Lesson 4.8: Life Science – Darwin & Evolution

Weekly Focus: Reading Comprehension
Weekly Skill: Taking Notes from Video/Lecture

Lesson Summary: This week students will watch a well thought out video explaining the background of evolution. Students will practice note taking and answering questions while watching the video. Then they will read a passage about Charles Darwin's theory of natural selection.

Note: These can be very controversial subjects. However the material presented in the videos and reading passages contain a lot of information that may be on the 2014 GED Science test. Time is spent at the beginning of the lesson to review the goals of science which may help with working with a controversial subject. **Please remind students of a mid-unit review quiz next week.**

Materials Needed:

- Video **Unit 4.8 – Evolution** (8:53 min)
- Video Note Sheet **Unit 4.8 Handout 1**
- Comprehension Reading **Unit 4.8 Handout 2**
- Extra Work/Homework **Unit 4.8 Handout 3** (Spectrum Science, Grade 6, pages 48-49)
- "Theory of Evolution" Note Pages

Objectives: Students will be able to…

- Read comprehension passages with vocabulary related to evolution and natural selection.
- Practice taking notes from a lecture or video presentation.

College and Career Readiness Standards: RI, RST, WHST

ACES Skills Addressed: EC, LS, ALS, CT, SM

Notes: Please review and be familiar with classroom routine notes for: handling controversial topics (**Routine 5**), reading for fluency strategies (**Routine 2**), summarizing techniques (**Routine 4**), self-management skills (**Routine 1**). The notes for the different activities will help with making a smooth transition to each activity.

GED 2014 Science Test Overview – For Teachers and Students

The GED Science Test will be 90 minutes long and include approximately 34 questions with a total score value of 40. The questions will have focus on three content areas: life science (~40%), physical science (~40%), and Earth and space science (~20%). Students may be asked to read, analyze, understand, and extract information from a scientific reading, a news brief, a diagram, graph, table, or other material with scientific data and concepts or ideas.

The online test may consist of multiple choice, drop down menu, and fill-in-the-blank questions. There will also be two short answer questions (suggested 10 minutes each) where students may have to summarize, find evidence (supporting details), and reason or make a conclusion from the information (data) presented.

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The work students are doing in class will help them with the GED Science Test. They are also learning skills that will help in many other areas of their lives.

Activities:

Warm-Up: KWL Chart	Time: 10 - 15 minutes

- As students enter the class, have the following written on the board or overhead **"The goal of science is to find the best possible explanations for natural occurrences. Scientists seek to understand why the natural world is the way that it is, as well as how the natural world works."** Have students create a **"KWL"** chart on a piece of notebook paper (below). This helps to activate students' prior knowledge by asking them what they already **K**now (column 1); students (collaborating as a classroom unit or within small groups) set goals specifying what they **W**ant to learn (column 2); and after reading students discuss what they have **L**earned (column 3).
- Students apply higher-order thinking strategies which help them construct meaning from what they read and help them monitor their progress toward their goals.
- *This may seem like a very "vague" KWL chart topic for writing, but the idea is to get students thinking of the goals of science and thus, the goals for the 2014 GED Science module.*

KWL Chart:

K - What (else) do I KNOW?	W - What do I WANT to know?	L - What did I LEARN?

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Activity 1: Notes from Video / Lecture (Unit 4.8 Handout 1)	Time: 40 - 45 minutes

1) Distribute the handout (**Unit 4.8 Handout 1**) to students. The video is about evolution. You may want to review how to handle working with controversial topics (Classroom routines Handout 5).
2) Have students preview the questions prior to watching the video. See if they know or can predict any of the answers.
3) Have students watch the video. You may have to show the video two times – the first time for students to get the overall idea of the video and a second time for them to fill in the blanks with information (time permitting).
4) After watching the video, ask students to check on their answers with classmates. Then review answers as a class. They can also fill in the "**L**" portion of the KWL chart from today's warm up.
5) The next activity in this lesson is to gain a better understanding of vocabulary and ideas related to the reproduction and meiosis.

