Journal:

The Galápagos Islands

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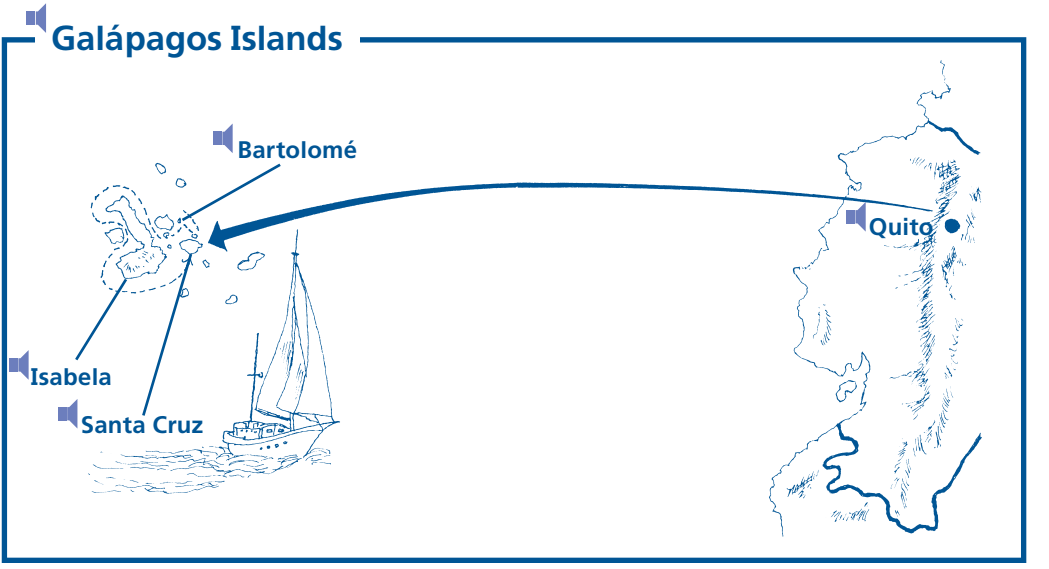
Day 1: Monday

Today my dad and I flew from Quito, Ecuador, to the Galápagos Islands for a five-day cruise. I love animals, especially reptiles, so this is a dream come true for me! We got up early this morning, took a taxi to the airport, and boarded the plane.

The islands are about 1000 km (600 mi) off the west coast of South America, and they're right on the equator. The islands formed when volcanoes erupted under the sea. I could see some of the higher volcanoes from the airplane window. The upper slopes of the highest volcanic mountains are covered in dense vegetation. Otherwise, the islands look pretty dry and stark.

We landed on the island of Santa Cruz, one of the 13 main islands in the Galápagos. We took a bus from the airport to the dock where our boat, the *Beagle II,* was moored. There we met our guide, Miguel. He's a biologist. Miguel told us that we are going to encounter some amazing living things on our trip, such as tortoises the size of refrigerators, sunflowers that grow into 15-meter (50-foot) trees, and marine iguanas that are the length of your arm. I can't wait!

Miguel explained that during the next five days, we are going to follow in the footsteps of Charles Darwin. Darwin was a famous British



naturalist who came to the islands aboard the original *Beagle* in 1835. Darwin observed the many strange plants and animals in the Galápagos, and he began to wonder why so many unusual plants and animals live in the Galápagos Islands and nowhere else in the world.

Darwin gathered a great deal of evidence during his voyage through the Galápagos. When he returned to England, he pondered this evidence and tried to make sense of it. After many years, he came up with his theory of natural selection. This became a very important theory in the field of biology.

Miguel said that he was going to show us some of the fantastic plants and animals that Darwin had observed, and point out some of the clues that Darwin had gathered in the islands. Then we could use these observations and clues to come up with our own theory to explain how the unusual plants and animals in the Galápagos came to be. I'll keep careful notes in this journal.

He said that we should pay close attention, starting now, because he was about to give us Clue #1. He asked us what we saw from the airplane on our journey from the mainland to the islands. I said that all I saw was water. He said, "Absolutely, and that's your first clue." He wrote:

Clue #1: The Galápagos Islands are isolated from other landforms.

Then he told us that the islands started out as bare volcanic rock far away from other land. The oldest of the islands was formed when volcanoes erupted about 3 million years ago. The youngest is only about 10,000 years old.

He wrote the following as our next clue:

Clue #2: The Galápagos Islands are very young.

