Station 1

Instructions:

1. Working with your partner, choose **one pair** of animals from the three pairs available (Either Iguanas, Tortoises, OR Cormorants).

2. Copy the chart into **each** of your science notebook. Fill in the heading with the names of the pair of organisms you selected.

Name 1 Here	Name 2 Here

3. Complete the chart by writing down observations about the difference between the organisms from the photos provided and the information. Look closely at the photos they may provide clues about important differences in habitats.

4. Below the chart, respond to the following prompt in each of your notebook. **Please use complete sentences.**

    1. Choose one of the two organisms you selected, and explain how the traits you observed may help the animal to survive or thrive in its habitat.

Station 1-Iguanas

Land Iguana — A large relative of the South American and Caribbean terrestrial iguana, it has a round tail, a pointed nose and is brownish-red in color on top, yellow-orange underneath. It eats grass and other terrestrial plants, especially the large prickly-pear cactus.

Marine Iguana — The only sea-going iguana in the world, it has a flat tail, a somewhat square nose, dark coloration, and partially webbed feet. The dark coloration allows young iguanas to be camouflaged by the dark lava on which they live and enables iguanas of all ages to absorb more heat from the sun.

Station 1-Tortoises

Saddleback Tortoise — One of the major groups of giant tortoises in the Galápagos Islands, it has an arched carapace (shell) in the front and has long legs, a long snout, and a long neck that allow it to reach for its food high above the ground. The saddleback type of Galápagos tortoise has been found on the dry areas of Española, Pinzon, Pinta, and Fernandina Islands.

Domed Tortoise — Another of the major groups of giant tortoises in the Galápagos, it has a rounded shell, blunt snout, and a shorter neck. The dome-shaped tortoise is found on islands with rich vegetation like Santa Cruz and Isabela. The domed tortoise is larger and heavier, and the rounded shape of its shell allows it to move through the thick vegetation more easily than the saddleback tortoise.

Station 1-Cormorants

Flightless Cormorant — Found only in the Galapagos, it is dark with black coloration above and brown underneath. It has a streamlined body, strong legs, sparsely feathered vestigial wings (small and useless for flight), and webbed feet. The flightless cormorant uses its strong legs and webbed feet to swim and capture fish, eels, and octopuses.

Cormorant — There are 28 other living species of cormorants, all of which use their wings for flight. Because these other cormorants have well-developed wing muscles, their bodies are not as streamlined as those of the flightless cormorant, but their legs, which are not used for swimming as much as with the flightless cormorant, are much more refined. Cormorants mainly eat fish.

Station 2

Instructions:

1. Working **INDEPENDENTLY** read the passage about Darwin's voyage on the HMS Beagle.

2. Answer the following questions or complete the following directions in your science notebook. **Please use complete sentences.**

    1. What did Darwin study during his travels? (List all that apply)

    2. Using the context clues in the article, how would you define the word **species**?

    3. Now checking in your science book on page 283, **write the definition** of species provided by the book in the vocabulary section of **your s**cience notebook.

    4. What did Darwin conclude about the species he saw? What was his hypothesis about species?

    5. How was he able to conclude this? What evidence did Darwin use?

GALAPAGOS

EDUCATION

DARWIN’S VOYAGE ON THE HMS BEAGLE

In December of 1831, Charles Darwin set sail from England aboard the HMS Beagle. During that time Darwin studied the plants, animals, land-forms, and fossils of the many countries and islands he visited during the five-year voyage. He dissected animals and plants, kept a journal, and wrote letters to friends and colleagues describing his observations.

In 1835, the Beagle traveled west from the coast of South America, arriving off the coast of San Cristóbal Island on September 17. The Beagle explored the Galápagos Islands for five weeks, from September 17 through October 20, 1835. During this time, Darwin landed on at least six of the larger islands, starting at San Cristóbal and ending at Pinta Island. After the visit, the Beagle left the Galápagos Islands and sailed west toward Tahiti.

