EDUCATOR'S GUIDE & ACTIVITIES

NATURE'S WONDERLAND

GALAPAGOS

NARRATED BY **JEFF CORWIN**

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A WORD FROM THE FILMMAKERS

The Galapagos Islands are one of the wonders of the world - a living science laboratory. We wanted to bring you the Galapagos as never before seen, using cutting-edge filming technologies. This film gives you the chance to not just see the amazing creatures and landscape of the Galapagos up very close, but to feel like you are right there amongst them. The Galapagos Islands are populated with charismatic and highly unusual animals — some unique to the islands — like tropical penguins, Galapagos Sharks, sea lions, diving black Marine Iguanas, and the newly-discovered Pink Iguanas. By studying how these animals and other life-forms adapted to this unique environment, we can better understand and protect not just the Galapagos Archipelago, but our entire fragile planet. We hope you enjoy the film and are inspired to learn more about the incredible Galapagos Islands.

David Attenborough, Writer
Anthony Geffen, Producer

A WORD FROM THE NARRATOR

I was thrilled to provide the narration for this amazing project. To see this film on the giant screen reminds us why the Galapagos Islands are so important. We think of the Galapagos as a resilient living community because it has withstood the test of time for millions of years. But it is still a delicate environment and in the 21st Century it faces many significant pressures from the effects of a changing climate, habitat loss, pollution, and the unsustainable harvesting of natural resources from the earth. This film not only gives us a better understanding of this living community, but it may also inspire increased environmental stewardship, so we can all make a difference in protecting this magical place.

Jeff Corwin, Narrator

nWave Pictures Distribution is proud to present this Educator's Guide & Activities for use in conjunction with the release of ***Galapagos: Nature's Wonderland***, written by world-renowned naturalist David Attenborough and narrated by conservationist Jeff Corwin.

This guide will help you prepare students to view the film and provides classroom activities that build on this viewing experience to help you make ***Galapagos: Nature's Wonderland*** a rich learning opportunity. The guide has been designed to supplement your science curriculum and aligns with both U.S. National Education Science Standards and Next Generation Science Standards for grades K-8, with complete units for grades K-2, 3-5, and 6-8 which you can modify and adapt to meet the specific needs of your classroom.

Please feel free to share this learning resource with other teachers at your school. Although the material is copyrighted, you have permission to duplicate the guide and activities for educational purposes.

We look forward to learning your opinion of ***Galapagos: Nature's Wonderland*** and this Educator's Guide & Activities. Please feel free to contact us at info@nWave.com or through Facebook.com/nWavePicturesDistribution with your comments or any questions you may have. We hope that this educational resource will enhance your enjoyment of ***Galapagos: Nature's Wonderland*** and your students' understanding of the world around them.

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INTRODUCTION

This educator's guide is designed to enrich your students' viewing of ***Galapagos: Nature's Wonderland*** at a large-screen theater in your community. Following are general suggestions for using the guide, including a synopsis of the film and ideas for pre/post-viewing discussion. Suggestions for using the accompanying classroom activities can be found in the Teaching Notes for each grade level.

TARGET AUDIENCE

This educational resource is designed for use with elementary and middle school students as a supplement to the science curriculum. In order to accommodate this wide grade-span, the guide's classroom activities are divided into separate units for grades K-2, 3-5, and 6-8.

EDUCATIONAL OBJECTIVES

- To examine the geologic processes that formed the Galapagos Islands and still shape life on the islands today.
- To investigate how ocean currents sustain life on the Galapagos Islands and link them to the broader ecosystem of the Pacific Ocean.
- To explore the different habitats on several of the Galapagos Islands and how animals and plants have adapted to these habitats to make the Galapagos a model of biodiversity.
- To observe how the famous Galapagos Tortoise has adapted to two very different habitats, and consider the role humans can play in protecting habitats from harm.

FILM SYNOPSIS

Galapagos: Nature's Wonderland

In the vastness of the Pacific Ocean, there is a paradise unlike any other: the Galapagos. Amongst these remote volcanic islands, life has played out over millions of years in relative isolation. The result is a wonderland of nature, with a remarkable collection of plants and animals that have all adapted to this unique environment. Meet giant half-ton tortoises and marine iguanas that spit sea-salt. Dance with the tropical albatrosses and dive for fish with the colorful blue-footed boobies. Swim with tiny penguins thousands of miles away from their expected habitats. This is a story of discovery, of survival against the odds, and of nature's ingenuity, all brought to life in stunning 3D.

PRE-VIEWING

- Show students the Galapagos Islands on a globe or map. Help students calculate how far the islands are from your community. Discuss the climate and habitats students expect to find in the Galapagos, based on its location.
- Create a KWL graphic organizer on the chalkboard/whiteboard, with columns labeled "What I KNOW Already," "What I WANT to Find Out," and "What I LEARNED." Fill in the first column by asking students what they already know about the Galapagos Islands. Ask students who have watched other documentaries or have seen wildlife from the Islands at a zoo or aquarium to describe what they remember. Then fill in the second column of the organizer by asking students what they want to find out about these unique islands. Lead the discussion with suggestions such as, "Types of plants and animals that live there," "What they look like," and "What makes them unusual." Conclude by having students copy the organizer so they can fill in the final column after they have seen the film.
- Ask students to think about how the Galapagos Islands might be connected to the rest of the world. Are there other islands or continents that might be similar? How do they think animals travel to and from the Galapagos and get food and other resources?

POST-VIEWING

- **All Grades:** Return to the KWL graphic organizer by filling in the "What I LEARNED" column on the chalkboard/whiteboard. Have students contribute facts and insights from their own notes. What fact about the Galapagos Islands most surprised them? Which animal or geological fact was most interesting?
- **Grades K-2:** Ask students to draw their favorite animal from the film and share its unique features with the class. What do they think would happen if they tried to keep this creature as a pet?
- **Grades 3-5:** Ask students to compare a habitat in your region with the habitats and animals they saw in the film. How do the two habitats differ? What basic relationships between plants and animals and their environment are the same in both habitats? What traits or adaptations help animals and plants survive in these two habitats? Could any plants or animals be transferred from one habitat to the other?
- **Grades 6-8:** Help students explore the ecological relationships between the animals and plants they saw in the film. Which ones live together in the same habitat? How do these animals and plants interact with one another and their environment? How do they interact with animals and plants in different habitats? Focus on the marine and land habitats in the Galapagos, then on specialized habitats within those two categories, to build up a picture of the interlocking ecosystems on these unique islands.

TEACHING NOTES

ACTIVITY 1: ISLANDS BORN OF FIRE

Read the activity sheet with students, which provides a basic introduction to plate tectonics and explains how the Galapagos Islands have been formed by a "hot spot" below the Earth's surface that remains stationary while the tectonic plate above it moves toward the east. If necessary, review how a volcano is formed when molten rock breaks through the Earth's surface and cools into solid rock, which can build up over time to become a mountain as more and more molten rock (lava) reaches the surface. Encourage students to come up with analogies for these geologic processes. Then have students use the map to complete the Galapagos Island timeline. If necessary, explain how to use the compass rose to determine direction.

Conclude by discussing what students think will happen to the Galapagos Islands over the next 4 million years. Point out on the map how the islands become smaller as they age, the result of erosion by weather and sea water, which wear down the volcanic peak and the island's circumference. Point to the submerged islands at the eastern edge of the map, which scientists believe may have been part of the Galapagos Islands at one time. Remind students of the oldest Galapagos Islands they saw in the film, which have become crags of rock surrounded by water, slipping beneath the waves.

Answers: Oldest - San Cristóbal; Middle-Aged - Santa Cruz; Youngest - Fernandina.

Follow Up: Help students identify other islands that were formed by volcanoes, such as Hawaii, Japan, and the Aleutian Islands. Do an image search in your library or online to compare these island chains with the Galapagos Islands. (Note: There is a map of the Hawaiian Islands on page 12 of this guide.) Have students chart similarities and differences, then draw conclusions about the role plate tectonics has played in forming these other island chains.

ACTIVITY 2: WINDS AND WATERS

Read the first part of the activity sheet with students, which describes the position of the Galapagos Islands and explains how steady winds create currents in the ocean. Help students locate the Galapagos Islands on the map and point out the three arrows indicating the main currents that flow toward the islands. Show students how to use the compass rose to gauge the direction of each arrow. Then read the descriptions of the three currents as students fill in the answer spaces on the map.

