**Objectives**

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|  | Students will understand the following:   |  |  | | --- | --- | | **1.** | The term *endemic,* as applied to animal and plant life, means "native," or "restricted to certain geographical areas" | | **2.** | The presence of *introduced* species, or animal and plant species not endemic to a certain area, can endanger endemic species in that area. | | **3.** | Many unusual animal species are endemic to the Galapagos Islands. | | **4.** | The presence of introduced animal and plant species in the Galapagos is endangering the endemic animal and plant populations. | |

**Materials**

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|  | For this lesson, you will need:   |  |  | | --- | --- | | • | Research materials on the Galapagos Islands | | • | Research materials (e.g., a field guide or materials available from your state department of agriculture) on plant and animal species in your area | | • | Computer with Internet access | | • | Pictures of the Galapagos Islands and of some of the animals endemic to the islands (e.g., giant tortoises, iguanas, blue-footed boobies) | | • | World map clearly showing Galapagos Islands | | • | Materials needed to create a garden of endemic plants on the school grounds or elsewhere | |

**Procedures**

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|  | |  |  | | --- | --- | | **1.** | Locate the Galapagos Islands on a world map so that students can clearly see where they are located (in the Pacific Ocean about 600 miles, or 970 kilometers, west of Ecuador). | | **2.** | Show students pictures of the Galapagos and of some of the unusual animals that live there (e.g., giant tortoises, iguanas, blue-footed boobies). | | **3.** | Review with your students what they know about the Galapagos Islands and their significance. Be sure they know that Charles Darwin visited the islands in 1835 and studied the animal life there. He was particularly interested to observe how animal species had adapted, over a long period of time, to conditions in an isolated part of the world. | | **4.** | On the chalkboard, write the terms *endemic* and *introduced.* Explain that endemic species of animals or plants are those that are native to certain geographical areas and restricted to those areas. Tell students that the animals in the pictures they have just seen are endemic to the Galapagos Islands. Then explain that introduced species are those brought into an area where they would not naturally exist. | | **5.** | Discuss with the class the possible effects of introduced species on endemic species, making the point that introduced species can actually endanger species endemic to a particular location. For example, certain introduced plants, also called "invasives," can take over an area and crowd or choke out native plants. Another example to consider is an introduced animal species that preys on endemic animal species or occupies the habitat of endemic species. | | **6.** | Go on to explain that, in the Galapagos Islands, introduced species are presently endangering endemic species. | | **7.** | Using research materials such as field guides, help students identify species of plants and animals endemic to your area. Help students find out what conditions might have allowed some plants to become endemic. (Your state department of agriculture can be a help.) | | **8.** | Have students list as many endemic plants as they can. | | **9.** | With the class, use the research students have done to plan a garden of plants endemic to your area. Plans should include how to keep introduced, or invasive, species out of the garden. | | **10.** | As a class project, create an endemic garden on the school grounds or on a nearby available plot of ground. | |

[Back to Top](http://www.discoveryeducation.com/teachers/free-lesson-plans/galapagos-beyond-darwin.cfm#top)

**Adaptations**

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|  | Have students do research on endemic and introduced species in the Galapagos, explaining how one endemic species has been endangered by one or more introduced species. |

[Back to Top](http://www.discoveryeducation.com/teachers/free-lesson-plans/galapagos-beyond-darwin.cfm#top)

**Discussion Questions**

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|  | |  |  | | --- | --- | | **1.** | How did Darwin's work aboard the Beagle differ from the way scientists today work aboard the Steward Johnson? | | **2.** | Why are island populations so important in the study of animal adaptation? | | **3.** | What significant evidence do sea mounts provide about the history of the animals located today on the Galapagos Islands? | | **4.** | What adaptations must deep water organisms make as they are brought up for study from the deep sea environment? | | **5.** | What is meant by evolution through natural selection? | | **6.** | Many people believe, incorrectly, that the phrase "survival of the fittest" means only the strong survive. What does "survival of the fittest" really mean? | |