I asked Miguel how plants and animals could have gotten to the Galápagos in the first place. After all, the islands had started out as bare volcanic rock, far away from any other land. He said that this was a very good question that scientists have been trying to answer for a long time. Of course, no one was actually here to observe what happened, but scientists have come up with some theories about it.

He said that the islands lie in the path of strong winds that blow from South America. Seabirds could ride these winds. The nonstop flying distance of 1000 km (600 mi) is not that far for seabirds like albatrosses. The islands provided a place where they could lay their eggs on the rocky cliffs and catch fish in the ocean.

First, fungi, algae, and other simple plants took hold on the barren rock. Then, over thousands of years, soil slowly formed, and a variety of seeds was able to take root. Seeds could travel on these winds, or travel with the birds, in their stomachs or stuck to their feet or feathers. Grasses, ferns, and other small plants slowly multiplied. When plants began to thrive, they became a source of food and shelter for animals. The wind also swept other small creatures, like insects and spiders, to the islands.

Some living things came by sea. Seeds that float, like mangrove and sea grape seeds, floated in on the Humboldt Current. The Humboldt Current begins in Antarctica and flows north along the coast of South America, and then west, straight into the Galápagos. Seals, sea lions, and penguins could have made the long journey to the islands following schools of fish.

Animals like giant tortoises and iguanas could not swim or fly to the islands. They probably rode on "rafts" that had formed from tangles of plants and debris. The landing of such a raft would have been a rare event—a raft would have to drift for hundreds of miles in the open ocean before bumping into the Galápagos by chance. Many passengers would never make it to the islands alive. Only animals with tough skin that would not dry out in the harsh tropical sun, who could survive with no fresh water to drink during the voyage and little or no food to eat would make it alive.

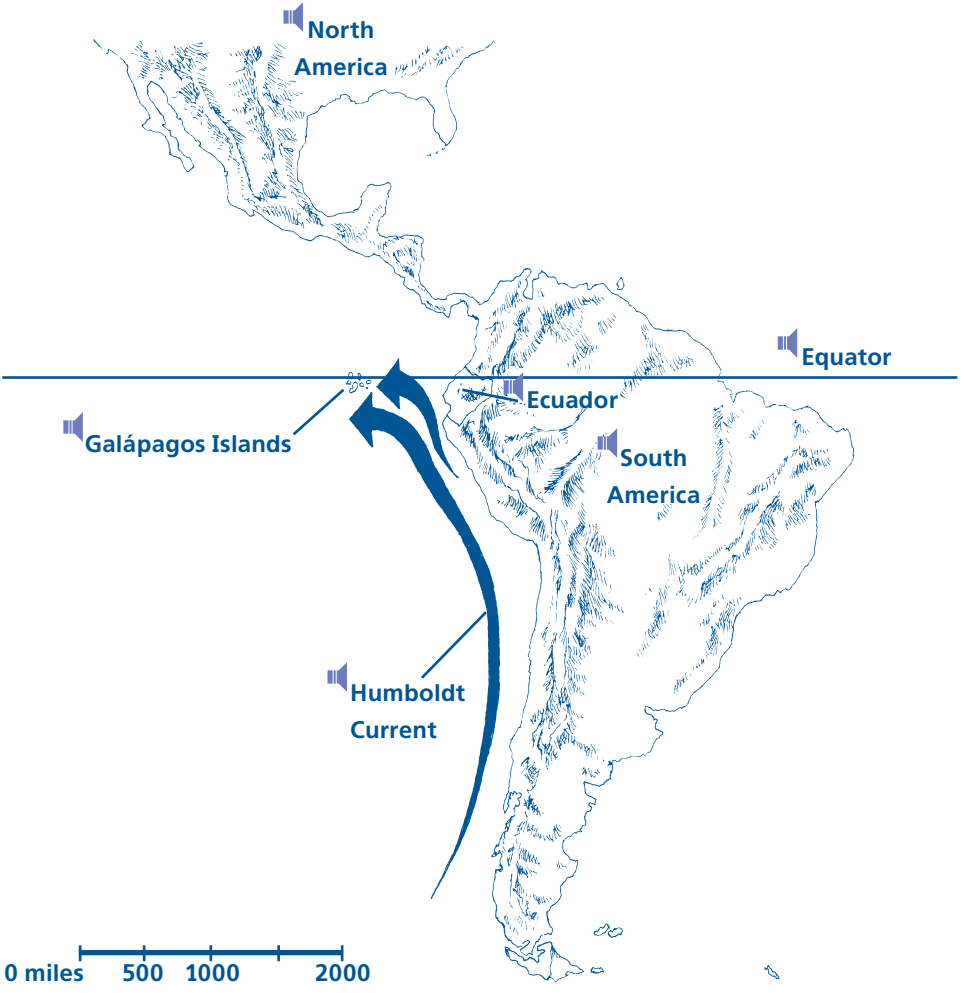
Miguel said that we should expect to see many reptiles and birds on the islands. However, we wouldn't see native amphibians, like frogs and salamanders, or native land mammals because they hide during the day. There are 22 species of reptiles here, only 2 mammal species, and no amphibians. In most other places, there are more mammals than reptiles.