Conclude by using the questions on the activity sheet to discuss how these currents help sustain life on the Galapagos Islands. Students should recognize that the Humboldt and Cromwell Currents bring food which sustains the Galapagos sea life, both in the ocean and on the coastline. They should recognize that the Panama and Humboldt Currents bring fresh water which sustains land-dwelling plants and animals on the islands. And they should realize that a diversion of any of these currents could alter the Galapagos ecosystem significantly, potentially destroying the sea-based or the land-based ecology.

Answers: Map (top to bottom) - Panama Current, Cromwell Current, Humboldt Current.

Follow Up: Every five to seven years, the Galapagos Islands experience a life-threatening change in these three currents when the atmospheric condition called El Niño raises water temperatures around all the islands and brings heavy rains. Life on land flourishes during these periods, but sea life can be devastated as fish move away from the nutrient-depleted waters along the coastline, causing starvation among the islands' sea birds, seals, and sea lions. Research this phenomenon with your students to illustrate how critical currents are to life on the Galapagos Islands, and investigate how the increasing frequency of El Niño events over recent decades may be connected to climate change.

ACTIVITY 3: ISLAND HABITATS

In this activity, students identify animals they saw in ***Galapagos: Nature's Wonderland*** that are adapted to the habitat found on Fernandina Island. Read the activity sheet with students and help them identify the key environmental factors included in the description of the Fernandina Island habitat. Then have students complete the matching activity and share why they think the animals they chose are adapted to the Fernandina habitat.

Conclude by discussing the concept of biodiversity. Help students recognize that, within each habitat on the Galapagos Islands, adaptation has produced a variety of animals and plants that all thrive in that habitat, but each in its own unique way. And adaptation continues to produce new kinds of animals and plants — new species — to increase the biodiversity of each habitat and of all the habitats on these remote islands. Work with students to find examples of biodiversity in your region — for example, the variety of species that live in and around a pond or lake, or the many different kinds of insects, birds, and plants that live in a park or even a backyard.

Answers: The Marine Iguana, the Galapagos Penguin, and the Galapagos Cormorant all inhabit Fernandina Island. The Amblypygid is a subterranean creature found in the lava tubes on Santa Cruz Island. The Galapagos Tortoise inhabits the inland regions of islands that support vegetation.

Follow Up: Introduce students to the concept of *endemic species* — that is, species found only one place in the world. A very large proportion of the animals on the Galapagos Islands are endemic species: about 80% of the land birds, 97% of the reptiles, more than 30% of the land plants, and more than 20% of the marine animals. Discuss how adaptation is more likely to produce endemic species in a remote location like the Galapagos, and what humans can do to help protect these rare plants and animals.

ACTIVITY 4: ISLAND GIANTS

In this activity, students can imagine themselves on a field trip to the Galapagos Islands observing two subspecies of the famous Galapagos Tortoise. They first answer a series of questions designed to sharpen their powers of observation, then fill in a chart with other characteristics they notice that distinguish these two subspecies from one another. If appropriate, read the activity sheet with students and guide them through the observation process. Older students can complete this activity on their own.

Conclude by having students use their observations to explain how the domed tortoise has adapted to living in a habitat with lush, low-growing vegetation, while the saddleback tortoise has adapted to a habitat with sparse, high-growing vegetation. Students might observe that the domed tortoise's shell allows it to push through vegetation, and its short legs and neck are suited to munching on low-growing plants. The saddleback tortoise, by contrast, has developed a notch at the front of its shell that allows it to stretch its long neck almost straight up to reach high-growing plants, and it has longer legs to give it an extra boost. Remind students that the domed and saddleback tortoise are an example of adaptation in action. Over thousands of years, the Galapagos Tortoise has adapted to two very different habitats, and as time goes on, these two types of tortoise might become two distinct species. For now, however, they are classified as members of the same species, despite their different appearances — another example of how different habitats promote biodiversity.

Answers: 1-A, 2-B, 3-B, 4-A.

Follow Up: Introduce students to the iguanas of the Galapagos Islands, which provide an example of adaptation leading to the evolution of distinct species. There are three species of land iguana on the islands, including the pink iguana found only at the northern tip of Isabela Island, plus the marine iguana, which is found along the coastline on every island, though its color varies from island to island. Scientists believe that these four species all developed from a common ancestor beginning more than 10 million years ago — that is, before any of the current Galapagos Islands existed. By contrast, scientists believe that the ancestor of the Galapagos Tortoise arrived on the islands only 2-3 million years ago. Have students compare these two animals to learn how the time scale of evolution differs from that of adaptation, and to speculate on whether the Galapagos Tortoise could develop into different species, like the iguana, over the next 8 to 10 million years.

Grades K-2	Activity			
U.S. National Science Standards	**1**	**2**	**3**	**4**
Science as Inquiry				
• Abilities necessary to do scientific inquiry	X	X	X	X
• Understanding about scientific inquiry	X	X	X	X
Life Science				
• Characteristics of organisms			X	X
• Life cycles of organisms			X	X
• Organisms and environments		X	X	X
Earth and Space Science				
• Properties of earth materials	X	X		
Science in Personal and Social Perspectives				
• Changes in environments	X	X		
Next Generation Science Standards	**1**	**2**	**3**	**4**
Interdependent Relationships in Ecosystems			X	X
Weather and Climate		X		
Earth's Systems: Processes that Shape the Earth	X	X		

GRADES K-2

ISLANDS BORN OF FIRE ACTIVITY 1

As you saw in the film ***Galapagos: Nature's Wonderland***, the Galapagos Islands are the tops of volcanoes that erupted at the bottom of the Pacific Ocean. The oldest of these volcanoes erupted millions of years ago and has moved slowly toward the east ever since. Today, it is more than 120 miles from where it started!

How does this happen? Scientists explain that the Earth's surface is made up of gigantic slabs of rock, called *tectonic plates*, that fit together like the pieces of a puzzle. But unlike puzzle pieces, tectonic plates slowly shift position by pushing into and pulling away from each other over millions of years.

The Galapagos Island volcanoes sit on a tectonic plate that is slowly pushing east into South America. But the "hot spot" that created these volcanoes is not moving at all, because it lies below the Earth's surface. As the tectonic plate moves over it, the hot spot keeps breaking through the surface in a different place, creating a new volcano as an older volcano moves out of the way.

You can see this process at work on the map below. Use the map to create a timeline of these three Galapagos Islands: **Fernandina** on the west, **Santa Cruz** in the center, and **San Cristóbal** on the east. Write the islands' names into the spaces to show which is oldest, which is middle-aged, and which is youngest.

_____ _____ _____

Oldest **Middle-Aged** **Youngest**

It took more than 4 million years for the oldest of the Galapagos Islands to move to where they are today. What do you think will happen over the next 4 million years? Will there be more islands? Look closely at the map to see what happens to the islands as they get older. Discuss in class what you think the Galapagos Islands will look like in another 4 million years.

GRADES K-2

WINDS AND WATERS ACTIVITY 2

As you saw in the film ***Galapagos: Nature's Wonderland***, scientists think that winds and waters brought plants and animals to the Galapagos Islands millions of years ago. Today, winds and waters are still important, because they bring food and rainfall to the islands.

When a steady wind blows across the ocean, it pushes the water along with it, creating what is called a *current*. A current is like a river flowing through the ocean, and it can carry water long distances from one place to another.

The arrows on the map show three currents that come together at the Galapagos Islands. Read about these currents with your teacher, and write the name of each current on the correct answer space.

- **Humboldt Current:** This current flows north along the western coast of South America, bringing cold water up from the South Pole. When it comes to the Equator, the current turns west and flows toward the Galapagos Islands. The cold waters and cool winds of this current create a mild climate on the islands, which are not as hot as most places on the Equator. These cold waters also carry nutrients that feed the islands' sea life. And the winds that push this current bring moisture to the islands, spreading a cloudy mist over the slopes of the volcanoes from May through December.

- **Panama Current:** This current flows south along the western coast of Central America, following the curve of the coastline. When it comes to the Equator, this current also turns west and flows toward the Galapagos Islands. The Panama Current brings warm water to the islands, which does not contain many nutrients for sea life. But the winds that push this current contain lots of moisture, which brings rainfall to the islands from December through May. This rainy season provides the plants and animals that live on the Galapagos Islands with fresh water.

