# Lesson 9. What Can Fossils Tell Us About the History of Present-Day Organisms Like Chickens?

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| The *"Big Idea"* | Fossil evidence can tell us how ancient and present-day organisms change over time. |
| Investigation Question | What can fossils tell us about the history of present-day organisms like chickens? |
| Summary | Students review the prior lesson about how fossils are formed, then explore fossil samples and brainstorm what they think the organisms might have been. They try to match the fossils to images of organisms living today. They discover the different evolutionary outcomes of each fossil (see table at the end of the lesson summarizing these). |
| Materials | For the class<br>● Investigation questions<br>● Slide deck for this lesson<br>For each small group<br>● Sets of pictures of present-day animal populations (turritella snails, garden snails, clams, nautilus, squid, chickens, rabbits)<br>● Samples of fossils (ammonite, trilobite, turritella plus Archaeopteryx photo) |

**Lesson Description and Rationale**
Over the course of the unit, students have synthesized their understanding to deduce the mechanism of natural selection. They have also learned that natural selection can result in environmental specialization of a species' traits ("adaptation by natural selection") and to the evolution of entirely new species whose traits are so different from those of an original population that they can no longer have offspring with them ("speciation by natural selection"). Importantly, the mechanism of natural selection is the same in the process of adaptation and of speciation. In the last lesson, students started to address the question, What is the evidence that supports a speciation story (e.g. miroungas)? They ended Lesson 8 beginning to explore fossils as the answer to that question.

Today, if necessary, they briefly review how fossils are formed again but then explore what fossils can tell us about the relationship of ancient animals to present-day organisms.

Students address the investigation question

*What can fossils tell us about the history of present-day organisms like chickens?*

Using photos and real fossils, students examine and describe the features of some individual fossil organisms and then match them to images of present-day organisms.

The students will be exploring specimens of 4 types of fossils (3 physical and 1 photo): ammonites, archaeopteryx, trilobites, and turritella snails. These examples represent different evolutionary outcomes. See the table at the end of this lesson that summarizes these outcomes.

By the end of this lesson, students will be able to argue that fossils provide evidence of organisms that lived long ago, and that fossil organisms may have similar traits to some organisms alive today. In addition, they will be able to use evidence about the environments of present-day organisms to infer the fossils' environments long ago. Students will understand that traits and environments of living organisms today help us interpret fossil evidence of plants and animals long ago.

This lesson sets the stage for the next lesson – the final Evolving Minds lesson – in which students will hear an evolutionary story about two real species and how scientists figured it out and get to generate an evolution story themselves.

*Note: This lesson asks students to make sense and pull together a lot of new information, so just listen for students' ideas. This is a chance for you to find out what your students are figuring out and learning.*

**Learning Targets in this Lesson**

- Fossils provide evidence of how organisms have changed over time.
- Fossils provide evidence that some kinds of animals that once lived on Earth are no longer found anywhere (extinction). Some kinds of animals have changed a little since ancient times, while others have changed a lot.
- Present day animals – and their present-day environments – can help us interpret fossil evidence.

| Sequence of Experiences | | |
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| **1. Introduction** | All class | 2 Minutes |
| **2. Review Fossilization** | All class | 5 Minutes |
| **3. Investigate Fossils Activity** | Small groups & All class | 20 Minutes |
| **4. Make Meaning** | All class | 10 Minutes |
| **5. Wrap Up** | All class | 2 Minutes |

**Preparation**

- Make sure that you recognize each fossil type and review the picture cards that students will use in the investigation to try to match fossil organisms and present-day organisms.

- Review the table at the end of the lesson that summarizes evolutionary outcomes for each fossil type.