The next clue was a question:

Clue #3: Why are there more species of reptiles on the Galápagos Islands than any other kind of animal?

My dad and I went back to our cabin for the night. We tried to figure out the answer to the question. We think that reptiles would have been the best rafters because they can live on very little food and water and their skin is thick and tough. Mammals would have died of thirst. Amphibians like frogs and salamanders have thin skin that would have dried out in the hot sun. The same traits that helped the reptiles survive on rafts would help them survive after they reached the rocky shores of the Galápagos. I think we answered the question!

The Humboldt Current



Day 2: Tuesday

We got up early this morning and ate breakfast as the boat took us to our first stop — the tiny island of San Bartolomé. It's only about 10,000 years old and mostly just volcanic rock. Stepping onto the island was like stepping onto the surface of the moon. We walked up a wooden stairway that rose about 90 m (300 ft) above the sea. From the top we saw the crescent beach in the shadow of Pinnacle Rock. This is where we headed next.

Swimming below Pinnacle Rock we had our first encounter with Galápagos penguins, which live only in the Galápagos—farther north than any other penguins in the world. These birds probably arrived here by following the fish and drifting on the Humboldt Current all the way from Antarctica. It was amazing how close we could get! I swam right up to one, and it just bent down and gazed at me. It had peach-colored eyes. Miguel said that many of the animals that live here in the Galápagos are very tame; because they haven't seen many humans, they aren't afraid of us.

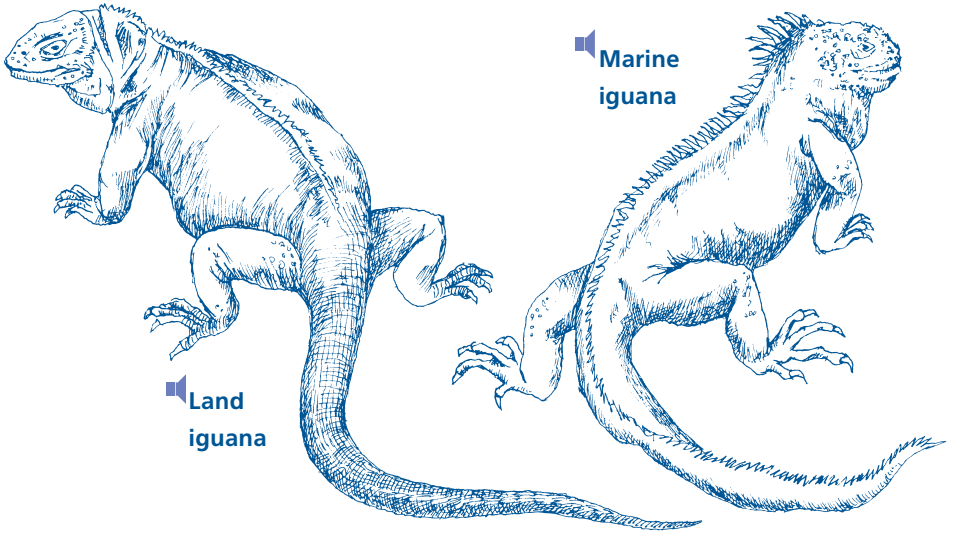
We also got to swim with very tame sea lions. They started playing around us, sometimes swimming straight at us and turning only at the last second. But I got out of the water in a hurry when I saw a white-tipped shark!