[Back to Top](http://www.discoveryeducation.com/teachers/free-lesson-plans/galapagos-beyond-darwin.cfm#top)

**Evaluation**

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|  | You can evaluate the class on how well students work together in planning the garden. You can evaluate individual students on the results of their research. |

[Back to Top](http://www.discoveryeducation.com/teachers/free-lesson-plans/galapagos-beyond-darwin.cfm#top)

**Extensions**

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|  | **A Comprehensive Field Guide** Create four-member teams of students, with each team responsible for writing a field guide on a specific Galapagos island. Assign each team member to represent a specialist on one group of organisms such as plants, birds, reptiles, or marine mammals. Instruct students to be sure each guide includes descriptions of specific adaptations by local populations to their physical habitat. Include the geographic location of each island described.  **Letter to Darwin** Since Darwin's time, massive additional evidence has accumulated supporting the concept of evolution. Have students write a letter to Charles Darwin explaining how his theory of evolution by natural selection has been confirmed by modern technology such as biochemical analysis, fossil records, electron microscopy, and so on. |

[Back to Top](http://www.discoveryeducation.com/teachers/free-lesson-plans/galapagos-beyond-darwin.cfm#top)

**Suggested Readings**

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|  | **"Diving Dragons"** Martin Wileski, Wildlife Conservation, May/June 1993   **"Paying the Price of Ecoturism"** Martha Honey, Americas, November 1994 |

[Back to Top](http://www.discoveryeducation.com/teachers/free-lesson-plans/galapagos-beyond-darwin.cfm#top)

**Links**

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|  | [**Images from the Galapagos Islands**](http://www.shunya.net/Pictures/Ecuador/Galapagos.htm) This site includes photos and descriptions of a few of the animals living on the Galapagos Islands.  [**Charles Darwin Research Station**](http://www.galapagosonline.com/Galapagos_Natural_History/Darwin_Foundation/Darwin_Station.html) This is the home page of the Charles Darwin Research Station. It describes the work done at the station and gives news from the Galapagos. |

[Back to Top](http://www.discoveryeducation.com/teachers/free-lesson-plans/galapagos-beyond-darwin.cfm#top)

