

## UNIT OVERVIEW

### EVOLUTION

**Unit Issue:** How people can affect and be affected by evolution.

**Anchoring Phenomenon:** Populations change over time. Some changes take place over very long time periods, while others take place over observable time periods.

Listed below is a summary of the activities in this unit. Note that the total teaching time is listed as 29–34 periods of approximately 45–50 minutes (approximately 6–7 weeks). There are no suggested activities to skip in this unit as skipping an activity in this case would mean losing key NGSS elements of the unit, e.g. the opportunity to practice elements of the PE prior to the activity that assesses it.

Activity Description	Topics	Advance Preparation	Assessment	Teaching Periods
<p>1. <b>Investigation: The Full Course</b> Students model the effects of antibiotics on a population of disease-causing bacteria during an infection. Students toss number cubes to determine whether an infected individual remembers to take the prescribed daily dose of antibiotics, which in turn affects the size and antibiotic resistance of the bacterial population in the patient. Students keep track of and graph the population size of the remaining bacteria depending on their resistance to antibiotics. Students consider the effect of changing the chemical environment on the survival of bacteria with varying levels of antibiotic resistance.</p>	<p>Antibiotic resistance, changing environment</p> <p>LITERACY MATHEMATICS</p>	Prepare Student Sheet(s).	ODA QUICK CHECK Proc.	2
<p>2. <b>Modeling: Hiding in the Background</b> Using toothpicks of two colors, students simulate the effect of prey coloration on predation rates by birds. They calculate and graph the changing frequencies of worm colors over successive generations. Students consider how this model is similar to the antibiotic scenario in the previous activity.</p>	<p>Traits, variation, population</p> <p>MATHEMATICS</p>	Prepare Student Sheet.	ODA PROC. AID A1	2
<p>3. <b>Role Play: A Meeting of Minds</b> Students role-play an imaginary meeting between Charles Darwin, Jean-Baptiste Lamarck, a modern-day science reporter, and a middle school student. In the role play, Darwin and Lamarck present and compare their explanations for how a change in a species occurs. Students learn that Darwin’s explanation has been accepted as the Theory of Natural Selection and that this theory is essential to our understanding of evolution.</p>	<p>Natural selection, trait, variation, populations, evolution</p> <p>LITERACY</p>	Prepare Student Sheet	EXP A3	1–2

EVOLUTION (continued)

Activity Description	Topics	Advance Preparation	Assessment	Teaching Periods
<p><b>4. Modeling: Battling Beaks</b> Students simulate the effect of natural selection on an imaginary forkbird species. Genetic mutations, represented by tosses of a number cube, introduce variation into the population. Differential survival and reproduction of particular types of forkbirds changes the composition of the population over time. At the close of the activity, the class discusses the role of variation in the process of natural selection.</p>	<p>Natural selection, evolution, trait, variation, mutation, genes</p>	<p>Buy any dry O-shape cereal, prepare plastic forks (break off tines)</p>	<p>MOD QUICK CHECK A4 EXP A5 (Assessment of PE MS-LS4-4)</p>	<p>2</p>
<p><b>5. Modeling: Mutations: Good or Bad?</b> Students follow the inheritance of a hemoglobin mutation through two generations. They investigate the effects of environmental conditions (incidence of malaria, survival rates, and resource availability) on the increase or decrease of the trait.</p>	<p>Natural selection, trait, variation, mutation, genes evolution, genes, structure/ function</p>	<p>Prepare Student Sheets.</p>	<p>MOD A3 (Assessment of PE MS-LS3-1)</p>	<p>2</p>
<p><b>6. Computer Simulation: Mutations and Evolution</b> Students use a computer simulation to extend their investigation around the inheritance of the hemoglobin mutation. The simulation first extends their data from the previous activity through 30 generations. Then students are able to adjust the environmental conditions to see how access to resources and the prevalence of malaria influence the distribution of the hemoglobin gene over time.</p>	<p>Evolution, natural selection, population, trait, variation, cause and effect, computer simulation</p>	<p>Arrange access to computers with Internet access.</p>	<p>EXP A2 (Assessment of PE MS-LS4-6)</p>	<p>2</p>
<p><b>7. View and Reflect: Origins of Species</b> Students watch a video segment on the evolution of Galapagos finches. They learn about Darwin’s original discovery of the finches and how the birds contributed to his ideas about natural selection. They also learn about recent research done by Peter and Rosemary Grant over several decades, who documented the phenomenon of evolving beak size. They use a viewing guide to help them understand speciation and natural selection in the Galapagos finches.</p>	<p>Evolution, speciation, diversity LITERACY</p>	<p>View video, prepare Student Sheet.</p>	<p>EXP A1</p>	<p>1–2</p>