- **Cromwell Current:** This current is unusual because it is not caused by winds. Instead, it flows below the surface of the ocean, like an underground river. The Cromwell Current travels east along the Equator, carrying water from Asia across the whole width of the Pacific Ocean. Because this current flows deep, its waters are cold and filled with nutrients. When it reaches the Galapagos Islands, the current is forced upward along the coastline of the western islands, which chills those waters and fills them with nutrients for sea life.

Now use what you have learned about the currents of the Galapagos Islands to discuss how they help support life there.

1. Which currents bring food to the islands?
2. Which currents bring fresh water to the islands?
3. What could happen to the plants and animals of the Galapagos Islands if one of these three currents changed direction and missed the islands?

ISLAND HABITATS

ACTIVITY 3

As you saw in the film ***Galapagos: Nature's Wonderland***, there are many different habitats on the Galapagos Islands. Read about the habitat on Fernandina, the youngest island, with your teacher. Then use what you learn to decide which Galapagos animals you might see living there.

FERNANDINA

Lava still flows on Fernandina. Its volcano is active, and the whole island is mostly a bare rocky mountain sloping down to the sea. But the waters around Fernandina are full of fish and other sea life. That's because it sits at the western end of the Galapagos, where the cold waters of the Cromwell Current bring in nutrients from across the Pacific Ocean.

Which of these animals could live on Fernandina? Read the description of each animal with your teacher. Think about what the animal eats. Could it find that food on Fernandina? Could it make a home on Fernandina's rocky slopes and shores?

Write an F in the answer space if you think the animal belongs in the habitat on Fernandina. Write an X if you think it belongs in a different habitat. Be ready to explain your answers in class.

	**Marine Iguana** This diving lizard lives on algae and seaweed, and needs to sun itself to stay warm.	
	**Galapagos Penguin** The only penguin found near the Equator, it needs cold water to stay cool and lots of fish to eat.	
	**Amblypygid** Related to spiders, this subterranean creature feels for its prey with long front legs that have become its main sensory organs.	
	**Galapagos Cormorant** After living so long on a coastline where it can always dive for fish, this bird's wings have become too small for it to fly.	
	**Galapagos Tortoise** This giant land turtle eats shrubs or cactus, and can drink gallons of fresh water.	

Fernandina is only one of many habitats found in the Galapagos Islands, each one home to a variety of plants and animals adapted to living there. This wide variety of habitats has made the Galapagos a model of *biodiversity* — a perfect example of how adaptation produces many different kinds of plants and animals within a habitat, and more different kinds for each different habitat. Can you think of examples of biodiversity in the habitats of your region?

ISLAND GIANTS

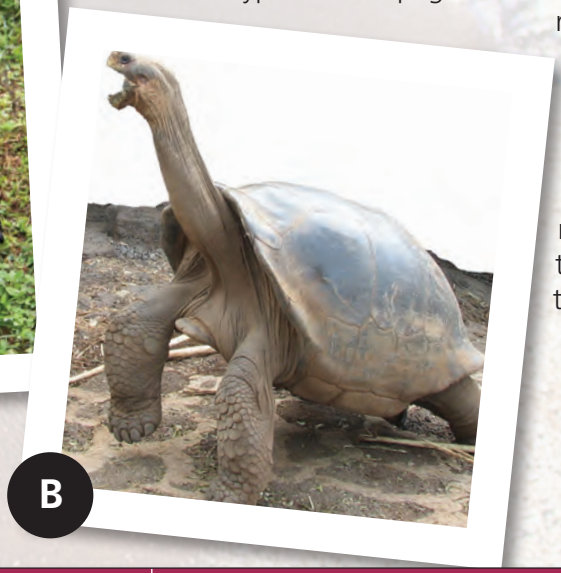
ACTIVITY 4

The Galapagos Islands were named for the giant tortoises that live there. A tortoise is a turtle that lives on land instead of in or near the water. The Galapagos Tortoise is the biggest tortoise on Earth. Its shell can be 5 feet long, and they can weigh 500 pounds!

As you saw in the film ***Galapagos: Nature's Wonderland***, there are two types of Galapagos Tortoise. One type has a shell that curves down in the front. The other type has a shell that curves up in the front, so the tortoise can stretch its neck almost straight up.

Here are pictures of the two types of Galapagos Tortoise. Study the pictures, then answer the questions by writing A or B on the blank line.

A



B

_____1. Scientists call one type of Galapagos Tortoise *domed* because its shell looks like the dome on a building. Which picture shows a domed tortoise?

_____2. Scientists call the other type of Galapagos Tortoise *saddleback* because its shell is shaped like a horse's saddle. Which picture shows a saddleback tortoise?

_____3. Both types of Galapagos Tortoise eat plants. Which type would you expect to find in a habitat where the plants grow high off the ground?

_____4. Which type would you expect to find in a habitat where the plants grow close to the ground?

Do you notice any other differences between the two types of Galapagos Tortoise? Use this chart to record your observations. First write *domed* or *saddleback* to identify the type of tortoise you are observing. Then describe anything you notice that makes one type look different from the other.

A	B
Type: _____	Type: _____
Observations: _____	Observations: _____
_____	_____
_____	_____

Now share your observations in a class discussion. Use what you have learned about the two types of Galapagos Tortoise to explain how one type has adapted to life in a moist habitat with lots of plants growing close to the ground, while the other type has adapted to life in a dry habitat with fewer, mostly tall plants.

TEACHING NOTES

ACTIVITY 1: ISLANDS BORN OF FIRE

Have students read the first part of the activity sheet, which provides a basic introduction to plate tectonics and explains how the Galapagos Islands have been formed by a "hot spot" below the Earth's surface that remains stationary while the tectonic plate above it moves toward the southeast. Then have students use the map to complete the Galapagos Island timeline. Review their answers in a class discussion, pointing out that while San Cristóbal is the oldest of the three islands on the timeline, Española, which is furthest southeast, is actually the oldest of the Galapagos Islands.

Conclude with the second part of the activity, which asks students to compare the Galapagos Islands with the Hawaiian Islands, which have also been formed by a hot spot erupting at the bottom of the Pacific Ocean. Students should recognize that the largest island, Hawaii, is the youngest in this island chain, while Kauai and Nihau, at the northwest end of the chain, are the oldest. Guide students toward an understanding that erosion is responsible for the size difference between young and older islands both in Hawaii and in the Galapagos. Over millions of years, weather and sea water wear down an island and reduce its circumference until it finally disappears back under the sea. Reinforce this point by calling attention to the submerged islands at the eastern edge of the Galapagos map, and remind students of the oldest Galapagos Islands they saw in the film, which have become crags of rock surrounded by water, slipping beneath the waves.

Students should also recognize that the Hawaiian Islands are not on the same tectonic plate as the Galapagos Islands, because they are moving northwest instead of southeast. In fact, these islands are located on the Pacific Plate, the largest tectonic plate in Earth's surface, which is being pushed toward the northwest by the North American plate.

Answers: Oldest - San Cristóbal; Middle-Aged - Santa Cruz; Youngest - Fernandina.

Follow Up: It has taken more than 4 million years for the oldest of the Galapagos Islands to move to where they are today. Ask students to speculate on what they think will happen to the Galapagos Islands over the next 4 million years. Will there be more islands, or will erosion keep the number of islands and the extent of this island chain fairly constant? How do students imagine Fernandina and Isabela Islands will look when they eventually move to the positions where San Cristóbal and Española are now?

ACTIVITY 2: WINDS AND WATERS

Have students read the first part of the activity sheet, which explains how steady winds create currents in the ocean. Then have them read the descriptions of the three currents that sustain life on the Galapagos Islands as they draw and label arrows to indicate the path of each current, using the compass rose to gauge the direction of each arrow. Review students' answers in a class discussion, using a large map of the whole Pacific region, if possible, to show students how far these currents travel.

Conclude by using the questions on the activity sheet to discuss how these currents help sustain life on the Galapagos Islands. Students should recognize that the Panama Current is most important to the land-dwelling plants and animals of the Galapagos, since it is their main source of fresh water. (The mists produced by the Humboldt Current do not soak into the soil to water plants and do not condense into drinking water for animals.) They should also recognize that the Humboldt and Cromwell Currents are most important to the islands' sea life, since they carry the nutrients upon which the entire marine food chain depends. Finally, students should recognize that the Humboldt Current is most important to the climate of the Galapagos, because its waters and winds cool the islands, where the temperature usually ranges from 70-80ºF. Ask students to imagine how higher temperatures would affect some of the islands' most temperature-sensitive animals, such as the Galapagos Penguin, and how it might affect the islands' fresh water supply (through increased evaporation). Guide students toward an understanding that all the effects of these three currents are essential to the ecology of the Galapagos Islands and to the life of its plants and animals.

