

## Exploring the Diversity of Life

**Context:** Scientists study biodiversity to understand the health of ecosystems and life on Earth. Natural selection helps us understand how living organisms are related. In this unit, students will investigate the question: **What can fossils and DNA evidence tell us about biodiversity and evolution of species?** *Exploring the Diversity of Life* is presented as a mystery, in which students use fossil and DNA evidence to construct an argument for where to place whale species in the phylogenetic tree.

**Project:** Students work in groups to produce a scientific poster that explains their hypothesis regarding how many species of orca exist in the world. The poster will include written components in addition to a student-created phylogenetic tree to illustrate the evolutionary history of this group of whales, based on multiple lines of evidence.

**Approach:** *Exploring the Diversity of Life* is presented as a challenge, in which students address an authentic question in evolutionary biology. Students use evidence from fossils and DNA sequence data to construct their own hypothesis of how orca whale species are related to each other and where they fit onto the tree of life. Students develop an understanding of the mechanisms of evolution and the principles of natural selection through two different types of simulations, a variety of examples from nature, and class discussions. Students then use both fossils and DNA sequence data to understand connections between species, as well as how to interpret and represent a species' evolutionary history through a phylogenetic tree. Students consider how environmental conditions have led to the diversity of life in particular places and why biological diversity is important. After investigating evidence from either the past or the present, teams will unite to share their understanding and create scientific posters to share what they have learned.

**Literacy Design Collaborative (LDC) Template Task:** Students will engage in extended reading of primary literature and scientific writing as they complete background research on orca species to create their posters.

**LDC Task:** After conducting background research by reading and researching applicable texts about the physical, behavioral, and genetic attributes of whales, as well as related species (both ancestral and current), write a synthesis of your research. What conclusions or implications can you draw? Cite at least five sources, discussing key evidence from each source to support your synthesis and conclusions/implications. Identify any unanswered questions that you still have after conducting this background research about the biodiversity of whales. Make sure to include a reference list. **(Informational or Explanatory/Synthesis)**

**Expert Involvement:** Experts interact with students throughout the unit to answer questions through an online discussion board. Students post questions for the experts about evolutionary biology or careers in the field to initiate expert-student interactions. As the unit progresses, students continue to post questions as they arise, as well as respond to other students' questions and ideas, particularly as they are working on their projects to determine how orca whales are related to other species.

**Digital Tools:** natural selection online simulations.

Primary Standards: Next Generation Science Standards- Performance Expectations
<ul style="list-style-type: none"> <li>● HS-LS2-8. Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.</li> </ul>
<ul style="list-style-type: none"> <li>● HS-LS3-3. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.</li> </ul>
<ul style="list-style-type: none"> <li>● HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.</li> </ul>
<ul style="list-style-type: none"> <li>● HS-LS4-2. Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.</li> </ul>

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| <ul style="list-style-type: none"><li>• HS-LS4-3. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.</li></ul>   |
| <ul style="list-style-type: none"><li>• HS-LS4-4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations.</li></ul>   |
| <ul style="list-style-type: none"><li>• HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.</li></ul> |