**The Lesson**

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**1. Introduction** (2 Min)

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*Previously we learned that natural selection can explain both how the traits in populations of organisms change over time and also how entirely new species come to be. In both adaptation and speciation, individuals with beneficial trait variants survived and reproduced over time, causing their trait variants to become more frequent over time.*
*Today, we will continue to look at the kinds of evidence from fossils that scientists use to construct natural selection histories just like the one that described how miroungas evolved from piloses.*

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**2. Review Fossilization** (5 Min)

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Briefly review the activity from the previous lesson in which students looked at photographs of a number of present-day organisms and shared their ideas about what parts of organisms might become fossilized.

Project the images of organisms and reference the handout and remind them that you asked:

> *What parts of these plants or animals do you think might remain if they died, fell into water, and remained covered by water, sand or mud for thousands of years?*

You may choose to ask students to reiterate a few of their responses. Listen for ideas about the soft parts of the plant or animal disintegrating and the hard parts remaining.

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**3. Investigate Fossils** (20 Min)

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Next, distribute to each group the real fossil samples, Archaeopteryx picture, and pictures of present-day animals. Explain to students that they will investigate answers to this question:

*What can fossils tell us about the history of present-day organisms like chickens?*

Tell students
*Today we will think like special kinds of scientists called "paleontologists" as we look at fossils.*

Explain that these are real fossils that collectors have found. *The fossils are thousands and thousands of years old, or older*. Each fossil was one member of a population that existed

thousands and thousands of years ago but it is a mystery why not all the individuals in the population became fossilized together. Tell students that they'll have about 15-20 minutes to observe the fossils, compare them to the pictures of present-day organisms, and think about how they would answer the questions shown on the chart on page 17 of their Notebooks. They can write or draw, and do not need to use complete sentences.

[Left to Right: Turritella, Ammonite, Trilobite, Archaeopteryx]

*Note: 1. The picture set of living organisms includes populations of: turritella sea snails, common garden snails, clams, nautilus, squid, chickens, rabbits.*
*2. Students may still remember their previous experiences in science where they were told to use all their senses for exploration. Therefore, allow students to wet the fossils (with tap water) and feel their texture i.e. encourage them to observe closely.*

Give students 15-20 minutes to examine and discuss the fossils in their small groups. Circulate to answer questions, and see that students are on track.

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**4**. **Make Meaning** (10 Min)

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Purpose of the discussion: to pull together students' experience with real fossils, real organisms in their environments, and information from last lesson's fossil video to understand how fossil evidence enables us to infer what organisms existed on Earth long, long ago, and what the environment was like in these ancient times.

*Note: 1. The turritella-turritella case is one of adaptation. 2. The trilobite case is one of extinction. 3. The archaeopteryx-chicken and ammonite-nautilus cases are examples of speciation. A summary of this information is included in a table at the end of this lesson. NB: It is difficult to tell in the ammonite-nautilus case how the fossil and the picture differ. If a student asks how scientists know they are different, tell them that they have evolved different structures inside.*

Project a picture of the **turritella fossil** and ask:

- *In the pictures of living organisms, could you find one that was similar to this fossil? What's similar? What's different?* *[Turritella – Turritella]*

- *What environment do you think these fossil organisms might once have lived in?*

- *So this fossil organism is the same but a little different to the organisms that are around today. Tell the many years ago and nowadays story to explain how this might be so.*

Project the picture of the **trilobite population** and explain that we know that trilobite populations lived long ago but there are none today, so we say they are extinct. Ask

> *What ideas do you have about what might have happened?*
> *[The environment changed so much that none of the individuals in the population were able to survive.]*

Repeat the questions listed above (e.g. for the turritella fossil) for the **ammonite**.

> *This fossil seems to have similarities but also differences from a nautilus. It might be related but it might not. Do you remember what happened in the miroungas story? How can it be that two animals that look different might actually be related?*
>
> *[Ammonite – nautilus]*

Repeat the questions listed above (e.g. for the turritella fossil) for the Archaeopteryx.