Answers: See page 7 for a map with arrows showing the positions of the three currents. Top to bottom on this map, they are the Panama Current, the Cromwell Current, and the Humboldt Current.

Follow Up: Every five to seven years, the Galapagos Islands experience a life-threatening change in these three currents when the atmospheric condition called El Niño raises water temperatures around all the islands and brings heavy rains. Life on land flourishes during these periods, but sea life can be devastated as fish move away from the nutrient-depleted waters along the coastline, causing starvation among the islands' sea birds, seals, and sea lions. Research this phenomenon with your students to illustrate how critical currents are to life on the Galapagos islands, and investigate how the increasing frequency of El Niño events over recent decades may be connected to climate change.

ACTIVITY 3: ISLAND HABITATS

In this activity, students match animals they saw in ***Galapagos: Nature's Wonderland*** to the habitats found on three islands — Fernandina, Santa Cruz, and Española — which are representative of the way habitats change as these islands grow older. Have students read the activity sheet, paying close attention to the environmental factors included in the description of each island habitat. Then have students complete

the matching activity and share why they think each animal is adapted to the island habitat or habitats they have chosen.

Conclude by discussing the concept of biodiversity. Help students recognize that, within each habitat on the Galapagos Islands, adaptation has produced a variety of animals and plants that all thrive in that habitat, but each in its own unique way. And adaptation continues to produce new kinds of animals and plants — new species — to increase the biodiversity of each habitat and of all the habitats on these remote islands. Work with students to find examples of biodiversity in your region: for example, the variety of species that live in and around a pond or lake, or the many different kinds of insects, birds, and plants that live in a park or even a backyard.

Answers: Marine Iguana-F, SC, E; Galapagos Cormorant-F; Galapagos Penguin-F; Scalesia-SC; Waved Albatross-E; Blue-Footed Booby-E.

Follow Up: Introduce students to the concept of *endemic species* — that is, species found only one place in the world. A very large proportion of the animals on the Galapagos Islands are endemic species: about 80% of the land birds, 97% of the reptiles, more than 30% of the land plants, and more than 20% of the marine animals. Discuss how adaptation is more likely to produce endemic species in a remote location like the Galapagos, and what humans can do to help protect these rare plants and animals.

ACTIVITY 4: ISLAND GIANTS

In this activity, students can imagine themselves on a field trip to the Galapagos Islands observing two subspecies of the famous Galapagos Tortoise, the domed tortoise and the saddleback tortoise. Students first fill out an observation chart using a "Characteristics List" of terms to describe the shell, neck, legs, and other features of these two subspecies. Then students use their observations to explain how the domed tortoise has adapted to a habitat with lush, low-growing vegetation, while the saddleback has adapted to a habitat with sparse, high-growing vegetation. Students might observe, for example, that the domed tortoise's shell allows it to push through vegetation, and its short legs and neck are suited to munching on low-growing plants. The saddleback tortoise, by contrast, has developed a notch at the front of its shell that allows it to stretch its long neck almost straight up to reach high-growing plants, and it has longer legs to give it an extra boost.

Conclude the activity by having students debate which of these subspecies would adapt best to the other's habitat. Students will likely conclude that the domed tortoise might starve in the saddleback's habitat, whereas the saddleback would still be able to eat in a habitat with more plentiful and easily accessible vegetation. In short, what might appear to be a very specialized adaptation in the saddleback can be interpreted as actually increasing its adaptability to habitat change compared to its domed cousin.

Remind students that the domed and saddleback tortoise are an example of adaptation in action. Over thousands of years, the Galapagos Tortoise has adapted to two very different habitats, and as time goes on, these two types of tortoise might become two distinct species. For now, however, they are classified as members of the same species, despite their different appearances — another example of how different habitats promote biodiversity.

Answers: Domed Tortoise - Shell: rounded, low neck opening; Neck: short; Legs: short; Saddleback Tortoise - Shell: narrowed, high neck opening; Neck: long; Legs: long.

Follow Up: Introduce students to the iguanas of the Galapagos Islands, which provide an example of adaptation leading to the evolution of distinct species. There are three species of land iguana on the islands, including the pink iguana found only at the northern tip of Isabela Island, plus the marine iguana, which is found along the coastline on every island, though its color varies from island to island. Scientists believe that these four species all developed from a common ancestor beginning more than 10 million years ago — that is, before any of the current Galapagos Islands existed. By contrast, scientists believe that the ancestor of the Galapagos Tortoise arrived on the islands only 2-3 million years ago. Have students compare these two animals to learn how the time scale of evolution differs from that of adaptation, and to speculate on whether the Galapagos Tortoise could develop into different species, like the iguana, over the next 8 to 10 million years.

Grades 3-5	Activity			
U.S. National Science Standards	**1**	**2**	**3**	**4**
Science as Inquiry				
• Abilities necessary to do scientific inquiry	X	X	X	X
• Understanding of scientific inquiry	X	X	X	X
Life Science				
• Characteristics of organisms			X	X
• Life cycles of organisms			X	X
• Organisms and environments		X	X	X
• Regulation and behavior			X	X
• Populations and ecosystems			X	X
• Diversity and adaptations of ecosystems			X	X
Earth and Space Science				
• Properties of earth materials	X	X		
• Structure of the Earth system	X	X		X
Science in Personal and Social Perspectives				
• Changes in environments	X	X		
• Populations, resources and environments			X	
Next Generation Science Standards	**1**	**2**	**3**	**4**
Interdependent Relationships in Ecosystems			X	X
Inheritance and Variation of Traits			X	X
Weather and Climate		X		
Earth's Systems	X	X		
Matter and Energy in Organisms and Ecosystems		X	X	

ISLANDS BORN OF FIRE ACTIVITY 1

As you saw in the film ***Galapagos: Nature's Wonderland***, the Galapagos Islands were formed by volcanoes at the bottom of the Pacific Ocean. Over millions of years, as they grow older, each of these volcanoes slowly moves toward the southeast, making room for a new volcano to arise out of the ocean to the west.

The volcanoes move because they are part of the Earth's surface, which is made up of gigantic slabs of rock, called *tectonic plates*, that fit together like the pieces of a puzzle. Unlike puzzle pieces, however, tectonic plates slowly shift position by pushing into and pulling away from each other over millions of years. The Galapagos Islands sit on a plate that is slowly pushing southeastward, toward South America, at a speed of about 2 inches per year. At that rate, the volcanoes that make up the islands move only about 30 miles in a million years!

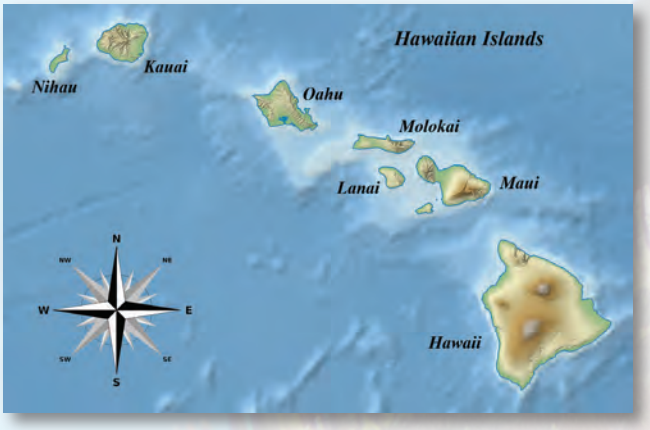
All the volcanoes of the Galapagos Islands were formed by a "hot spot" where molten rock from the center of the Earth has broken through the surface. This hot spot does not move, because it lies below the Earth's surface. As the tectonic plate moves over it, the hot spot keeps breaking through in a different place, creating new volcanoes as the older ones keep moving away toward the southeast.

You can see this process at work on the map below. Use the map to create a timeline of these three islands: **Fernandina**, **Santa Cruz**, and **San Cristóbal**. Write the islands' names into the spaces to show which is oldest, which is middle-aged, and which is youngest.

_____ **Oldest**

_____ **Middle-Aged**

_____ **Youngest**



Now use what you have learned about tectonic plates to compare the Galapagos Islands map with this map of the Hawaiian Islands, which were also formed by volcanoes erupting from a hot spot at the bottom of the Pacific Ocean.

- Which is probably the youngest of the Hawaiian Islands? Which are the oldest? How can you tell?
- Do you think the Hawaiian Islands are on the same tectonic plate as the Galapagos Islands? What direction are they moving?