**Vocabulary**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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|  | Click on any of the vocabulary words below to hear them pronounced and used in a sentence.   |  |  | | --- | --- | | [speaker](http://school.discoveryeducation.com/lessonplans/vocab/galapagos-beyonddarwin/adaptation.aiff) | [**adaptation**](http://school.discoveryeducation.com/lessonplans/vocab/galapagos-beyonddarwin/adaptation.aiff) |   **Definition:**In biology, the process by which a living organism adjusts to its environment. **Context:**Evolutionary adaptation does tend to make species better at surviving.   |  |  | | --- | --- | | [speaker](http://school.discoveryeducation.com/lessonplans/vocab/galapagos-beyonddarwin/archipelago-galapagos.aiff) | [**archipelago**](http://school.discoveryeducation.com/lessonplans/vocab/galapagos-beyonddarwin/archipelago-galapagos.aiff) |   **Definition:**A group of scattered islands. **Context:**This is the newest edition to the Galapagos Islands, as the archipelago itself continues to grow.   |  |  | | --- | --- | | [speaker](http://school.discoveryeducation.com/lessonplans/vocab/galapagos-beyonddarwin/evolution-galapagos.aiff) | [**evolution**](http://school.discoveryeducation.com/lessonplans/vocab/galapagos-beyonddarwin/evolution-galapagos.aiff) |   **Definition:**The biological theory that existing living organisms have developed from previously existing organisms through a process of gradual change and modification. **Context:**As a paleontologist, he has done extensive work on the evolution of land life on the Galapagos.   |  |  | | --- | --- | | [speaker](http://school.discoveryeducation.com/lessonplans/vocab/galapagos-beyonddarwin/fossil-galapagos.aiff) | [**fossil**](http://school.discoveryeducation.com/lessonplans/vocab/galapagos-beyonddarwin/fossil-galapagos.aiff) |   **Definition:**The term used to describe the remains of a plant or animal, usually imbedded in the earth's crust, of a past geologic age. **Context:**I can't wait to have a new person come out and dig up fossils and...   |  |  | | --- | --- | | [speaker](http://school.discoveryeducation.com/lessonplans/vocab/galapagos-beyonddarwin/hotspots-galapagos.aiff) | [**hot spots**](http://school.discoveryeducation.com/lessonplans/vocab/galapagos-beyonddarwin/hotspots-galapagos.aiff) |   **Definition:**Volcanic areas where hot magma from the lower mantle of the earth wells upward to break through the crust of the upper mantle. **Context:**This heat is escaping from volcanic hot spots beneath the ocean.   |  |  | | --- | --- | | [speaker](http://school.discoveryeducation.com/lessonplans/vocab/galapagos-beyonddarwin/lavatubes.aiff) | [**lava tubes**](http://school.discoveryeducation.com/lessonplans/vocab/galapagos-beyonddarwin/lavatubes.aiff) |   **Definition:**Volcanic pipes or chimneys made from cooled lava. **Context:**Lava tubes are sheltered from the weather and chemically favorable to long term preservation of fossils.   |  |  | | --- | --- | | [speaker](http://school.discoveryeducation.com/lessonplans/vocab/galapagos-beyonddarwin/naturalselection-galapagos.aiff) | [**natural selection**](http://school.discoveryeducation.com/lessonplans/vocab/galapagos-beyonddarwin/naturalselection-galapagos.aiff) |   **Definition:**The biological process in which organisms adapt to a changing environment by a gradual alteration of hereditary characteristics, leading those organisms that successfully change to increase their chances of survival in succeeding generations. **Context:**Through natural selection, marine iguanas separated from the land iguanas and became a new species.   |  |  | | --- | --- | | [speaker](http://school.discoveryeducation.com/lessonplans/vocab/galapagos-beyonddarwin/niche-galapagos.aiff) | [**niche**](http://school.discoveryeducation.com/lessonplans/vocab/galapagos-beyonddarwin/niche-galapagos.aiff) |   **Definition:**A place, position or activity for which a person or organism is best suited. **Context:**A specialty provides a competitive advantage or allows them to move into a niche where less competition exists.   |  |  | | --- | --- | | [speaker](http://school.discoveryeducation.com/lessonplans/vocab/galapagos-beyonddarwin/seamounts.aiff) | [**sea mounts**](http://school.discoveryeducation.com/lessonplans/vocab/galapagos-beyonddarwin/seamounts.aiff) |   **Definition:**Underwater mounds rising from the ocean floor. **Context:**Geologists found underwater mountains called sea mounts.   |  |  | | --- | --- | | [speaker](http://school.discoveryeducation.com/lessonplans/vocab/galapagos-beyonddarwin/species-galapagos.aiff) | [**species**](http://school.discoveryeducation.com/lessonplans/vocab/galapagos-beyonddarwin/species-galapagos.aiff) |   **Definition:**A biological classification category comprising related organisms potentially capable of interbreeding. **Context:**They are discovering, on average, a new species a day.   |  |  | | --- | --- | | [speaker](http://school.discoveryeducation.com/lessonplans/vocab/galapagos-beyonddarwin/submersible.aiff) | [**submersible**](http://school.discoveryeducation.com/lessonplans/vocab/galapagos-beyonddarwin/submersible.aiff) |   **Definition:**A small, underwater craft often used for deep-sea research. **Context:**Scientists made fifty-five deep dives in submersibles. |

[Back to Top](http://www.discoveryeducation.com/teachers/free-lesson-plans/galapagos-beyond-darwin.cfm#top)