Back on the boat, we had dinner, and then Miguel talked to us about our next destination—Fernandina Island. Here we'd see marine iguanas. This reptile exists only in the Galápagos Islands, and it is the only sea-swimming lizard in the world. Miguel explained that a land iguana also lives in the Galápagos. These two iguanas are closely related, but they have adapted to different ways of life. Land iguanas thrive in dry landscapes away from shore. They get most of their food and water from eating cacti. Marine iguanas are well equipped for ocean life. They can stay under water for an hour, grazing on algae.

Day 3: Wednesday

We anchored the *Beagle II* just offshore from Fernandina Island and took rubber rafts to the shoreline. This is what is called a dry landing, meaning that you can step from the boat right onto land. You don't have to wade through water to get onshore. We stepped onto a pure lava shoreline.

Marine iguanas and land iguanas on Galápagos



I was looking at the dark volcanic rock when suddenly I noticed that the rock was moving! It wasn't, of course. It was marine iguanas that were moving. They are so well camouflaged that you don't see them at first. There were hundreds of them, all basking in the sun. We could get really close to them—they didn't seem to mind. They looked like little stone statues, sitting so still. You could hear them sneezing. Miguel explained that they have special glands in their nostrils for removing excess salt. Frequent sneezing expels salt, which coats their heads with a white crust. Yuck!

Miguel told us that even though they look fierce, they eat only plants. They dive down into the water and scrape off algae growing on the rocks. They have flattened tails, and they swim by wiggling their bodies from side to side. Their long, sharp claws help them cling to slippery rocks while being pounded by waves. Their short snouts let them scrape algae off the rocks more efficiently with their razor-sharp teeth. The land iguanas don't have any of these adaptations for living and feeding in the ocean.

We found a small colony of flightless cormorants. These birds looked very strange, flapping their stubby wings to dry them after feeding in the water. They're the only cormorants in the world that have such stubby wings. I asked Miguel why they don't have long wings.

He said that that was both a good question and our next clue:

Clue #4: Why don't cormorants in the Galápagos have long wings?

He gave us a couple of hints—they have no natural predators on the island, and they feed no more than 100 m (328 ft) offshore near the bottom on squid, octopus, eel, and fish.

In the afternoon, we sailed to the island of Isabela. This was supposed to be another dry landing, but I slipped on the side of the raft and fell into the water! We hiked uphill for about two hours to a spot with a good view of the island and Wolf Volcano, the highest point in the Galápagos Islands. The southern side of the volcano was covered in clouds. Moisture in the air coming from the ocean to the south is pushed up the southern side of the volcano. As it condenses it forms clouds and rain. Because of the abundant rain, many grasses and ferns grow there. The northern side of the volcano is barren, and the rest of the island is also quite dry.

Miguel said to pay close attention, because he was going to give us a big clue:

Clue #5: Several different climate zones exist in the Galápagos Islands, from the cloud forests at the higher altitudes to deserts in the lowlands to mangrove forests near the water. Each Galápagos plant and animal must be adapted to its own climate zone in order to survive.

On the hike back, Miguel pointed out some of the plant life that grows here in the Galápagos. There are several different forms of the prickly pear cactus— some are sprawling, some are shrubby, and some are treelike. They are the land iguana's favorite food. There are also no fewer than 20 different sunflower relatives that live here in the Galápagos and nowhere else. Some are trees that can reach heights of 12 m (40 ft). Others grow like shrubs.

The next clue was another question:

Clue #6: Why do several different prickly pear cactus and sunflower relatives live in the Galápagos Islands and nowhere else in the world?

Day 4: Thursday

Today we sailed to the island of Santa Cruz and visited the Darwin Research Station. We finally got to see the giant tortoises! It was a long walk from the park entrance to the research station. We walked past a lot of Galápagos plants and trees. Many of them were very large. As Miguel explained, gigantism is a feature of many plants and animals in the Galápagos. Our next clue was another question:

Clue #7: Why are many Galápagos plants and animals so huge?

The giant tortoises are kept in corrals. Our first look wasn't just a look; we got to go right into the corrals with them! They are impressive—the adults weigh about 272 kg (600 lb), and they can live to be more than 150 years old. Darwin took one giant tortoise named Harriet back to England. Eventually, it was sent to a zoo in Australia, where it is still living today! At 172, it is the oldest known living animal on Earth.