Break: 10 minutes

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Activity 2: Comprehension Reading (Unit 4.8 Handout 2)	Time: 45 - 50 minutes

1) Hand out **Unit 4.8 Handout 2** to students.
2) Explain to students they will continue with a reading passage on natural selection and evolution. This information is important foundational knowledge for questions that may be on the 2014 GED Science module. This can be a controversial subject matter. It may be useful to refer to the classroom routines handout on this (Routine Handout 5).
3) Discuss with students that when reading for comprehension, there are many strategies to use: read the title to predict what the reading is about; look at the words in bold and their definitions on the left side of page; if there are images, look at them to get a better understanding; while reading remember to ask "What is this all about?"
4) Have students read the passages independently while answering the questions on each page.
5) Circulate class while they are reading to make sure they understand the information presented and see if there are any questions.
6) Review answers as a whole class. Ask students to point to the evidence from the reading passage that helped them determine the answer.
7) If there is time, students can summarize the reading or write a main idea.
8) Students can fill in the **"L"** portion of the KWL chart.

Wrap-Up: Summarize	Time: 5 minutes

Have students turn to a partner (or write in their journals) about what they have learned today about the theories of natural selection and evolution. Ask them to tell a partner one thing they learned today in one or two sentences. *Note: Use Routine 4 Handout*

Extra Work/Homework: Unit 4.8 handout 3	Time: 30 minutes outside of class

Students can continue work with another reading passage on the theories discussed today. These are controversial subject areas and students may be asked to write about them on a test in the future.

Differentiated Instruction/ELL Accommodation Suggestions	Activity
If some students finish early, they can turn their paper over and summarize the reading passage.	**Activity 1 and Activity 2**
Teachers should be aware that ELLs could have some difficult time with some of the vocabulary encountered in the handouts for Activity 1 & 2. Encourage them to look for context clues in the reading that will help them with interpreting the main idea of each reading passage.	**Activity 1 & 2**

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Online Resources:

If students have Internet connection, they can try their hands at an online quiz with questions on genetics and evolution.

http://www.lessonplansinc.com/lessonplans/demo_evolution_theory.html

Another resource is from the University of California, Berkeley. (Note, it is perhaps for students who have higher level of reading) Go to site, click on "Go to this resource" at the top of the page, read and respond to prompts.)

http://evolution.berkeley.edu/evolibrary/search/lessonsummary.php?type_id=12&thisaudience=13-16&resource_id=217

Suggested Teacher Readings:

- GED Testing Service – GED Science Item Sample (to get an idea of what the test *may* be like)

http://www.gedtestingservice.com/itemsamplerscience/

- Assessment Guide for Educators: A guide to the 2014 assessment content from GED Testing Service:

http://www.riaepdc.org/Documents/ALALBAASSESSMENT%20GUIDE%20CHAPTER%203.pdf

- Minnesota is getting ready for the 2014 GED test! – website with updated information on the professional development in Minnesota regarding the 2014 GED.

http://abe.mpls.k12.mn.us/ged_2014_2

- Essential Education's 2014 GED Test Curriculum Blueprint (PDF)

http://www.passged.com/media/pdf/educators/curriculum-blueprint.pdf

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Unit 4.8 handout 1

What Exactly Is Evolution?

Answer following questions and take notes while watching the video on evolution.

1. How is evolution defined in biology? _____

_____

2. What is DNA compared to? _____

3. What are errors that modify the DNA called? _____

4. From where did all dogs originally evolve? _____

5. Who guided the evolution of wolves over the generations? _____

6. What is the name of the process discovered and defined by Darwin and Wallace?

_____

Notes:

_____

_____

_____

Survey about Science (not from video – these are your thoughts):

7. What is a scientific theory? Give an example.

_____

_____

8. What is a scientific law? Give an example.

_____

_____

9. Why is evolution called a theory?

_____

_____

Unit 4.8 Handout 1

TEACHER ANSWER KEY

What Exactly Is Evolution?

1. How is evolution defined in biology?

Any change in the heritable traits within a population that across generations.

2. What is DNA compared to**?** **A chain like chemical stored in each one of our cells**

3. What are errors that modify the DNA called? **mutations**

4. From where did all dogs originally evolve? **Grey wolves**

5. Who guided the evolution of wolves over the generations? **Humans**

6. What is the name of the process discovered and defined by Darwin and Wallace?

Natural selection

Survey about Science (not from video – these are your thoughts):

7. What is a scientific theory? Give an example.

Answers may vary: Possible answer: A scientific theory explains some aspect of the natural world through many observations. It also makes predictions about future observations based upon the past observations. A theory in science is not a "guess" it has well documented explanations of observations. An example is the theory of evolution.