WINDS AND WATERS ACTIVITY 2

As you saw in the film ***Galapagos: Nature's Wonderland***, scientists believe that life arrived on these remote islands millions of years ago, carried by winds and waters. Today, winds and waters still sustain life on the Galapagos by bringing food and rainfall to the islands.

When the wind blows steadily across the surface of the ocean, it pushes the water along with it, creating what is called a *current*. These currents are almost like rivers flowing through the ocean and can carry water long distances from one region to another. The Galapagos Islands happen to be located at a spot where several currents come together from different directions. Draw and label these currents on the map below as you read about how they sustain life on the islands.

- **Humboldt Current:** Created by steady winds blowing toward the north along the western coast of South America, the Humboldt Current carries cold water up from Antarctica, then turns west at the Equator toward the Galapagos Islands. The cold waters and cool winds of the Humboldt Current create a milder climate on the islands than one would expect at the Equator, and they carry nutrients that feed algae and plankton, which draws fish and other sea life to the islands' coastlines. In addition, the winds that push the Humboldt Current bring moisture to the islands, spreading a cloudy mist over the slopes of the volcanoes from May through December.

- **Panama Current:** Created by steady winds blowing toward the south along the western coast of Central America, the Panama Current flows along the curve of the coastline to the Equator, where it turns west toward the Galapagos Islands. This current brings warm water to the islands, which does not contain many nutrients for sea life. But the humid winds that push this current brings rainfall from December through May, providing the islands with a rainy season that supplies the land-dwelling plants and animals with fresh water.

- **Cromwell Current:** The third current flowing toward the Galapagos Islands is not caused by winds. Instead, the Cromwell Current flows below the surface of the ocean, like an underground river, carrying water from Asia across the whole width of the Pacific Ocean as it travels eastward along the Equator. Because it flows deep, the Cromwell Current's waters are cold and rich with nutrients, including nutrients washed into the sea by rivers on the islands of southeast Asia. When it reaches the Galapagos, this current is forced upward along the coastline of the western islands, which chills the water there and fills it with nutrients, creating an ideal environment for sea life.

Draw and label these three currents on the map at left.

Now use your map and what you have learned about the currents of the Galapagos Islands to discuss these questions in class.

- Which current is most important to the land animals and plants that live on the islands? Why?
- Which currents are most important to the sea life that lives along the coastlines of the islands? Why?
- Which current is most important to the climate of the Galapagos Islands? How would a change of climate affect the plants and animals that live on the islands and in its waters?

ISLAND HABITATS

ACTIVITY 3

As you saw in the film ***Galapagos: Nature's Wonderland***, there are many different habitats on the Galapagos Islands. Read about the habitats found on three of the islands, then use this information to match some of the animals and plants you saw in the film to their island homes.

FERNANDINA

Lava still flows on Fernandina, the archipelago's youngest island, which is mostly a bare rocky mountain sloping down to the sea. But this island's coastal waters are full of life. That's because it sits at the western end of the Galapagos, where the Cromwell Current brings in nutrients from across the Pacific Ocean.

SANTA CRUZ

The volcano that formed Santa Cruz Island has not erupted for more than a million years.

Instead, its peak now condenses moisture in the cool winds blowing off the Humboldt Current, spreading a cloudy mist over the plants of the highlands, and triggers rainfall when the Panama Current brings humid winds to the island.

ESPAÑOLA

Española, one of the oldest Galapagos Islands, has been worn down to rocky sea cliffs and sandy beaches by millions of years of erosion. With no highlands to draw moisture from the winds, this island has only sparse plant life and an arid climate.

Identify the island (or islands) where you would expect to find the Galapagos plants and animals shown below. Circle **F** for Fernandina, **SC** for Santa Cruz, and/or **E** for Española. Be ready to explain in class why each plant and animal seems adapted to the island habitat you have chosen.

Marine Iguana
This diving lizard lives on algae and seaweed, and can "sneeze" the salt from sea water out of its system.

F **SC** **E**

Scalesia
A tree-size relative of the dandelion, this plant grows in dense groves on moist hillsides.

F **SC** **E**

Galapagos Cormorant
After living thousands of years on a coastline where it can always dive for fish, this bird's wings have become too small for it to fly.

F **SC** **E**

Waved Albatross
This broad-winged sea bird breeds only in the Galapagos, nesting on rocky cliffs where it can easily launch itself into the air.

F **SC** **E**

Galapagos Penguin
The only penguin found near the Equator, it needs cold waters and abundant sea life to survive.

F **SC** **E**

Blue-Footed Booby
This sea bird needs flat, rocky terrain for its breeding colonies, which can contain thousands of nests.

F **SC** **E**

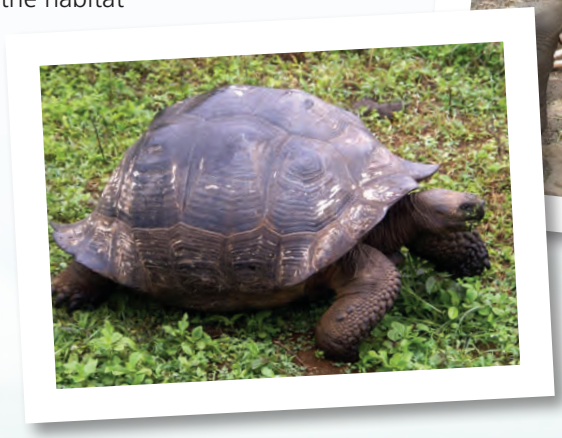
The wide variety of habitats found in the Galapagos has made this isolated chain of islands a model of *biodiversity* — a perfect example of how adaptation produces many different kinds of plants and animals within a habitat, and even more different kinds for each different habitat. Can you think of examples of biodiversity in the habitats of your region?

ISLAND GIANTS

ACTIVITY 4

The Galapagos Islands were named for the giant tortoises that have lived there for nearly 2 million years. These massive reptiles have shells up to 5 feet long and can weigh 500 pounds!

There are many subspecies of the Galapagos Tortoise, each one adapted to the habitat found on a specific island. But as you saw in the film ***Galapagos: Nature's Wonderland***, scientists have identified two main types of Galapagos Tortoise, shown in the pictures at right. The *domed* tortoise has a shell shaped like the dome of a building. The *saddleback* tortoise has a shell shaped liked a horse's saddle.



What other differences do you notice between these two types of Galapagos Tortoise? Sharpen your observation skills by looking closely at the pictures at left. Use the chart to record your observations. Start by using the terms in the "Characteristics List" to describe each type's shell, neck, and legs. Then describe other differences that you notice.

Domed Tortoise	Saddleback Tortoise
Shell:	Shell:
Neck:	Neck:
Legs:	Legs:
Other Characteristics:	Other Characteristics:

CHARACTERISTICS LIST:

long short rounded narrowed high neck opening low neck opening

You probably remember from the film that one type of Galapagos Tortoise is usually found in a dry habitat where the vegetation is mostly tall cactus plants, while the other is usually found in a moist habitat where thick vegetation covers the ground. Use your observations to explain how each type is adapted to its special habitat.

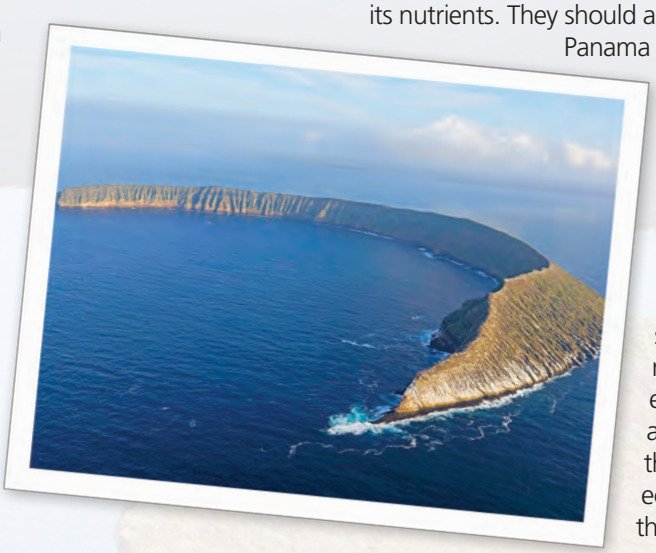
Domed Tortoise	Saddleback Tortoise
Habitat:	Habitat:
Adaptations:	Adaptations:

Now, in a class discussion, debate which type of tortoise is better adapted to live in the other's habitat. Could a domed tortoise survive in the saddleback's habitat? What would happen to a saddleback living in domed-tortoise territory?