> *This fossil also seems to have similarities but also differences from a chicken. It might be related but it might not. Do you remember what happened in the miroungas story? How can it be that two animals that look different might actually be related?*
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> *[Archaeopteryx-chicken]*

To summarize and help students make meaning, return to the investigation question

*What can fossils tell us about the history of present-day organisms like chickens?*

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| *Note: This lesson asks students to make sense and pull together a lot of new information, so just listen for students' ideas. This is a chance for you to find out what your students have learned in this lesson.* |

Listen for ideas about what can be inferred from present-day organisms:

- Present-day organisms that are similar to fossils can provide evidence of what ancient ancestor species many thousands of years or more ago might have looked like
- Present-day organisms that are similar to ancient species can provide evidence of what environments the fossils might have lived in

Listen for ideas about <u>natural selection and evolution</u>:

- Some ancient organisms (*Turritella*) have descendant populations today that look very like them (*Turritella*). What we understand about natural selection suggests that their environment could not have changed much or we would see bigger differences between fossils and present-day organisms.
- Some ancient organisms (ammonite, Archaeopteryx) have descendant populations that scientists describe as different species today (*nautilus, chicken*). What we understand about natural selection (e.g., from miroungas) suggests that their environment must have changed enough over long periods of time that new species formed or that some members of the population got separated from the rest a long time ago.
- Some ancient organisms *(trilobite*) became extinct. What we understand about natural selection suggests that environmental change must have been too quick or too huge: there were no individuals in the "long ago" trilobite population that had trait variants that meant they could survive and reproduce.

Finally, project the slide showing the ammonite-nautilus and Archaeopteryx-chicken pairs. Remind students that they have seen similarities and differences between the fossils and the descendants. Ask:

- *Do you remember what happened in the miroungas story?*
- *Remind me again, how can it be that those two animals* [point to ammonite-nautilus pair or to Archaeopteryx-chicken pair] *that look pretty different might actually be related?*

Listen for ideas about <u>speciation</u>:

- Some ancient organisms (ammonite, Archaeopteryx) from many, many thousands of years ago have populations or descendants that scientists describe as different species today (*nautilus, chicken*). What we understand about natural selection (e.g., stories like the miroungas) suggests that their environment must have changed enough over long periods of time that new species formed or that some members of the population got separated from the rest of the population a long time ago.

*Note: The lesson ends by returning to the two speciation cases so that students have the opportunity to make the connection to the case of the miroungas. This also sets the stage for the next and final lesson which focuses on speciation story of a real species and the kinds of evidence that support the evolutionary story.*

**5. Wrap Up** (2 Min)

*Our question today was: What can fossils tell us about ancient and current organisms? We found out that we can use fossil evidence to suggest what organisms existed on Earth long, long ago, and what the environment might have been like in these ancient times. But it is very rare to find a whole population of fossils that died together, so, we can only suggest what the long ago and nowadays natural selection stories of the fossil organisms might be.*

*In the next lesson, we will read and discuss the history of the juramayas which scientists have reconstructed from fossil evidence.*

**Teacher Reference**

Here is a summary of scientists' current interpretations of the fossils that students have investigated in this lesson. **This is for your reference only**.

| Ancient Species | Correspond-ing Current Species | Process | Environmental change | Description |
|---|---|---|---|---|
| Turritella | Turritella | Adaptation | Likely stable environmental conditions over evolutionary time | The Turritella has living descendents that may be a little bit different from ancient turritellas (due to adaptation), but they are still very similar after all these years, so they are still considered to be the same species. |
| Ammonite | Nautilus | Speciation | Conditions in the ancient marine environment must have fluctuated such that populations got separated. | The ammonite has living descendents, but those descendents are so different from the ammonites that they are considered a different species. |
| Archaeopteryx | Chicken | Speciation | Conditions in the ancient marine environment must have fluctuated such that populations got separated. | The Archaeopteryx has living descendents, but those descendents are so different from the Archaeopteryx that they are considered a different species. |
| Trilobite | N/A | Extinction | Likely due to very large changes and disruptions in the ancient environment. | The Trilobite has no living descendents. The Trilobite species did not survive the environmental changes and has become extinct. |