8. What is a scientific law? Give an example.

Answers may vary: Possible answer: A scientific law is a statement based on repeated experimental observations that describes some aspect of the world. A scientific law always applies under the same conditions, and implies that there is a causal relationship involving its elements. Newton's Law of Gravity is an example.

9. Why is evolution called a theory?

Answers may vary: Possible answer: Evolution is called a theory because it uses a collection of laws or facts to explain it.

Unit 4.8 Handout 2 (5 pages total)

A Bird With Many Beaks

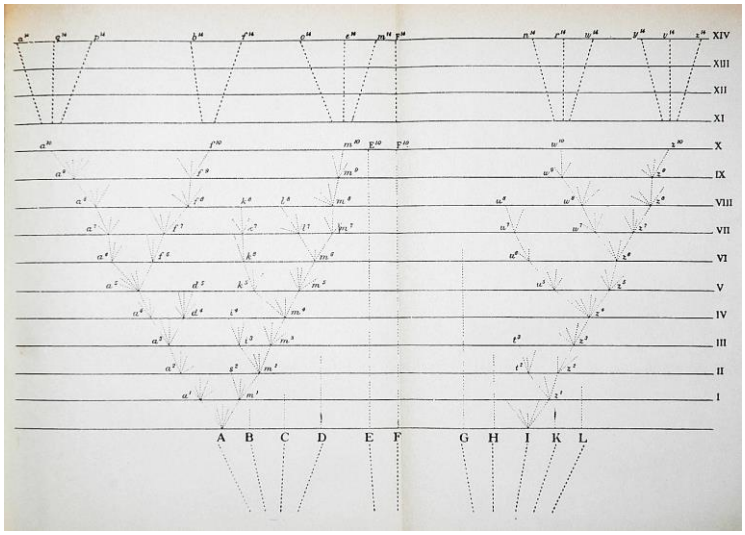

Diagram representing the divergence of species, from Charles Darwin's "On the Origin of Species"

When the famous naturalist Charles Darwin, who helped develop the theory of evolution, visited the Galápagos Islands in the 1830s, he made an interesting discovery about native birds. He noticed that 13 different species of finches were all very similar, but differed in the size and shape of their beak. Some of the birds had long, thin beaks, while others had short, thick ones; others still had shapes somewhere in between. Darwin hypothesized that these species all came from a common ancestor—a single species of bird that later evolved into the 13 distinct species he had observed. But how and why did this happen? Why did all the birds not have beaks of the same length?

Darwin noticed that each of the species occupied separate islands in the Galápagos. On each of these islands, the finches subsisted on different types of food. On one island, for example, they lived on grubs and other small insects, while on another, they ate fruits and nuts. Darwin then made an important connection between the shape of the finches' beaks and the kind of food they lived on. Each beak, he realized, was suited to their diet. Darwin observed that the finches with long, thin beaks lived in places where they had to reach between rocks to gather

insects, while finches with thick, claw-like beaks lived on islands where they used their beaks to break open nuts.

Now, someone else might have just considered this a remarkable coincidence. But these finches turned out to be crucial in helping Darwin shape his theory of evolution. Darwin realized that the birds had grown beaks specialized for their environment because nature had forced them to over many generations. Long ago, birds with many different types of beaks had probably been present on each island. However, over time, the birds with beaks better suited for each of the islands' food supply—for example, birds with long, thin beaks on islands where insects were prominent—had flourished, while finches with other kinds of beaks had dwindled. Over time, the poorly suited finches had died out altogether, leaving only those finches with proper adaptations to thrive.

The process, by which certain biological traits, such as a beak size, become more or less prominent in a specific environment, is known as natural selection. Natural selection is based on the idea that animals with specific biological traits well-suited to survive in an environment, will reproduce at a much faster rate than animals with biological traits that are poorly suited to an environment. Eventually, this means that the population of animals with well-suited biological traits will entirely replace the other animals that may become extinct. This can take many hundreds or even thousands of years to happen. The result is a situation like that which Darwin observed in the Galapagos, with many different species well-suited to their environment.