Miguel explained that the word *galápago* in Spanish means "saddle" and refers to the shells of some of these huge reptiles. From island to island, the shells of the tortoises vary in size and shape. The smaller saddlebacks have long necks and limbs and a shell that is raised in the front. They are well adapted to the environment on the lower, drier islands. Although they usually eat fallen cactus pads and low-growing vegetation, they sometimes have to reach up high for taller shrubs, when the lower vegetation is unavailable. Larger, dome-shaped tortoises are typical on the higher, more overgrown islands, where they feed on grasses, fruits, and other low-growing vegetation.

Sunflower trees on Galápagos

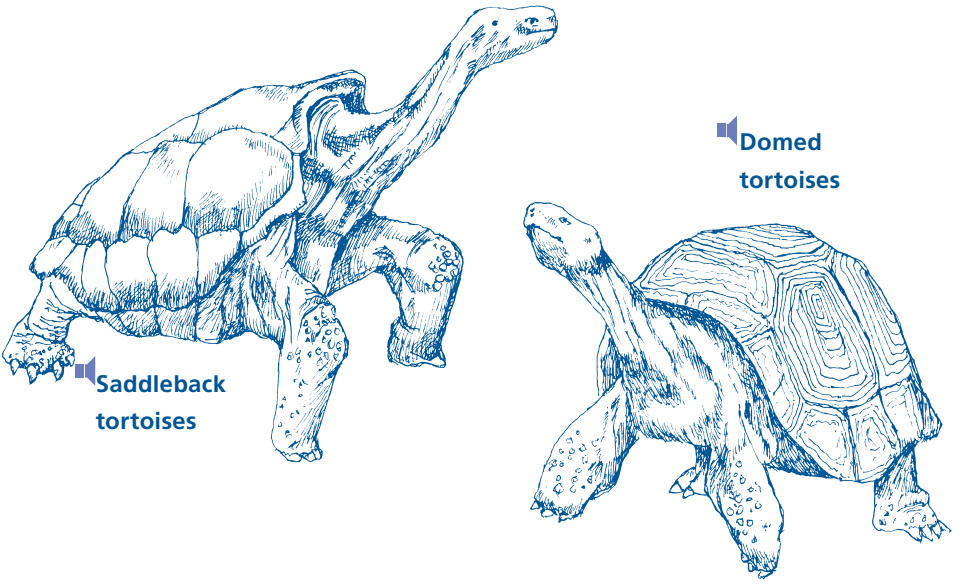
Clue #8: Why are there 12 different kinds of giant tortoises of different shapes and sizes, each from a different part of the Galápagos Islands?

I asked why they keep the tortoises in corrals. The park ranger explained that this is part of a conservation effort. When Darwin first visited the Galápagos, there were around 250,000 giant tortoises. By 1974, there were only about 14,000 left.

I asked what happened to all of them. The park ranger explained that throughout the nineteenth century, sailors ate giant tortoises. The giant tortoises were a handy source of fresh meat for sailors during their long sea voyages. The tortoises could live for months without food and water. They could be kept in the cargo hold of the ship until they were needed as food. Tens of thousands of tortoises were killed in this way.

Giant tortoises were also preyed on by animals that people brought to the Galápagos. As early as the sixteenth century, rats jumped off sailing ships, scurried onto the islands, and feasted on tortoise eggs. By

Galápagos Tortoises



1900, many settlers and their animals had come to the Galápagos. Pigs, dogs, and cats that people brought to the islands ate tortoise eggs and sometimes even ate young tortoises. Goats and cattle competed with the tortoises for scant food supplies—the few leaves and berries or other fruits that were growing on the islands.

