

## Life Science:

### Unit 5

# The Argument for Evolution: Introduction

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

**Essential Question:** What is the argument for evolution?

**Unit Storyline Synopsis:** Why don't humans have tails? Where do humans come from? How have populations changed over time? Can the human population change to have superpowers in the future? In this unit, scholars work toward answering all of these questions and more as they study the argument for evolution through fossil evidence, comparative anatomy, DNA sequences, and more!

**Why This Unit?** In 1831 Charles Darwin boarded the HMS *Beagle* as the voyage's naturalist, setting course to change scientists' understanding of life on Earth. When he published [\*On the Origin of Species\*](#) years later, the world's view of God as the creator of all life was flipped to a new story: one of men from apes and all life from one single cell. His findings were thrown away as rubbish, though, because people could not see themselves as the same as other "animals" and refused to abandon their beliefs. DNA evidence did not yet exist, but plenty of other evidence for the theory of evolution by natural selection did.

Darwin's revolutionary idea stated that populations naturally contain variation, and when outside factors come into play, those differences cause some organisms to survive and reproduce and others to die, leading to changes in the gene pool. Over billions of years, this process has allowed for single-celled organisms to evolve into the complex creatures on Earth today.

So, why was Darwin's idea discredited at the time, and why is the theory still so powerful? Your driving purpose in this unit is to create critical thinkers who do not accept the theory on blind faith alone. To become confident debaters, your scholars must be able to navigate the controversy stirred up in Darwin's time, the evidence he used to prove his theory, and the new evidence we have since uncovered.

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# What Is the Bottom Line?

**Big Idea 1:** The theory of evolution is founded on the heritable changes in a population's gene pool that are acted upon by natural selection over time—the process of evolution primarily results from four factors: *variation, overpopulation, competition, and selection.*

- Organisms of the same species are very similar, but they do have individual differences in their traits. These differences across a population provide variation. Sexual reproduction and genetic mutations create variation in an organism's heritable traits.
- Species reproduce more than the environment can support, which results in overpopulation. Overpopulation leads to struggle and competition for food, water, mates, and necessities of life.
- In the face of competition, organisms with more beneficial traits go on to survive longer and produce more offspring, changing the gene pool of a population over time. Fitness is the ability of an organism to survive (while competing for limited resources) and reproduce in its environment. This is known as natural selection.
- The environment plays a crucial role in natural selection. Changes to the environment, either gradual or sudden, force the hand of natural selection.
- Individual organisms have genetic variation, but only species as a whole are said to evolve because the beneficial variation must create a shift in the broader makeup of a population. In other words, individual organisms do not evolve, only populations do.
- In biological populations, evolution by natural selection usually occurs slowly over many generations.
- Despite the stunning diversity of life on Earth today, all living things have evolved from a single common ancestor. Scientists use phylogenetic trees to represent this tree of life stemming back billions of years.

**Big Idea 2:** The evidence for evolution comes from many different branches of science—the fossil record, comparative anatomy, developmental evidence, biogeography, and DNA comparisons are primarily used as the strongest evidence for the argument of evolution.

- The fossil record provides evidence of the emergence, evolution, and extinction of species over time.
- Scientists compare the embryological development of different species to help infer relationships not evident in their adult anatomy.
- Structural similarities and differences between organisms living today and extinct organisms enable the reconstruction of evolutionary history.
- Advances in science have led to the discovery of DNA evidence that further supports Darwin's theory.

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

- **Engaging in Argument from Evidence**
  - Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts.

- 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.

**Crosscutting Concepts** highlighted in this unit:

- **Cause and Effect**

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

- **Patterns**

- Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

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## Safety

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

- In Lesson 4, scholars use gummy worms. Be conscious of the allergies your scholars have whenever using food products in the classroom. If scholars have severe allergies to gummy worms needed for Lesson 4, you will need to find an alternative. Ensure that scholars wear proper personal protective equipment (PPE) indicated for this lesson (gloves, goggles, and aprons).

