals exist in the world today? Why do these large animals primarily eat photosynthetic organisms?

- How do today's environments differ from prehistoric environments? Populations of organisms have changed greatly over time due to natural extinction events which allow opportunities for new species to emerge. If we were to experience a natural extinction event (it is hypothesized that we are living in one right now), which species would suffer most? Why? Which species/species types would dominate or emerge? Why?
- **Home connection:** How are modern poultry farms changing the natural environment to maximize production? What inherited traits are we supporting by utilizing animal science, engineering and biosecurity features to increase bird health? Create a compare/contrast list of natural environments (such as those experienced in the hungry chicken game) and commercial poultry environments. Analyze the differences between these habitats and facilitate a discussion on consumer needs and poultry production.

Support information

- The expression of inherited traits of an organism are influenced by the environment in which the organism lives. Environmental factors such as diet, temperature, humidity, oxygen levels, light cycles, and the presence of mutagens all impact gene expression.
- The *Tyrannosaurus rex* has shown evidence of controlled growth stages which are proposed to be linked to food availability within their environment. The *T. rex* grew faster in an environment with greater food availability than in one without, similar to modern alligators.
- Several organisms like the snowy owl lay fewer eggs when food is scarce, or sometimes even none at all. The Hungry Chicken modeling game is meant to draw a direct connection from food availability to growth. If a chicken is able to eat enough food, the chicken will survive and reproduce. Reproduction is the goal for all organisms so that they can survive and pass on their traits to the next generation.

Career connections

Have you ever wondered what type of poultry careers help to make a healthy, safe environment for commercial birds? Let's take a look!

- **Poultry Caretakers** help with monitoring flocks for their health and well-being, ensuring they have constant access to fresh food and water as well as a safe living environment. Caretakers walk their barns every day to check their flock and the equipment that helps to keep them safe and fed.
- **Animal Scientists** apply principles of the biological, physical, and social sciences to the problems associated with poultry production and management. In other words, they study animal health and behavior in order to help design the perfect environment for commercial birds to live in and produce meat and eggs.
- **Nutritionists** are animal scientists who create diets for different types of poultry by examining their genetics, health conditions or other factors to best determine their nutritional needs.
- **Veterinarians** care for the health of the poultry flock and work to protect public health. They diagnose, treat, and research medical conditions and diseases of pets, livestock, and other animals.