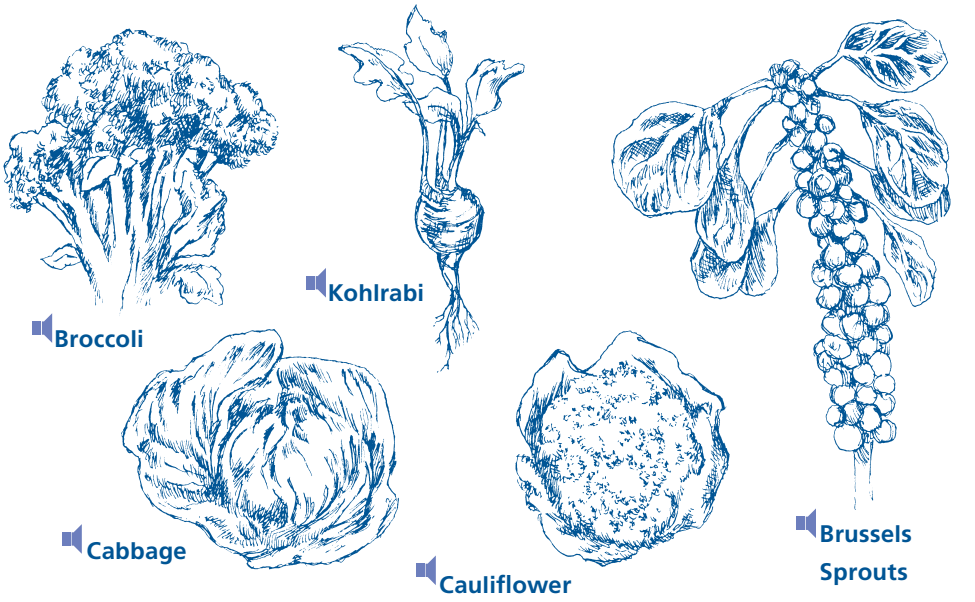
Miguel explained that before humans arrived on the islands, the tortoises had no natural predators and little competition from other animals for food. When the first tortoises arrived on the islands, scientists theorize that their population grew quickly. When humans and their domestic animals arrived, the population dropped drastically. The tortoises were on the verge of extinction. This means that they would have died out as a species. Our next clue was:

Clue #9: Because they had no predators or competition for food, the population of tortoises grew rapidly after they arrived in the islands. When other animals arrived, including predators, the population of tortoises began to decrease rapidly.

I was happy to learn that humans are now giving tortoises a helping hand, instead of killing them. The tortoise conservation program started in 1965. Tortoise eggs are brought to the station, where they're hatched in incubators. This prevents rats from preying on the eggs. When the tortoises are four or five years old, they're big enough to fend for themselves, so they can be released back into the wild. More than 3,500 tortoises have been released into the wild.

The conservation program is always short of staff and funds, but it's been very successful. Originally, there were 15 sub-species of tortoises, each from a different island. All 15 sub-species were believed to be part of the same species. When the conservation program began, 3 sub-species had already become extinct. We saw one tortoise, named "Lonesome George," in a corral by himself. He's the only known survivor of his sub-species, and when he dies, his sub-species will become extinct. There's no way to help those 4 sub-species, but all of the other 11 sub-species of tortoises are now increasing in number. Scientists are conducting DNA tests to find out whether the 15 sub-species are actually 15 unique species.

All of these vegetables were developed from one type of plant.



After seeing the tortoises, we went to the gift shop to buy souvenirs. I bought a poster of Lonesome George. I felt good about spending my money at the shop because the money they make goes to help protect the tortoises.

At supper, Miguel told us to take a closer look at the vegetables we were eating, because that was our next clue! We had been served a dish of mixed vegetables, including broccoli, cabbage, kohlrabi, cauliflower, and Brussels sprouts. (These are definitely not my favorite vegetables!) He explained that all of these vegetables descended from one type of plant. Ancient farmers began growing this plant as a food crop.

To grow crops for the next season, they had to save seeds from their crops each year. They recognized that offspring inherit the traits of their parents, so they chose seeds from the best plants for planting the following year. Each year they did the same, so their crops steadily improved.

Some people preferred to eat the green flowers and stems of this plant, and each year they selected seeds from plants with the best green flowers and stems. After several hundred years of selecting seeds, they had plants that we call broccoli. Other people preferred using enlarged buds, so they selected seeds from plants with the largest buds. This led to the development of cabbage. Likewise, selecting for white flower clusters produced cauliflower, selecting for enlarged roots produced kohlrabi, and selecting for side buds produced Brussels sprouts.

Miguel wrote our next clue:

Clue #10: Humans developed all of the different plants in the cabbage family from a single type of plant by saving the seeds of plants that had the traits they wanted. This is called artificial selection. Could a similar selection process be responsible for the 15 different kinds of giant tortoises found in the Galápagos Islands?

Dad and I pondered this question. Of course, humans did the selecting of seeds that led to the development of vegetables in the cabbage family. What could be doing the selecting that led to the development of 15 kinds of tortoises?

Day 5: Friday

This was our last day in the Galápagos Islands. We went to the small island of Daphne Major to visit some scientists, the Grants. They told us about how they have been studying Darwin's finches since the 1970s. These birds were named for Darwin, in part because he studied them when he visited the islands in 1835. He observed 13 different species of finches that were all very similar except for the shapes of their beaks.