TEACHING NOTES

ACTIVITY 1: ISLANDS BORN OF FIRE

Have students read the first part of the activity sheet, which provides a basic introduction to plate tectonics and explains how the Galapagos Islands have been formed by a "hot spot" below the Earth's surface that remains stationary while the Nazca Plate above it moves toward the southeast. Then have students use the map to identify the youngest and the oldest islands in the Galapagos archipelago, and to estimate how long ago the oldest island was formed by measuring its distance from the hot spot beneath the youngest island. Review students' answers in a class discussion, and if time allows, have them repeat the measuring process to create a timeline for all the older islands.



Conclude with the second part of the activity, which asks students to consider why the older Galapagos Islands are smaller and have lower elevations compared to the younger islands. Students should recognize that erosion is primarily responsible for these differences. Over millions of years, weather and sea water wear down an island and reduce its circumference until it finally disappears back under the sea. Reinforce this point by calling attention to the submerged islands at the eastern edge of the Galapagos map, and remind students of the oldest Galapagos Islands they saw in the film, which have become crags of rock surrounded by water, slipping beneath the waves.

Answers: Youngest - Fernandina; Oldest - Española, which lies approximately 140 miles away from the hot spot under Fernandina and was formed approximately 4.5 million years ago.

Follow Up: Help students identify other islands that were formed by volcanoes, such as Hawaii, Japan, and the Aleutian Islands. Do an image search in your library or online to compare these island chains with the Galapagos Islands. (Note: There is a map of the Hawaiian Islands on page 12 of this guide.) Have students chart similarities and differences, then draw conclusions about the role plate tectonics has played in forming these other island chains.

ACTIVITY 2: WINDS AND WATERS

Have students read the first part of the activity sheet, which explains how steady winds create currents in the ocean. Then have them read the descriptions of the three currents that converge on the Galapagos Islands as they draw and label arrows to indicate the path of each current, using the compass rose to gauge the direction of each arrow. Review students' answers in a class discussion, using a large map of the whole Pacific region, if possible, to show students how far these currents travel.

Conclude by using the questions on the activity sheet to discuss how changes in these currents could affect life on the Galapagos Islands. Students should recognize that pesticides washing into the Pacific in southeast Asia could pollute the Cromwell Current and poison the Galapagos sea life that depends on its nutrients. They should also recognize that pushing the Panama Current away from the islands would effectively cause a drought that could devastate the land-dwelling plants and animals of the Galapagos. Similarly, if the Panama Current were to predominate, its nutrient-deficient warmer waters would disrupt the marine food chain and the increased rainfall could wash sediments into the sea water that might permanently change this coastal environment. Guide students toward an understanding that all the effects of these three currents are essential to the ecology of the Galapagos Islands and to the life of its plants and animals.

Answers: See page 7 for a map with arrows showing the positions of the three currents. Top to bottom on this map, they are the Panama Current, the Cromwell Current, and the Humboldt Current.

Follow Up: Every five to seven years, the Galapagos Islands experience a life-threatening change in these three currents when the atmospheric condition called El Niño raises water temperatures around all the islands and brings heavy rains. Life on land flourishes during these periods, but sea life can be devastated as fish move away from the nutrient-depleted waters along the coastline, causing starvation among the islands' sea birds, seals, and sea lions. Research this phenomenon with your students to illustrate how critical currents are to life on the Galapagos islands, and investigate how the increasing frequency of El Niño events over recent decades may be connected to climate change.

ACTIVITY 3: ISLAND HABITATS

In this activity, students match animals they saw in ***Galapagos: Nature's Wonderland*** to the habitats found on three islands — Fernandina, Santa Cruz, and Española — which are representative of the way habitats change as these islands grow older. Have students read the activity sheet, paying close attention to the environmental factors included in the description of each island habitat. Then have students complete the matching activity and share why they think each animal is adapted to the island habitat or habitats they have chosen.

Conclude by discussing the concept of biodiversity. Help students recognize that, within each habitat on the Galapagos Islands, adaptation has produced a variety of animals and plants that

all thrive in that habitat, but each in its own unique way. And adaptation continues to produce new kinds of animals and plants — new species — to increase the biodiversity of each habitat and of all the habitats on these remote islands. Work with students to find examples of biodiversity in your region: for example, the variety of species that live in and around a pond or lake, or the many different kinds of insects, birds, and plants that live in a park or even a backyard.

Answers: Marine Iguana-F, SC, E; Galapagos Cormorant-F; Galapagos Penguin-F; Scalesia-SC; Waved Albatross-E; Blue-Footed Booby-E; Amblypygid-SC; Prickly Pear Cactus-E.

Follow Up: Introduce students to the concept of *endemic species* — that is, species found only one place in the world. A very large proportion of the animals on the Galapagos Islands are endemic species: about 80% of the land birds, 97% of the reptiles, more than 30% of the land plants, and more than 20% of the marine animals. Discuss how adaptation is more likely to produce endemic species in a remote location like the Galapagos, and what humans can do to help protect these rare plants and animals.

ACTIVITY 4: ISLAND GIANTS

In Part 1 of this activity, students can imagine themselves on a field trip to the Galapagos Islands observing two subspecies of the famous Galapagos Tortoise, the domed tortoise and the saddleback tortoise. Students fill out an observation chart to describe the shell, neck, legs, and other features of these two subspecies, then use their observations to explain how the domed tortoise has adapted to a habitat with lush, low-growing vegetation, while the saddleback has adapted to a habitat with sparse, high-growing vegetation. Students might observe, for example, that the domed tortoise's shell allows it to push through vegetation, and its short legs and neck are suited to munching on low-growing plants. The saddleback tortoise, by contrast, has developed a notch at the front of its shell that allows it to stretch its long neck almost straight up to reach high-growing plants, and it has longer legs to give it an extra boost.

Part 2 of the activity tells the story of the Pinta Island subspecies of the Galapagos Tortoise, which became extinct when the last specimen, named Lonesome George, died in 2012. This occurred because the habitat of Pinta Island was decimated by goats, which multiplied from a small herd of three animals to a giant herd of 40,000 in only a decade. Students learn that these goats are an example of an invasive species, which can be any species that is introduced into a habitat where it faces little competition for food and little danger from predators, and can consequently reproduce quickly, driving out other species. Tell students that the goats were finally removed from Pinta Island in 1990, and that the habitat is now beginning to recover. Encourage students to research other invasive species that conservationists on the Galapagos are attempting to control — cats, dogs, black rats, and pigs, as well as fire ants and wasps — and to investigate how invasive species are threatening habitats in the United States.

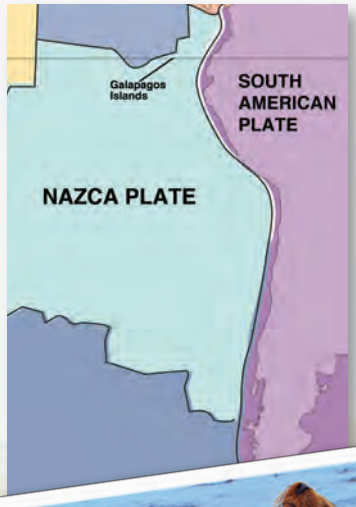
Then discuss why it is so difficult to remove an invasive species from a threatened habitat. Students should recognize that these species are also examples of the power of adaptation, adjusting quickly to an unfamiliar habitat and thriving there. Yet because they reduce biodiversity, by driving out other species, they are ultimately destructive of the ecosystems they invade. That is why, whatever the difficulty, invasive species should be recognized and removed or prevented whenever possible.

Follow Up: Introduce students to the iguanas of the Galapagos Islands, which provide an example of adaptation leading to the evolution of distinct species — a process perhaps only beginning with the Galapagos Tortoise, which is still classified as a single species despite the different appearances of its domed and saddleback subspecies. There are four different iguana species in the Galapagos: three species of land iguana, including the pink iguana found only at the northern tip of Isabela Island, plus the marine iguana, which is found along the coastline on every island. Scientists believe that these four species all developed from a common ancestor beginning more than 10 million years ago — that is, before any of the current Galapagos Islands existed. By contrast, scientists believe that the ancestor of the Galapagos Tortoise arrived on the islands only 2-3 million years ago. Have students compare these two animals to learn how the time scale of evolution differs from that of adaptation, and to speculate on whether the Galapagos Tortoise could develop into different species, like the iguana, over the next 8 to 10 million years.

