Investigate ancestry

Focus question
Where did chickens come from?

Standards
- **8.LS.2** Every organism alive today comes from a long line of ancestors who reproduced successfully every generation.
- **8.LS.3** The characteristics of an organism are a result of inherited traits received from parent(s).

Introduction
Welcome to Chickenology! In this lesson, students explore the ancestral link between chickens and the *Tyrannosaurus rex, T. rex.* What evidence connects these two organisms to one another? Students will investigate three separate stations and evaluate each body of evidence that supports the theory that chickens descend from the *T. rex* ancestral line.

Student prior knowledge
The awareness that organisms pass down traits from one generation to the next is helpful in this lesson. Students should understand that relatedness is an evolutionary relationship between ancestors and their descendants which demonstrate connections back to a common ancestor.

Suggested timeline
2 class periods (90 minutes)

Materials
- Stations cards (1 per group of students, 4 groups needed)
- Station answer sheet (1 per student)
- 4 Foldscopes
- 4 chicken feathers
- Computer/projector (ready for video resources)
- Masking tape
- Permanent marker

Teacher preparation
- Print stations cards (1 per group of students).
- Print station answer sheet (1 per student).
- Place a station card at each student grouping.
- Place Foldscopes (including magnifying glass) at student groupings (1 per group).
- Place chicken feathers at student groupings.
- Set up computer/projector for video clip in lesson introduction.
- Prepare for wrap-up activity: Using masking tape, create a line on the floor across the length of the learning space. Use the permanent marker to divide the line into quarters, labeling the divisions 1, 2, 3, and 4.

DIFFERENTIATION

- Create heterogeneous groups of students (of varying knowledge and ability levels) to complete stations cards together.
- View the following videos as a class for content support:
- Phylogenetic Tree Interpretation: **youtu.be/X7UX5g0GJiM**
- What is Common Ancestry lesson: **youtu.be/Gi86jDjKu-c**

Procedure

1. Divide students into groups.
2. Select a student to read the Introduction on the Stations Cards document. Ask the students to examine the diagram (cladogram) below the Introduction. Pose the following questions to the students:
    a. What do you think this diagram represents?
    b. According to this diagram, which are more closely related, chickens and theropods, or chickens and armored dinos? How can you tell?
    c. What do you think the dots on the diagram represent (common ancestors)?
    d. What does one line splitting off from another mean?
3. Discuss the answers to these questions as a whole group.
4. Divide the class into groups. Pass out the station answer sheet, one per student. Students begin stations 1–3 (one group per station), recording answers on the stations answer sheet. Students cycle through each station in the stations cards document. (Each station and response on the student answer sheet should take 5–10 minutes.) Stations are as follows:
    - Station 1: Anatomy (Students explore the skeletal similarities between a *T. rex* and chicken.)
    - Station 2: Feathers (Students learn of the existence of dinosaur feathers and compare them under microscope to chicken feathers.)
    - Station 3: Collagen (Students learn of the discovery of *T. rex* collagen and its similarity to that of chicken collagen.)

SUGGESTED WRAP-UP ACTIVITY

1. The class will revisit each station. They will evaluate the strength of each body of evidence they analyzed today.
2. Ask students to revisit Station 1 in their Stations Cards document. Ask students to consider the following questions about Station 1's information.
    a. Is the evidence tested with rigorous, proven methods?
    b. Is the evidence repeatable, tested in more than one situation or sample?
    c. Is there any information missing from the evidence? .
    d. Are there any alternative explanations for the evidence?
3. How many of these 4 requirements does the evidence meet? After considering these questions, ask students to rank this body of evidence according the following scale:
   (1 = Not strong; 2= Moderately strong; 3 = Very strong; 4= Strong enough to be considered fact)
4. Ask students to line up on the masking tape line in front of the number they chose matching the strength of the evidence. Ask a student at each number to explain their reasoning.
5. Repeat this procedure with the other stations, ranking the strength of evidence at each station.

More challenges

- Investigate the “Chickenosaurus”: What is the idea of the “chickenosaurus”? How is one created? Compare and contrast a chickenosaurus and a dinosaur. How would a chickenosaurus help us learn about organism ancestry? (**livescience.com/50886-scientific-progress-dino-chicken.html**)
- Brainstorm a theory: Can you think of any other explanations that might explain or connect the similarities between chickens and theropods?
- Compare phylogenetic trees: Gather several phylogenetic trees. Practice reading and interpreting them. If there are differences between them, compare the points of difference. Why are they different and similar? What does this communicate about the ideas of scientists who formed each tree?
- **Home connection:** Start a conversation about the connection between modern day birds and their ancestral dinosaurs. Discuss common characteristics between theropods and birds such as four-chambered hearts, feathers, scales, hollow bones, etc. Discuss differences between them such as metabolisms (endo/ectothermic), leathery/hard shelled eggs, size, etc. How are modern commercial poultry similar to theropods? How are they different?

Support information

Scientists propose that chickens are a descendent of the *Tyrannosaurus rex.* The *T. rex* is a member of a family of bipedal dinosaurs called theropods. Students are introduced to a phylogenetic tree to determine how dinosaurs and chickens may be related. At the crux of each split in the tree, a common ancestor (or several) is/are proposed to have existed. The common ancestors are not listed in this tree, but it should be noted to students that the common ancestor(s) are not *T.rex*es or chickens. It is an organism that contains the traits of both in its DNA. In addition to searching for common ancestors in the fossil record, there are four main bodies of evidence that support the linkage between the chicken and the *T. rex.* These bodies of evidence, especially anatomical similarities (station 1), and collagen (station 3), have been applied to many organisms in search of their lineages. In evaluating the strength of each body of evidence students learn to think critically and weigh evidence, helping them to contribute to the genesis of sound theory.

- Phylogenetic Tree Investigation: **youtu.be/X7UX5g0GJiM**
- What is Common Ancestry lesson: **youtu.be/Gi86jDjKu-c**
- Are Birds Modern-Day Dinosaurs? lesson: **youtu.be.com/eaWb0UUNc00**
- *T. rex* linked to Chickens: **smithsonianmag.com/science-nature/t-rex-linked-to-chickens-ostriches-180940877**

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.
- **Ornithologists** are scientists that specializes in the behavior, physiology, and conservation of birds (Class Aves), their ancestors and their habitats.

Teaching suggestions

1. Make the Stations sheet available through Google documents. Students may then click directly on links in the document. They may also type answers to the task questions or create another Google document in which to do so.
2. Preload different video tutorials on student computers or classroom iPads at each station.

Vocabulary

- **Ancestry:** the evolutionary or genetic line of descent of an organism
- **Paleontologist:** a scientist who studies the history of life on Earth through fossil and genetic records
- **Phylogenetic Tree:** a diagram that depicts the lines of evolutionary descent of different species, organisms, or genes from a common ancestor
- **Clades:** a branch within a phylogenetic tree that includes a single common ancestor and all of its descendants
- **Fossil:** the remains or impression of a prehistoric organism preserved in petrified form or as a mold or cast in rock