For example, the ground finch has a short, stout beak that works well for crushing and eating seeds. The cactus finch has a long beak that can reach into flowers. The tree finch has a strong, blunt beak that it uses to strip bark and find insects. The strangest of Darwin's finches is the sharp-beaked ground finch. This finch is also called the vampire finch because it uses its sharp beak to peck at other birds, such as masked boobies and red-footed boobies, until they bleed, and then it drinks their blood!

The Grants pointed out the finch they have been studying—the medium ground finch. It's a small brown bird and not that noticeable. It lives on the island of Daphne Major and has few predators or competitors. The weather is the major factor that affects finch survival because it affects their food supply. Like the other ground finches, the medium ground finch has a short beak and eats mostly seeds.

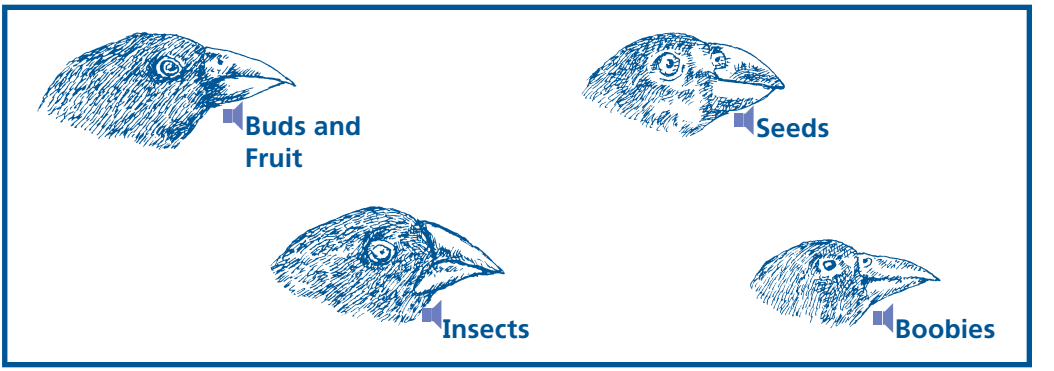
In 1977, there was a severe drought on the island. Plants withered, and the tiny seeds these finches were used to eating grew scarce. The medium ground finches with larger beaks could crack open larger seeds. Those with smaller beaks couldn't do this, so they starved to death.

The next year, the Grants returned to measure the beak sizes of the next generation of ground finches. They found that, on average, the finches had beaks that were 3 to 4 percent larger than those of their parents.

Clue #11: Is the natural selection of finches with larger beaks similar to artificial selection of plants in the cabbage family? What do you predict would happen to the size of beaks if large-seeded plants permanently replaced all of the small-seeded plants on the island?

That night after dinner, we reviewed all of our observations over the last five days. Dad and I put all of our clues and observations together and used them to try to answer the question that Darwin had tried to answer in 1835:

How did the fantastic animals and plants in the Galápagos come into existence, and why here and nowhere else in the world?



Here is our theory:

The Galápagos Islands were formed relatively recently, and they are very isolated, far away from any other landforms. The arrival of plants, small birds, and reptiles would have been chance events. The animals that arrived, such as tortoises, iguanas, and finches, would have had little competition for food and no predators. Likewise, the plants that happened to arrive, such as prickly pear cactus and sunflowers, would have had little competition from other plants for space and soil nutrients. Therefore, the plants and animals that found their way to the Galápagos would have multiplied quickly.