During his visit to the Galápagos, one thousand kilometers west of South America, Darwin observed that the islands were all formed of volcanic rock. Although the archipelago is near the equator, Darwin observed that the climate was "far from being excessively hot," due to the "low temperature of the surrounding water, brought here by the great southern Polar current."

Darwin also carefully observed the animals in the Galápagos, finding species of birds, lizards, and tortoises unique to each island. Because the climate and geography of the islands were similar, he concluded that species had evolved in response to the different habitats of each island.

The Beagle encountered scarce (little) evidence of humans on the islands. Although the islands were visited by pirates, seal hunters, whalers, warriors, and scientists by 1835, there was only one established settlement, and that was a penal (prison) colony established by the Ecuadorian government on the island of Floreana. Even today, the residents of the Galápagos are citizens of Ecuador and speak Spanish as their native language.

Station 3

Instructions:

1. Working **INDEPENDENTLY** select **ONE** of the "Letter from the Galapagos" to read. You and your partner should choose different letters.

2. Taking turns with your partner, summarize the letter you chose for your partner out loud.

3. Answer and discuss out loud the following questions with your partner.

    1. What did each character observe while they were on the islands?

    2. What does this tell you about the landscape of the Galapagos Islands?

Letter 1. Fray Tomas de Berlanga

Fray Tomas de Berlanga, spiritual head of all the known and unknown Spanish territories in the Americas, was sent to Peru by the Pope to investigate conditions under the governorship of the conquistador Francisco Pizarro, especially charges that Native Americans were being treated cruelly. During eight days with no wind, en route to Peru, crew members sighted one of the Galápagos Islands and decided to go ashore for water.

6 April 1535, Berlanga's report to Charles V, the Holy Roman Emperor:

The water on the ship gave out and we were three days in reaching the island on account of the calms, during which all of us, horses as well as people, suffered great hardships. The boat once anchored, … some were given charge of making a well From the well there came out water saltier than that of the sea. … With the thirst the people felt, they resorted to a leaf of some thistles like prickly pears, and because they were somewhat juicy, although not very tasty, we began to eat of them and squeeze them to draw all the water from them. [Before fresh water was located, on the third day ashore, three men and ten horses died of thirst.]

On a second island we saw many seals, turtles, iguanas, tortoises, and many birds like those of Spain, but so silly that they do not know how to flee, and many were caught in the hand. On the whole island, I do not think that there is a place where one might sow a bushel of corn. It is as though God had sometime showered stones; and the earth there is worthless, because it has not even the power of raising a little grass.

Letter 2. Captain John Cook

In the l7th century, Spanish ships carrying wealth from South America were tempting prey for pirates. Pirate Captain John Cook called his ship the Bachelor's Delight, and his crew of buccaneers the "Merry Boys." He found the Galápagos, for all their inconveniences, ideal places to hide while waiting for a passing ship.

8 March 1684, from Cook's journal:

We landed at Lobos to mend our caravel [ship] and spy for galleons After we had been watching for about a week we sighted three tall Spanish treasure ships. Because we had the advantage of surprise, we were able to overpower them easily. We captured 100 prisoners, but when we ransacked their stores we found no gold, but only much timber; 1500 bags of flour; and eight tons of quince marmalade. One of the prisoners laughed in our faces and told us that his ship, the flagship of the fleet, had left Lima with 800,000 pieces of eight. When they landed at Guanchoco for water and fresh provisions, however; they heard that our caravel had been sighted, so they left the gold pieces there for safekeeping.

When we came to anchor in a very good harbor; lying toward the northernmost end of a fine island under the equinoctial [equator]. This was one of the islands the Spanish call enchanted islands, saying they are but shadows and no real islands. Here being great plenty of provisions, as fish, sea and kind tortoises, some of which weighed at least 200 pound weight, which are excellent good food. We put in at many other islands, but we could find no good water on any of all these, save on the San Salvador Island. Some Of the Spanish cargo we left in caves on the islands another time that we have need.