Grades 6-8	Activity			
U.S. National Science Standards	**1**	**2**	**3**	**4**
Science as Inquiry				
• Abilities necessary to do scientific inquiry	X	X	X	X
• Understanding of scientific inquiry	X	X	X	X
Life Science				
• Characteristics of organisms			X	X
• Life cycles of organisms			X	X
• Organisms and environments		X	X	X
• Regulation and behavior			X	X
• Populations and ecosystems			X	X
• Diversity and adaptations of ecosystems			X	X
Earth and Space Science				
• Properties of earth materials	X	X		
• Structure of the Earth system	X	X		X
Science in Personal and Social Perspectives				
• Changes in environments	X	X		
• Populations, resources and environments			X	
Next Generation Science Standards	**1**	**2**	**3**	**4**
Matter and Energy in Organisms and Ecosystems		X	X	X
Interdependent Relationships in Ecosystems		X	X	X
Growth, Development, and Reproduction of Organisms			X	X
Natural Selection and Adaptation			X	X
History of Earth	X			
Earth's Systems	X	X		
Weather and Climate	X	X		

ISLANDS BORN OF FIRE ACTIVITY 1

As you saw in the film ***Galapagos: Nature's Wonderland***, the Galapagos Islands are like no place else in the world. They form a collection of unique habitats that can differ dramatically from island to island, as volcanoes add new islands to the chain and the shifting of the Earth's surface carries the older islands slowly toward the southeast.



Scientists have discovered that the surface of the Earth is made up of gigantic slabs of rock that fit together like the pieces of a puzzle. These are called *tectonic plates*, but unlike puzzle pieces, the tectonic plates slowly shift position by pushing into and pulling away from each other over millions of years. The Galapagos Islands sit at one edge of the Nazca Plate, which is moving slowly toward South America at a speed of about 2 inches per year. This slow pressure of the Nazca Plate pushing into the South American Plate is what formed the Andes Mountains.

The Galapagos Islands are located at a "hot spot" on the Nazca Plate where molten rock from the center of the Earth has broken through the surface to form volcanoes. This hot spot does not move, because it lies below the Earth's surface. As the Nazca Plate moves over it, the hot spot keeps breaking through in a different place, creating new volcanoes as the older ones keep moving away toward the southeast.

Use this map to identify the oldest and youngest of the Galapagos Islands. Then use the map scale to estimate how long ago the oldest island was formed. You will need to remember that the youngest island marks the position of the "hot spot" that has formed all these volcanoes, and that the Nazca Plate is moving at a speed of about 2 inches per year. (Hint: There are 63,360 inches in a mile.)

As you study this map, you will notice that the Galapagos Islands become smaller as they grow older. You may also notice that they become lower — the ones to the west have volcano cones that rise as high as 5,600 feet, while on the oldest island the highest point is only about 650 feet. Discuss in class what causes the Galapagos Islands to change shape in this way, and how this might contribute to the variety of habitats on the different islands.

Youngest Island: _____

Oldest Island: _____

The oldest island was formed approximately _____ million years ago.

WINDS AND WATERS ACTIVITY 2

As you saw in the film ***Galapagos: Nature's Wonderland***, scientists believe that life arrived on these remote volcanic islands millions of years ago, carried by winds and waters from Central and South America. Today, winds and waters remain important to life on the Galapagos because they bring food and rainfall to the islands.

Steady winds create currents in the ocean by pushing against the water's surface. These currents are almost like rivers flowing through the ocean and can carry water long distances from one region to another. The Galapagos Islands are located at a spot where several currents come together, pushed by winds coming from different directions and bringing water from different regions. Draw and label these currents on the map at right as you read about how they sustain life on the islands.

- **Humboldt Current:** Winds blowing toward the north along the western coast of South America create what is called the Humboldt Current. This current carries cold water up from Antarctica to the Equator, where it turns west toward the Galapagos Islands. The cold waters and cool winds of the Humboldt Current create a subtropical climate for the Galapagos, instead of the sweltering heat one expects at the Equator. These cold waters also carry nutrients that feed algae and plankton in the islands' waters, providing the basis for a food chain that includes fish and all the animals that feed on fish. In addition, the winds that push the Humboldt Current bring moisture to the islands, spreading a cloudy mist over the slopes of the volcanoes from May through December.

- **Panama Current:** Winds blowing toward the south along the western coast of Central America create what is called the Panama Current, which flows along the curve of the coastline to the Equator, where it turns west toward the Galapagos Islands. The Panama Current brings warm waters to the islands, which contain far fewer nutrients than cold water. But the humid winds that push this current brings rainfall from December through May, providing the islands with a rainy season that supplies the land-dwelling plants and animals with fresh water.

- **Cromwell Current:** The third current flowing toward the Galapagos Islands is not caused by winds. It is a subsurface current that flows 300 feet below the surface of the ocean, like an underground river. The Cromwell Current carries water from Asia across the whole width of the Pacific Ocean, traveling east along the Equator. Because it flows deep, the Cromwell Current's waters are cold and rich with nutrients, including nutrients washed into the sea by rivers on the islands of southeast Asia. When it reaches the Galapagos, the Cromwell Current is forced upward by the underwater base of the western islands, which chills the waters along the coastline of these islands and fills them with nutrients, creating an ideal environment for sea life.

Now use your map to discuss in class how changes in the winds and currents could affect life on the Galapagos Islands. For example, what could happen if:

- Pesticides used by farmers on the islands of southeast Asia were carried by rivers into the Pacific Ocean?
- The winds driving the Humboldt Current remained strong all year long, pushing the Panama Current away to the north of the Galapagos Islands?
- The winds driving the Humboldt Current became weaker, allowing the Panama Current to increase rainfall on the islands and warm the waters along the islands' coastlines?

GRADES 6-8

ISLAND HABITATS

ACTIVITY 3

As you saw in the film ***Galapagos: Nature's Wonderland***, the work of volcanoes, winds, and waters have created many different habitats on the Galapagos Islands. Read about the habitats found on three of the islands, then use this information to match some of the animals and plants you saw in the film to their island homes.

FERNANDINA

Lava still flows on Fernandina, the archipelago's youngest island, which is mostly a bare rocky mountain sloping down to the sea. But this island's coastal waters are full of life. That's because it sits at the western end of the Galapagos, where the cold Cromwell Current brings in nutrients from across the Pacific Ocean.

SANTA CRUZ

The volcano that formed Santa Cruz Island has not erupted for more than a million years. Instead, its peak now condenses moisture in the cool winds blowing off the Humboldt Current, spreading a cloudy mist over the plants of the highlands, and triggers rainfall when the Panama Current brings humid winds to the island. In addition, on this island, the volcano has left behind *lava tubes* — long tunnels carved long ago by hot flowing lava.

ESPAÑOLA

Española, considered the oldest of the Galapagos Islands, has been worn down to rocky sea cliffs and sandy beaches by millions of years of erosion. With no highlands to draw moisture from the winds, this island has only sparse plant life and an arid climate.

Identify the island (or islands) where you would expect to find the Galapagos plants and animals shown below. Circle **F** for Fernandina, **SC** for Santa Cruz, and/or **E** for Española. Be ready to explain in class why each plant and animal seems adapted to the island habitat you have chosen.

The wide variety of habitats found in the Galapagos has made this isolated chain of islands a model of *biodiversity* — a perfect example of how adaptation produces many different kinds of plants and animals within a habitat, and even more different kinds for each different habitat. Can you think of examples of biodiversity in the habitats of your region?

Marine Iguana
This diving lizard lives on algae and seaweed, and can "sneeze" the salt from sea water out of its system.

F **SC** **E**

Waved Albatross
This broad-winged sea bird breeds only in the Galapagos, nesting on rocky cliffs where it can easily launch itself into the air.

F **SC** **E**

Galapagos Cormorant
After living thousands of years on a coastline where it can always dive for fish, this bird's wings have become too small for it to fly.

F **SC** **E**

Blue-Footed Booby
This sea bird needs flat, rocky terrain for its breeding colonies, which can contain thousands of nests.

F **SC** **E**

Galapagos Penguin
The only penguin found near the Equator, it needs cold waters and abundant sea life to survive.

F **SC** **E**

Amblypygid
A relative of spiders, this subterranean creature feels for its prey with its long front legs.