## EVOLUTION (continued)

Activity Description	Topics	Advance Preparation	Assessment	Teaching Periods
<p><b>8. Reading: History and Diversity of Life</b> Students read text and examine graphs and charts to obtain information about both a brief history of life on Earth and a glimpse at the diversity of life on Earth today, as well as in the past. Stop to Think questions guide them through the reading to develop an understanding of the dynamic nature of life on Earth.</p>	Evolution, speciation, diversity, extinction  LITERACY	Prepare Student Sheet.	COM QUICK CHECK A4	1–2
<p><b>9. Laboratory: Fossil Evidence</b> Students examine and describe four types of fossils from various localities and geologic time periods. Students then examine four simulated drill cores, representing a fictional series of rock layers found in different parts of the world. The fossils in the drill cores are the same four fossils they examined. Based on the fossils contained within the layers, students are asked to determine how the layers in each locality correlate to the layers from the other localities. They are then challenged to use this fossil evidence to construct a timeline showing the relative timespans of each species represented by the actual fossils.</p>	Fossils, paleontology, geologic time scale, evolution	Prepare Student Sheet.	AID A2	2
<p><b>10. Investigation: Fossilized Footprints</b> Students interpret fossilized footprint evidence that is presented to them in stages. Through this process, they develop their skills at distinguishing observations from inferences, and at modifying hypotheses in light of new evidence. They also learn about other kinds of evidence that can be gathered from fossils, such as behavior.</p>	Trace fossils, paleontology, evidence versus inference, evolution  LITERACY		ARG PROC. QUICK CHECK A3	1–2
<p><b>11. Investigation: Family Histories</b> Students draw and compare double bar graphs showing changes in the numbers of fossil families in the fish, reptile, and mammal classes over geologic time. From this evidence, they can conclude that both speciation and extinction have occurred in all classes of vertebrates for as long as each class has existed. Students discuss how this evidence provides further support for a branching model for evolution.</p>	Evolution, speciation, extinction, classes, evolutionary tree		AID A1 (Assessment of PE MS-LS4-1)	2

**EVOLUTION** (continued)

Activity Description	Topics	Advance Preparation	Assessment	Teaching Periods
<p>12. <b>Investigation: A Whale of a Tale</b> Students investigate how fossil history provides another line of evidence for evolution. They compare the skeleton of a living whale to fossils of its extinct ancestors and use anatomical differences to arrange the skeletons in order. Students apply the theory of natural selection to whale evolution, using anatomical adaptations to infer the habitats and lifestyles of extinct species.</p>	Evolution, speciation	Prepare Student Sheet.	EXP A4 (Assessment of PE MS-LS4-2)	2
<p>13. <b>Investigation: Embryology</b> Students first examine six species to identify bones with homologous structures and functions. Although the fully formed limbs appear different on the outside, students are able to identify similarities at the skeletal level. Students then examine embryological development of limbs and notice many similarities between different species. Finally, students then examine development of whole embryos of different species to infer evolutionary relationships.</p>	Evolution, embryos, embryology	Prepare Student Sheet, organize cards.	AID A3 (Assessment of PE MS-LS4-3)	2
<p>14. <b>Talking it Over: The Sixth Extinction?</b> Students examine a graph showing rates of extinction over time and identify episodes where rates of extinction were well above the background rate of extinction. They match information on cards about the five major extinction events identified by scientists to the graph. They also summarize the possible causes for these extinctions. Students then read about rates of extinction since 1500 and examine possible causes for those extinctions. Students consider whether there is currently a sixth mass extinction due to humans and, if so, whether people should do anything to prevent it.</p>	Extinction, extinction events, evidence and trade-offs	Copy Student Sheet.	ARG A2 E&T QUICK CHECK A4	2

## EVOLUTION (continued)

Activity Description	Topics	Advance Preparation	Assessment	Teaching Periods
<p>15. <b>Reading: Bacteria and Bugs: Evolution of Resistance</b> Students read about four types of organisms that cause problems for people, the use of chemicals to control those organisms, and how the organisms ultimately develop resistance to these chemicals. Students draw connections to the evolution of antibiotic resistance introduced at the start of the unit.</p>	<p>Evolution, natural selection, resistance  LITERACY</p>	<p>Prepare Student Sheet.</p>	<p>EXP A2</p>	<p>1</p>
<p>16. <b>Investigation: Manipulating Genes</b> Students search a collection of websites for information about one or more technologies that people have developed to affect traits of organisms. They summarize the key points from at least two sources and synthesize the information. They evaluate each source according to a set of criteria. Students share the results of their research with their peers. Finally, students consider the possible trade-offs of using these technologies.</p>	<p>Genetic engineering, genetically modified organism, selective breeding, artificial selection</p>	<p>Arrange Internet access; prepare Student Sheet.</p>	<p>COM A2 (Assessment of PE MS-LS4-5) E&amp;T A3</p>	<p>2–3</p>
<p>17. <b>Project: Evolution and Us</b> Students develop a presentation or visual display to help scientists convince the public that learning about and understanding evolution is directly relevant to people’s lives. They share this presentation or visual display within the classroom (and may also share it outside of the classroom).</p>	<p>Evolution, natural selection</p>	<p>Gather supplies for presentations/visual displays.</p>	<p>COM PROC.</p>	<p>2</p>