Letter 3. Captain James Colnett

The whaling industry dominated shipping in the 18th century. By the end of that century so many whales had been killed that they began to be scarce in the Atlantic. Great Britain's Royal Navy loaned the services of the experienced Captain James Colnett to a whaling company interested in exploring the Pacific. On one of his many voyages around the Galápagos, Colnett may have set up the post office barrel on Santa María Island. To this day visiting ships check the barrel for outbound mail.

1792, Colnett's journal entry (no day or month noted):

I frequently observe the whales coming, as it were, from the main and passing along from the dawn of day until the night in one extended line, as if they were in haste to reach the Galápagos. It is very much to be regretted that these isles have been so little known but only to the Spaniards.

On reaching the South point of San Salvador Isle I got sight of three other islands which I had not seen before. The Southernmost, which I named Barrington Isle, is the largest and was the greatest distance from me. … This isle appears to have been a favorite resort of the buccaneers, as we found not only seats, which had been made by them of earth and stone, but a considerable number of broken jars scattered about…in which the Peruvian wine and liquors of that country are preserved. We also found some old daggers, nails, and other implements.

Letter 4. Captain David Porter

During the War of 1812, the United States was the underdog. As underdogs have always done, American strategists looked for indirect ways to harass their opponent—in this case the superior, but overextended, British Navy. One of the most successful of such operations was led by Captain David Porter and based in the Galápagos. With only one ship, the Essex, Porter managed to capture more than half of Great Britain's whaling fleet. Letters intercepted from the post office barrel on Santa María Island helped him to accomplish his mission.

1812, from Porter's report to his superiors:

Although we knew from the letters that ships were to be expected, we waited two anxious weeks in the Galápagos before we saw the first sail. The prized [captured] ships were worth our wait, however, containing many provisions of which we stood in great need. We obtained an abundant supply of cordage [rope], canvas, paints, and tar, all of the best quality. We found on board of them also fresh meat to furnish our crew with several delicious meals. They had been in at James [San Salvador] Island, and had supplied themselves abundantly with those extraordinary animals which properly deserve the name of elephant tortoise. The most valuable item of all we captured, however, was water, even though it was contained in the oily casks of the whale-ship, and from them derived no very agreeable taste or smell.

I would advise every vessel visiting the Galápagos to lay in good store of that necessary article, for all the fresh water in the islands owes its existence to temporary rains, and cannot be relied upon. We did however find fresh food to counteract the scurvy, both an herb resembling spinach and other fresh herbs. We found prickly pears in great abundance, stewed them with sugar, and used them to make excellent pies, tarts, etc., which helped to keep the men healthy.

Letter 5. Charles Darwin

In 1835 Charles Darwin spent five weeks in the Galápagos. What he saw there was to occupy his mind for the rest of his life and influence the thinking of all future generations. His first impression of the islands, however, like that of most visitors, was rather negative. When his party landed a boat on San Cristóbal Island, the black sand burned their feet right through their shoes.

1835, or later, Darwin's Diary notes:

The black rocks, heated by the rays of the vertical sun like a stove, give to the air a close and sultry feeling. The plants also smell unpleasantly. The whole country was like we might imagine the cultivated parts of [hell]. The rocks on the beach are frequented by large (2–3 ft.) most disgusting clumsy lizards. They are as black as the porous rocks over which they crawl and seek their prey from the sea. Somebody calls them "imps of darkness." They assuredly well become the land they inhabit.

Letter 6. Early Galápagos Settler

William Beebe's 1924 book about the islands, Galapagos, World's End, was an international bestseller. The idea of living astride the equator was particularly appealing to people in cold northern climates. Many Norwegians responded to an advertising campaign mounted by the unscrupulous Harry Randall who charged potential emigrants large sums of money for resettlement in the Galápagos. Within two years, all but a handful of the settlers had died or gone home.