Without evolution, there would be no natural selection. Evolution refers to the process by which traits inherent to a species of animal change, and sometimes grow more specialized to the environment. For example, one theory that scientists have proposed is that humans evolved from a common, ape-like ancestor. It is believed that this happened as the humans gained larger brains and the ability to walk upright. These traits made them better able to reproduce than apes with smaller brains and poor posture, allowing the human population to grow. These evolutionary changes sometimes occur randomly. For example, a single member of a species may undergo a sudden mutation – like in X-Men comics – that gives it a new ability. Some scientists believe that, long ago, a single ape-like creature mutated so that he walked upright instead of on all fours. That ape continued to reproduce, and his ancestors developed other mutations until they became us – humans. However, because an individual member of a species undergoes a mutation, it does not necessarily mean that the rest of its species will die off. Apes continue to breed and survive to this day.

We can see examples of natural selection everywhere in nature. Let us examine insects. One of the greatest threats to the insect population over the last few centuries has been the use of pesticides. Pesticides are designed to kill all of a particular species of insect. However, if a single insect in that species undergoes a mutation, which allows him to survive the pesticide, then he is uniquely qualified to reproduce. As he reproduces, this trait is passed on to his children and to their children, and so on. Eventually, the population of insects that can be killed by pesticides falls, while

the population of insects immune to pesticides rises – just as the population of thin-beaked finches on islands with insects rose, while the other kinds of finches fell.

Charles Darwin may have been the first to describe the process of selective breeding. But the practice may be more than 2,000 years old. The Romans are said to have practiced selective breeding among their livestock, showing favor to cows that produced a lot of milk. But it wasn't until the 18th century that farmers began practicing it on a large, industrial scale.

Because insects breed very quickly, they are able to evolve more quickly too. Some insects are born, breed and die, all within a single day. This means you can have 30 generations of mosquitoes born within a single month. By contrast, 30 generations of humans—who can only breed at about 12 years of age, and usually wait until much, much later—would take centuries to be born. This means that natural selection occurs much more quickly in insects than in humans. A single insect that is resistant to pesticide may be able to produce hundreds of thousands of descendants in a single month, allowing the population of immune Insects to increase quite rapidly. For humans, any genetic mutation would take thousands of years to be reproduced in similarly large numbers.

However, sometimes evolution can work faster than we expect. More than 100 years after Darwin made his discovery with the finches, two scientists, Peter and Rosemary Grant, returned to the Galapagos to take a closer look at the finches. Beginning in 1973, the Grants began to mark, weigh and measure many of the Medium Ground Finches, a specific species of finch on one of the islands, Daphne Major. They did this every year and then compared the results with the previous year. These finches had almost no natural predators, so their survival was based mostly on the availability of food, which was usually based on weather conditions on the island.

For several years, the Grants noticed few dramatic changes in the traits of the finches. Then, in 1977, the island underwent an enormous drought. For almost two years, it did not receive a single drop of rain. Many of the plants on the island died, and the food available to the birds decreased. The finches had grown used to eating small seeds. But suddenly, only large seeds were available. However, birds with small beaks were unable to crack open these seeds – only the birds with large beaks could. The birds with large beaks thrived, while the birds with small beaks starved to death and died out.

The next year, the Grants returned and measured the beaks of the next generation of birds. They noticed that the average beak size of the finches was 4% larger than the beaks of their grandparents, who have lived before the drought. The drought, the Grants realized, had accelerated natural selection, so that profound changes occurred in merely a few years. Over the next 30 years, the Grants observed the beak size of the finches changing many times, usually in response to the changes to the food supply. In this way, they were able to document how natural selection and evolution occurred as a natural process in which a species reacted to changes in its environment.

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Comprehension Questions

1. Which scientific theory did Charles Darwin shape?

A. circumnavigation **B.** cell theory **C.** theory of evolution **D.** climate change theory

2. The passage describes the sequence of events by which an insect population can become immune to pesticides. Which event allows future generations of insects to become immune to pesticides?

A. A pesticide is designed to kill all of a particular species of insect.

B. Insects breed very quickly.

C. A single insect undergoes a genetic mutation that allows it to survive the pesticide and reproduce.

D. The population of insects that can be killed by pesticides falls.

3. The different types of beaks that Darwin found on finches in the Galápagos helped him shape his theory of evolution. What evidence from the text supports this conclusion?