F **SC** **E**

Scalesia
A tree-size relative of the dandelion, this plant grows in dense groves on moist hillsides.

F **SC** **E**

Prickly Pear Cactus
Unlike its shrub-size cousins in arid regions of North America, the Galapagos Prickly Pear can have a trunk and grow as tall as a tree.

F **SC** **E**

ISLAND GIANTS

ACTIVITY 4

The Galapagos Islands were named for the giant tortoises that have roamed the archipelago for more than 2 million years. These massive reptiles have shells up to 5 feet long and can weigh 500 pounds!

PART 1

As you saw in the film ***Galapagos: Nature's Wonderland***, scientists have identified two main types of Galapagos Tortoise. One type, the saddleback tortoise, is usually found on older islands where the dry climate limits vegetation to mostly tall cactus plants. The other type, the domed tortoise, is usually found on younger islands, with a moist climate, where thick vegetation covers the ground.

Use your observation skills to study these two types of Galapagos Tortoise in the pictures at right. Look closely and describe differences you notice in their shells, necks, legs, and other features. Then, based on your observations, explain how each type is adapted to its habitat.

PART 2

Until a few years ago, there were 11 subspecies of the Galapagos Tortoise, each one adapted to the habitat found on a specific island. In 2012, however, this number dropped to 10, when the Pinta Island Tortoise became extinct.

How did this happen?

In 1958, some fishermen brought three goats to Pinta Island to raise for food. Ten years later, there were 40,000 goats on the island, which had devoured almost all the vegetation, leaving the Pinta Island Tortoise without food. By 1971, scientists could find only one tortoise on the island, a male whom they called Lonesome George because there was no female with whom he could mate. When Lonesome George died in 2012, the Pinta Island Tortoise vanished from the Earth.

The goats in this story are what scientists call an *invasive species* — that is, a species introduced into a habitat where it faces little competition for food and little danger from predators. Under these conditions, the invasive species reproduces quickly, driving native species out of the habitat or, like the Pinta Island Tortoise, causing them to become extinct.

Discuss in class how scientists can help protect the diverse habitats of the Galapagos Islands from the threat of invasive species. Then find out more about invasive species at the Invasive Species Knowledge Center (www.nature.nps.gov/views/KCs/Invasives/Invasives_Index.htm) and discuss how invasive species could threaten habitats in your region.

A Domed Tortoise	B Saddleback Tortoise
Habitat: moist climate, thick vegetation	**Habitat: dry climate, tall vegetation**
Shell:	Shell:
Neck:	Neck:
Legs:	Legs:
Other:	Other:
How adapted to its habitat:	How adapted to its habitat:

RESOURCES

ABOUT *GALAPAGOS: NATURE'S WONDERLAND*

- ***Film Website***, http://Galapagos.nWave.com
- ***nWave Pictures Distribution Facebook Page***, www.Facebook.com/nWavePicturesDistribution

ABOUT THE GALAPAGOS ISLANDS

- ***Climate and Meteorology of the Galapagos Islands***, www.geol.umd.edu/~jmerck/galsite/research/projects/ader/
- ***Destination: Galapagos Islands***, www.pbs.org/safarchive/5_cool/galapagos/g1_welcome.html
- ***The Effect of El Nino in Galapagos on the Marine Fish and Birds***, www.marinebio.net/marinescience/02ocean/enmarfb.htm
- ***Expedition to Galapagos***, www.mnh.si.edu/expeditions/galapagos/#intro
- ***The Galapagos***, https://worldwildlife.org/places/the-galapagos
- ***Galapagos Conservancy***, www.galapagos.org
- ***Galapagos Conservation Trust***, http://savegalapagos.org/
- ***Galapagos Geology on the Web***, www.geo.cornell.edu/geology/Galapagos.html
- ***Ocean Currents Tutorial***, http://oceanservice.noaa.gov/education/tutorial_currents/welcome.html
- ***This Dynamic Earth: The Story of Plate Tectonics***, http://pubs.usgs.gov/gip/dynamic/dynamic.html

NATIONAL GEOGRAPHIC RESOURCES

- ***Animals***, http://animals.nationalgeographic.com/animals
- ***National Geographic Kids***, http://kids.nationalgeographic.com/kids

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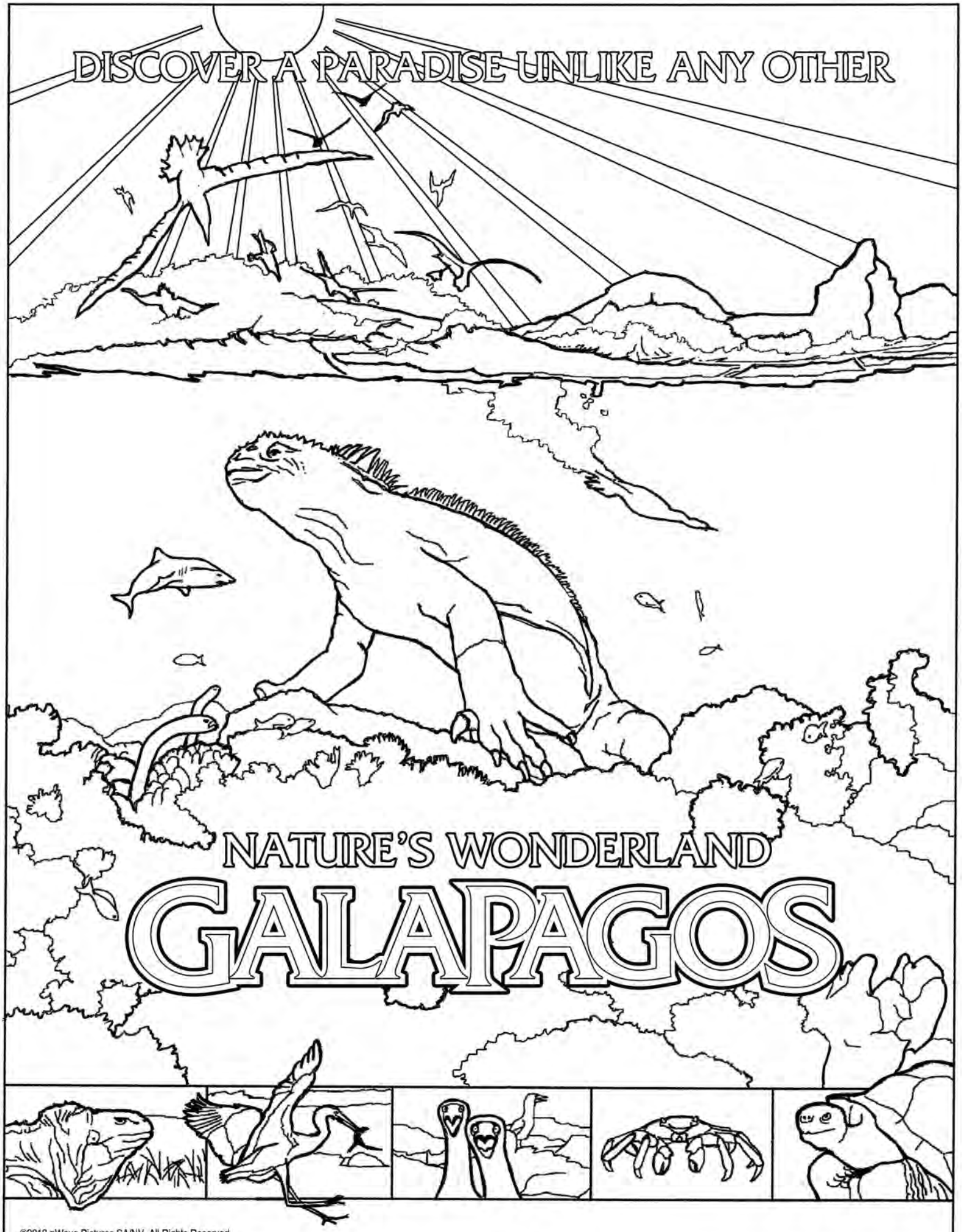
All other images: nWave Pictures SA/NV.



NATURE'S WONDERLAND
GALAPAGOS





DISCOVER A PARADISE UNLIKE ANY OTHER

A Colossus Productions Film in association with SKY 3D
An nWave Pictures Distribution release

A Film Written by ***David Attenborough***
Narrated by ***Jeff Corwin***
Produced by ***Anthony Geffen*** *& Directed by* ***Martin Williams***

For additional educational resources, games and online activities,
please log on to Galapagos.nWave.com

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