**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.

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## Unit Storyline

**Engage:** These two Engage lessons allow scholars to play with the evidence for the theory of evolution before they have all the ideas for natural selection“ purposefully. By creating a buzz around this heated and often debated topic, scholars should leave the Engage portion of the unit questioning: *Just what is the argument for evolution?*

- **Lesson 1: The Next Great Superhero** As a fun introduction to the Evolution unit, scholars invest in the Essential Question by developing theories on how the next great superheroes can be created. They use mutant characteristics to brainstorm the processes needed for humans to change over time to have superpowers.
- **Lesson 2: The Big Dig** On Day One, scholars simulate an archeological dig as they excavate fossils, draw conclusions about their identity, and revise those conclusions as further evidence becomes available. On Day Two, scholars uncover evidence for evolution that has been buried beneath the earth for millennia. Through the classification and dating of fossils, scholars study lines of evolutionary descent.

**Explore:** Where did the theory of evolution come from? And what evidence of it do we see in animal populations today? In these lessons, scholars experience firsthand how relative fitness and mutation can affect a species over time, but they may not yet be able to connect it back to the evidence they discussed in the Engage.

- **Lesson 3: Theories of Evolution** Scholars study and evaluate two contending theories of evolution (Lamarck's and Darwin's). This lesson provides an authentic demonstration of how scientific study can lead to conflicting ideas and illuminates the need for evidence-based conclusions.
- **Lesson 4: Birds of a Feather: Adaptations and the Environment** Scholars act as hungry predators catching prey to explore the effects of varied coloration on the prey's survival rates. This lesson activates scholars' prior knowledge of adaptations and introduces the concept of reproductive success.
- **Lesson 5: Genetic Mutations: The Driving Force of Variation** Scholars discover the connection between genetic variation and natural selection as they simulate how genetic mutations affect rabbits' ability to survive under varying environmental pressures.
- **Lesson 6: Speciation, Extinction, and the Tree of Life** How is it possible that all organisms share a common ancestor? Scholars model speciation and extinction by creating a LEGO® tree of life. With a deeper understanding of phylogenetic trees, they make connections between common ancestors and evolution.

**Explain:** By revisiting the fossil record and studying comparative anatomy, scholars will leave these lessons able to explain the interrelatedness of all living things and identify the causes of the appearance (and disappearance) of various evolutionary lines throughout the Earth's history. Most scholars (at least 80 percent) should understand the four factors required for natural selection before moving on to the Elaborate.

- **Lesson 7: Examining the Fossil Record for Evidence of Evolution** Scholars compare the skeleton of tetrapod limbs from their extinct ancestors. Using anatomical clues, they arrange the skeletons in chronological order to show the line of evolutionary descent and how tetrapods developed digits.
- **Lesson 8: Comparative Anatomy and Evolutionary Clues** Is there really evidence that humans are related to monkeys, wolves, or swordfish? Scholars investigate embryonic stages of development and compare and contrast humans and other animals.

**Elaborate:** This Elaborate brings scholar application of newly gained knowledge to the present day. Scholars will see how modern science has contributed further evidence in support of the theory of evolution as they study DNA sequencing.

- **Lesson 9: Modern Advances Contribute Further Support for Evolution** How well does Darwin's theory stack up against modern science? Scholars research and discuss the use of DNA sequence comparisons to see how they help resolve disputes about how closely modern species are related.

**Evaluate:** In this lesson, scholars will demonstrate their mastery of the unit goals through the composition of a compelling argument in response to a real-world issue. At the end, scholars must be able to independently answer the Essential Question: What is the argument for evolution? In Discourse, you will also revisit those superpowers from Lesson 1, and scholars should now be able to articulate why X-Men-style mutations are not feasible evolutionary advances for the human race anytime soon.

- **Lesson 10: The Argument for Evolution** Scholars construct detailed responses to the unit's Essential Question as they pen letters to the Turkish government in response to its refusal to allow evolution to be taught in schools.
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## 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](#)