A. The Grants discovered that a drought led to the increase of the size of finch beaks.

B. Darwin realized that birds had grown specialized to their environment because nature had forced them to.

C. Darwin found thirteen different types of finch beaks on the Galápagos Islands when he visited in the 1830s.

D. Evolution refers to the process by which traits inherent to a species of animal change.

4. Based on the text, why is natural selection important to the survival of certain animal species?

A. It leads to a population of animals that are able to change their environment.

B. It leads to a population of animals with the traits best suited for an environment.

C. It makes animals more aggressive and violent toward humans.

D. It leads to more cooperation between humans and animals.

5. What is this passage mostly about?

A. the way that birds find food to eat **B.** the way that farmers use pesticides

C. natural selection and evolution **D.** the history of Charles Darwin

6. Read the following sentences: "Darwin realized that the birds had grown beaks specialized for their environment because nature had forced them to over many generations. Long ago, birds with many different types of beaks had probably been present on each island. However, over time, the birds with beaks better suited for each of the islands' food supply—for example, birds with long, thin beaks on islands where insects were prominent—had flourished, while finches with other kinds of beaks had dwindled." As used in this passage, what does the word **"specialized"** mean?

A. well-trained and obedient

B. drastically mutated to become more powerful than a previous generation

C. well-suited for a particular environment

D. very talented

7. Choose the answer that best completes the sentence below.

Pesticides are designed to kill all of a specific kind of insect. _____, if just one insect undergoes a genetic mutation, it can pass that trait down and reduce the effectiveness of that pesticide.

A. Unless **B.** However **C.** Therefore **D.** Moreover

8. Describe one example of natural selection discussed in the passage.

_____

_____

9. Peter and Rosemary Grant discovered that the average finch beak size increased 4% after an extreme drought. Explain why the average finch beak size increased

_____

_____

_____

10. Explain how environmental conditions can affect the rate of natural selection. Use information from the text to support your answer.

_____

_____

Unit 4.8 handout 2

TEACHER ANSWER KEY

1. C

2. C

3. B

4. B

5. C

6. C

7. B

8. *Answer will vary. Suggested answer*: Students may take notes of Darwin's initial discovery of finches developing specialized beaks based on their food supply, the scientific theory that human life evolved from a common, ape-like ancestor, the resistance by insects to pesticides over generations, or the Grants' discovery that finch beak increased after the drought in the Galapagos.

9. *Answer will vary. Possible answer*: There will be a shorter life of the dairy cow.

Chickens that are bred for their large beasts cannot support the extra weight on their legs.

10. *Answer will vary, as long as they are supported by the evidence from the passage. For example if they explain that the process of natural selection can be accelerated by certain environment conditions, as was the case with the finches observed by the Grants.*

Theory of Evolution

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Biology

Big Picture

Darwin's voyage on the *HMS Beagle* to visit the Galápagos Islands in 1831 and his resulting theory of evolution proved to play an instrumental role in our understanding of the organisms on earth today, despite the extreme controversy of his theory at the time. He introduced the idea of natural selection, in which the animals that were best fit to the environment were most likely to survive and reproduce. We understand evolution by looking at three different aspects of an organism's life: what the fossils of similar organisms look like, how the organism compares with other current species, and what kind of impact the environment had on the organism.

Key Terms

Evolution: Change in characteristics of living things over time.

Natural Selection: Organisms better fitted to the environment are more likely to survive and reproduce than organisms who aren't fitted to the environment.

Fitness: How adapted an organism is to its environment.

Inheritance of Acquired Characteristics: Mistaken idea that animals whose traits changed in their lifetime could pass on those traits to their offspring. For example, a giraffe's neck can extend its lifetime and pass the trait for long necks to its offspring.

Artificial Selection: A human practice to select certain traits wanted in a certain species.

Comparative Anatomy: Study of the differences and similarities between different species.

- **Homologous Structure**: Organisms that have similar structures to organisms of other species because they descend from the same ancestor.
- **Analogous Structure**: Animals with analogous structures inhabit the same types of environments, or perform tasks that require them to have a certain trait. These animals must then adapt, causing them to have similar traits that perform the same job, but this does not mean that their evolutionary history is related to each other.

Comparative Embryology: Study of the differences and similarities between different species as embryos.

Vestigial Structure: Structure found in an organism that has no obvious use.

Biogeography: The study of the environmental role of why animals live in a certain area.

Adaptive Radiation: Process by which a single species evolves into many new species to fill available niches.

Darwin's Theory

During Darwin's trip to the Galápagos Islands located off the coast of South America, Darwin observed that the individual islands differed from each other in climate and soil. He also observed that the plants and animals on the islands differed. The tortoises on different islands had different shells, and it was possible to tell which island the tortoise came from by looking at the shell.