1927, from a settler's letters home:

As you know, Klaus and I paid Mr. Randall a total of 6,000 kroners, our life savings. Then we borrowed from both our families and sold everything we owned to purchase cows, chickens, seeds, tools, timber, a tractor and fishing equipment. I even sold my wedding ring to buy a drill, since Randall told us there were diamonds to be mined in the islands. After a long and dangerous journey, we landed on Santa María Island. You cannot imagine the scene that met our eyes! There was nothing but hideous, bare, black rock, with grotesque animals, spiny cactuses, and a cold, soaking rain over everything.

The next day we went to work and began building houses, roads, and dams to store water. In the morning the rains came again, and washed everything away. When there is no rain, our stored water leaks out through the cracks in the rock. This is a land that makes people go insane. The only creatures that thrive are the cattle and chickens we brought, and the pigs and dogs that other families brought with them. The animals of the islands are monsters not fit to eat, though they seem not to mind our intrusion. How I long for all of you at home!

Letter 7. World War II Nurse

World War I had little or no impact on the Galápagos, but as World War II approached and the importance of air power grew, the islands were recognized for their strategic location. In 1938, American President Franklin Roosevelt visited the islands, which had come to be known as the Achilles' heel (or weak spot) of the Panama Canal. In 1942 the U.S. Air Force built a base on Baltra Island (located just north of Santa Cruz), both to shield the Canal and to prevent the islands from being used as a base by the Japanese. After the United States abandoned the base in 1947, its materials were recycled into homes all over the islands, and the Ecuadorian Air Force established its own headquarters on the island. Most visitors to the Galápagos now arrive on Baltra, and depart from there.

1942, letter written by an American nurse:

Never has this island heard such noise—at least not since the last time the volcano erupted! Our engineers are using tons of dynamite to blast the lava level enough for an airstrip. For two of them, in fact. Plans call for a pair of landing strips, each 1800 meters long (about a mile). There have been some accidents, of course, but nothing worse than the loss of a few fingers. I doubt if any of the hearing loss the crew has suffered will be permanent. Our corps is also building hospitals, such as the one where I will work, roads, and a water distillation plant, so we'll no longer need to fill up our living space with bottled water. I suspect that once the work is done both crew and officers will find this service boring, but perhaps by that time the war will be over. Here, though we keep watch 24 hours a day for Japanese planes, we are so far away that we can almost forget the bloodshed.

Letter 8. Dr. Carole Baldwin

The El Niño events are an opportunity for some scientists and a setback for others, just as they were a boon to some species and a disaster for others. The rhythm of nature was thrown off course, and so was the rhythm of work at the Charles Darwin Research Station (CDRS). Life gradually goes back to normal, but after the 1982–83 El Niño there was so little rain that when fires broke out in 1985 there was not enough water to put them out. The CDRS burned that year, along with most of its contents. Fires on Isabela Island raged from February to July. In 1998–99 the Smithsonian and Imax Ltd. led expeditions to the islands to make their 3D film Galapagos. Below is a journal entry from Smithsonian marine biologist Dr. Baldwin, made during that the 1999 trip, noting the aftereffects of the 1997–98 El Niño.

10 February 1999, Puerto Ayora:

A lot has changed in the six months that we've been away. After the heavy rains of El Niño, it is now about as dry as it gets. Local naturalist Godfrey Merlin told me yesterday at CDRS that this dry spell following El Niño happened in the severe 1983 episode as well. One extreme to the other—truly a tough set of circumstances for the animals and plants. So now, the finches are not nesting, the vegetation is dying (although the Acacia trees are simply brilliant with their masses of orange or yellow flowers), upwelling has apparently resumed leading to large growths of algae (we shall soon see for ourselves), and the marine iguanas are looking nice and fat!