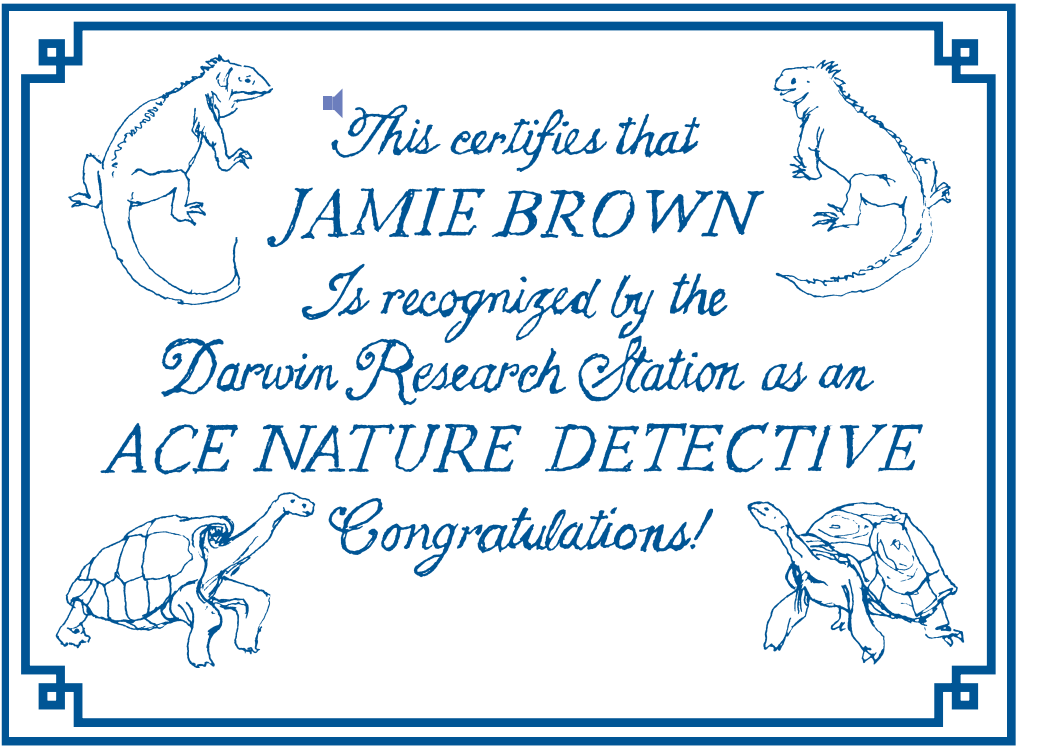
On the mainland, animals have much more competition for food, and they must contend with predators. Many more animals are born or hatched than can survive. Only some survive. For example, a lizard lays hundreds of eggs. Only a few make it to adulthood. Those that have some selective advantage, such as better camouflage, are more likely to reach adulthood and produce offspring. Likewise, plants make thousands of seeds, and not every seed grows into a mature plant to make more seeds. Because offspring inherit traits from their parents, the traits that make a plant or animal better adapted to its environment would become more abundant in each generation.

In the Galápagos, there was a great deal of wide-open space that plants could take over when they arrived. Seeds from the few plants that arrived by chance in the Galápagos could have found their way to some of its many other islands. There they might have encountered different climate zones. Because there was no competition from other living things, there could have been time for them to adapt to whatever climate zone was there. For example, seeds from a single sunflower species would have found their way to several different Galápagos islands. The sunflowers would have adapted to the particular climate on each island. That would have led to the development of 20 different sunflower species. Similarly, the prickly pear could have adapted to several different climate zones. These two kinds of plants would also have been able to change into very big plants because they did not have competition from other plants.

In the same way, the finches, iguanas, cormorants, and tortoises that arrived in the Galápagos could have spread to some of its many other islands and adapted to the climate and food supply that existed on each. This could have resulted in 12 different kinds of giant tortoises, 13 different species of finches, and 2 kinds of iguanas.

The fact that the islands are very young explains why you can see only a few types of plants and animals adapted to each climate zone. If the islands were older, then more different kinds of plants and animals would have arrived or adapted by now.

Miguel congratulated us on our detective work. He presented this certificate to us:



Think and Write

1. What do you predict would happen to the size of the beaks of ground finches if large-seeded plants permanently replaced all of the small-seeded plants on the Island of Daphne Major?
2. Explain how people have used artificial selection to develop different breeds of dogs.
3. Explain how the available sources of food on each of the Galápagos Islands influenced the kinds of beaks that finches living there have.
4. **Persuasive Writing** The arrival of humans in the Galápagos has had a negative effect on the unique plant and animal life there. For example, when Darwin visited in 1835, there were about 250,000 giant tortoises in the islands. Now there are fewer than 14,000. Write a paragraph **persuading** tourists to help preserve the plants and animals in the Galápagos.

Hands-On Activity

Test Bird Beaks Collect some sunflower seeds and some tools to represent bird beaks, such as pliers, chopsticks, and tweezers. Find out how many seconds it takes each "beak" to crack the shell and remove the seed inside. Try each "beak" several times. Record your times in a data table. Calculate the average time for each "beak." Construct a bar graph of the averages.

School-Home Connection

Make a Brochure Share this reader with a family member. Prepare a one-page brochure for arriving visitors to help them understand the unusual plants and animals they'll see in the Galápagos.