**Standards**

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|  | This lesson plan may be used to address the academic standards listed below. These standards are drawn from Content Knowledge: A Compendium of Standards and Benchmarks for K-12 Education: 2nd Edition and have been provided courtesy of the[Mid-continent Research for Education and Learning](http://www.mcrel.org/)in Aurora, Colorado.   **Grade level:**9-12 **Subject area:**Earth science **Standard:** Understands basic Earth processes. **Benchmarks:** Knows that molten rock from below the Earth's surface creates pressure that is released by volcanic eruptions; under the ocean basins, molten rock may well up between separating plates to create new ocean floor; and volcanic activity along the ocean floor may form undersea mountains, which may eventually become islands.  **Grade level:**9-12 **Subject area:**life science **Standard:** Knows about the diversity and unity that characterize life. **Benchmarks:** Knows that the variation of organisms within a species increases the likelihood that at least some members of the species will survive under changed environmental conditions, and a great diversity of species increases the chance that at least some living things will survive in the face of large changes in the environment.  **Grade level:**9-12 **Subject area:**life science **Standard:** Understands how species depend on one another and on the environment for survival. **Benchmarks:** Knows that organisms both cooperate and compete in ecosystems; the interrelationships and interdependencies of these organisms may generate ecosystems that are stable for hundreds or thousands of years.  **Grade level:**9-12 **Subject area:**life science **Standard:** Understands the basic concepts of the evolution of species. **Benchmarks:** Knows that the basic idea of evolution is that the Earth's present-day life forms have evolved from earlier, distinctly different species as a consequence of the interactions of (1) the potential for a species to increase its numbers, (2) the genetic variability of offspring due to mutation and recombination of genes, (3) a finite supply of the resources required for life, and (4) the ensuing selection by the environment of those offspring better able to survive and leave offspring.  **Grade level:**9-12 **Subject area:**life science **Standard:** Understands the basic concepts of the evolution of species. **Benchmarks:** Knows that natural selection and its evolutionary consequences provide a scientific explanation for the fossil record of ancient life forms, as well as for striking molecular similarities observed among the diverse species of living organisms; the millions of different species that live on the Earth today are related by descent from common ancestors.  **Grade level:**9-12 **Subject area:**technology **Standard:** Understands the nature of scientific knowledge. **Benchmarks:** Knows that because all scientific ideas depend on experimental and observational confirmation, all scientific knowledge is, in principle, subject to change as new evidence becomes available; in areas where data, information or understanding is incomplete, it is normal for scientific ideas to be incomplete, but this is also where the opportunity for making advances may be greatest.  **Grade level:**9-12 **Subject area:**technology **Standard:** Understands the nature of scientific knowledge. **Benchmarks:** Knows that from time to time, majors shifts occur in the scientific view of how the world works, but usually the changes that take place in the body of scientific knowledge are small modifications of prior knowledge; change and continuity are persistent features of science.  **Grade level:**9-12 **Subject area:**technology **Standard:** Understands the nature of scientific inquiry. **Benchmarks:** Knows that results of scientific inquiry - new knowledge and methods - emerge from different types of investigations and public communication among scientists; the nature of communicating and defending the results of scientific inquiry is guided by criteria of being logical and empirical and by connections between natural phenomena, investigations, and the historical body of scientific knowledge.  **Grade level:**9-12 **Subject area:**technology **Standard:** Understands the scientific enterprise. **Benchmarks:** Knows that scientists in different disciplines ask different questions, use different methods of investigation, and accept different types of evidence to support their explanations; many scientific investigations require the contributions of individuals from different disciplines (including engineering) and new disciplines of science often emerge at the interface of two older systems (e.g. geophysics, biochemistry).  **Grade level:**9-12 **Subject area:**technology **Standard:** Understands the interactions of science, technology and society. **Benchmarks:** Knows that science often advances with the introduction of new technologies and solving technological problems often results in new scientific knowledge; new technologies often extend the current levels of scientific understanding and introduce new arenas of research. |

[Back to Top](http://www.discoveryeducation.com/teachers/free-lesson-plans/galapagos-beyond-darwin.cfm#top)

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