Darwin's observations helped him formulate his theory of **evolution**:

1. Organisms change, or evolve, over time.
2. Evolution occurs by **natural selection**.

Natural Selection

Natural selection explains the great diversity of life.

- Over time, the traits that are best suited to the environment will prevail and over time, the species will evolve.
- Organisms with physical traits that are best fitted to the environment will survive. **Fitness** refers to how well an organism is able to get food and produce fertile offspring. If there were two organisms with two different traits, the "more fit" organism would be better adapted to the environment than the other organism.
- Unlike the idea of **inheritance of acquired characteristics**, the phenotypes (and the underlying genotypes) of the organisms are the only important things to consider when understanding natural selection. An individual does not evolve; a population does.
- The survival and reproduction of the animals with the best traits to the environment causes a change in the genetic diversity of the population.

Artificial Selection

Humans can affect the evolution of a population or species by **artificial selection**. Artificial selection works much like natural selection does, but with humans, instead of nature, favoring specific traits.

For example, wolves were bred so that certain desirable traits would show up in the offspring. After thousands of years, these wolves evolved into the domesticated dogs we have today.

An organism does not have to be perfectly adapted; it just needs to beat the other organisms.

Biology

Theory of Evolution cont.

Evidence of Evolution

We can look at an animal's evolutionary history by studying the fossil record.

- Example: The fossil record shows that the whale evolved from a land-dwelling creature.

We can also use **comparative anatomy** to compare one living species with another and figure out how these species evolved.

- **Homologous structures**, such as the forelimbs of of mammals, suggest descent from a common ancestor. These structures may serve many different purposes, but they are still made up of similar parts.
- **Analogous structures**, such as the wings of bats and birds, have the same function, but examining the structures show that the organisms did not come from a common ancestor.

Comparative embryology compares living species at the embryo stage. Because embryos can have traits that do not appear in the organism in adulthood (**vestigial structures**), it is beneficial to compare embryos of different species because then one can tell if the two species ever had the same traits, or were related as a result of having the same traits.

- This is different from comparing species in adulthood because some vestigial structures disappear by adulthood.
- A vestigial structure means that the organism needed that particular trait before but the environment no longer calls for it.
- The human tail bone is an example of a vestigial structure.

DNA comparisons can also be used to understand how species evolved.

- DNA sequences can be used to estimate how long it has been since related species diverged from a common ancestor.
- Species with greater differences in their DNA sequences are assumed to have diverged from their common ancestor in the more distant past.

We can use **biogeography** to understand an animal's environment and the environmental niche the animal must fill.

- By understanding the patterns of the environment, we can predict the types of evolutionary changes in a certain species, as the species must adapt to the environment as the environment changes.
- As many populations within one species migrate to different environments, these populations will all adapt to their respective environmental niches, and over time, these changes will bring about many new species.
- An example of **adaptive radiation** is the finches that Darwin discovered on his trip to the Galápagos Islands. He noticed that the birds on various Galápagos islands had differing traits, matched to the types of food the environment had. Darwin hypothesized that the birds had evolved to better fit the environment, and because the islands were separated and had slightly different food, the birds had different traits depending on the island.

Figure: Here is a picture of the finches that Darwin observed on his trip to the Galápagos Islands. The beaks of the finches are slightly different from each other because each of the islands on the Galápagos have different environments and therefore different foods. The finches adapted to their respective environments, thus changing their physical features.

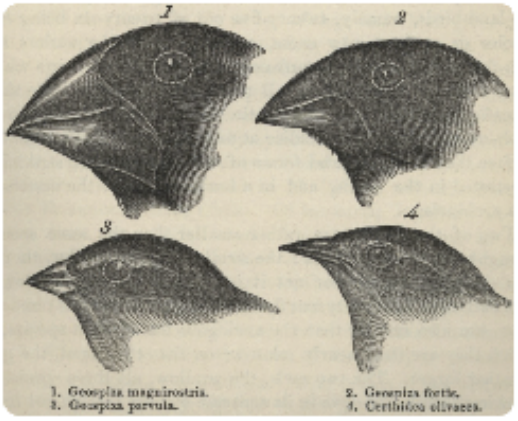

Image Credit: John Gould, Public Domain

Notes