Got a good picture yesterday of a marine iguana on the rocks outside my hotel room. I had just read that one species of finch acts as a "cleaner" of marine iguanas. During cleaning, the iguana apparently stands on all fours like a cat. When I got close enough to the iguana outside my room to get a full-frame shot, there was a finch hopping around on him and picking up things, presumably parasites. This lifestyle of "cleaners" has evolved many times it seems at least in birds and fishes. While it's fairly easy to understand how such a relationship between a finch and a vegetarian iguana formed, it's much more difficult to imagine the events that led to, for example, a small fish being able to swim safely inside and "clean" the mouth of a large, fish-eating fish!

Station 4

Instructions:

1. With your partner, use the iPad to watch the video “Theory vs. Hypothesis.”

2. Paste the lyrics into your science notebook.

3. Answer the question in your science notebook. **Please answer in complete sentences.**

    1. What is the difference between a theory and a hypothesis?

Theory versus Hypothesis

You got the Theory and the Hypothesis
But have you ever wondered what the difference is?
You got the Theory and the Hypothesis
But have you ever wondered what the difference is? GO!

You hear it all the time, people tell you about their theories
But what they mean to say is that they have hypotheses

Hypotheses are the ideas that can be tested
You do it all the time, they're called educated guesses

Hypotheses are based on **observations**
And **testing** is done for further evaluation
Evidence is gathered to disprove or support it
Theories contain hypotheses that support them
Hypotheses are the ideas that people are working on
And theories are the explanations of phenomenons

Theories are **precise** and Theories **define**
Theories contain contributions from remarkable minds

The study of Physics is Pretty Amazing
Explains the universe with mathematical equations
But luckily you don't need a PhD
To understand what String...Hypothesis...means
...That sounds weird doesn't it?

The theory of evolution explains life on our planet
The theory of relativity explains motion and standing

And some of these theories are extremely old
But that doesn't mean that they're set in stone
Because Theories are modifiable and reject-able
If and only if new evidence is acceptable

Science is cool and it's always changing
The greatest tool ready for new information

I know it sounds cool, but now that we know what the difference is
Instead of a theory what you've got is a Hypothesis
I know it sounds cool, but now we know what the difference is
Instead of a theory what you've got is a Hypothesis
(Now a little quiz)
Dark Matter, Theory or Hypothesis?
Dark Energy, Theory or Hypothesis?
String Theory, Theory or Hypothesis?

I'll give you the hook to think of this

You've got the Theory and the Hypothesis
But have you ever wondered what the difference is?
You got the Theory and the Hypothesis
But have you ever wondered what the difference is? Go!

Dark Matter, is a Hypothesis
And that's because we don't have enough evidence

Dark Energy is a Hypothesis
And that's because we don't have enough evidence

String Theory is pretty tricky
The math checks out but we don't have enough evidence

Relativity It's a theory ya'll
It concisely explains a phenomenon

And Gravity it's a theory ya'll
It concisely explains a phenomenon

But...it's also a law
Uh-oh looks like we have to write another song!

Theory versus Hypothesis

You got the Theory and the Hypothesis
But have you ever wondered what the difference is?
You got the Theory and the Hypothesis
But have you ever wondered what the difference is? GO!

You hear it all the time, people tell you about their theories
But what they mean to say is that they have hypotheses

Hypotheses are the ideas that can be tested
You do it all the time, they're called educated guesses

Hypotheses are based on **observations**
And **testing** is done for further evaluation
Evidence is gathered to disprove or support it
Theories contain hypotheses that support them
Hypotheses are the ideas that people are working on
And theories are the explanations of phenomenons

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And that's because we don't have enough evidence

Dark Energy is a Hypothesis
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String Theory is pretty tricky
The math checks out but we don't have enough evidence

Relativity It's a theory ya'll
It concisely explains a phenomenon

And Gravity it's a theory ya'll
It concisely explains a phenomenon
But...it's also a law
Uh-oh looks like we have to write another song!

Station 5

Instructions:

1. Read the article with your partner (either out loud or silently).

2. Answer the following question through discussion with your partner and then **write the answers** in your science notebook.

    1. What is artificial selection?

    2. How does artificial selection support Darwin's hypothesis?