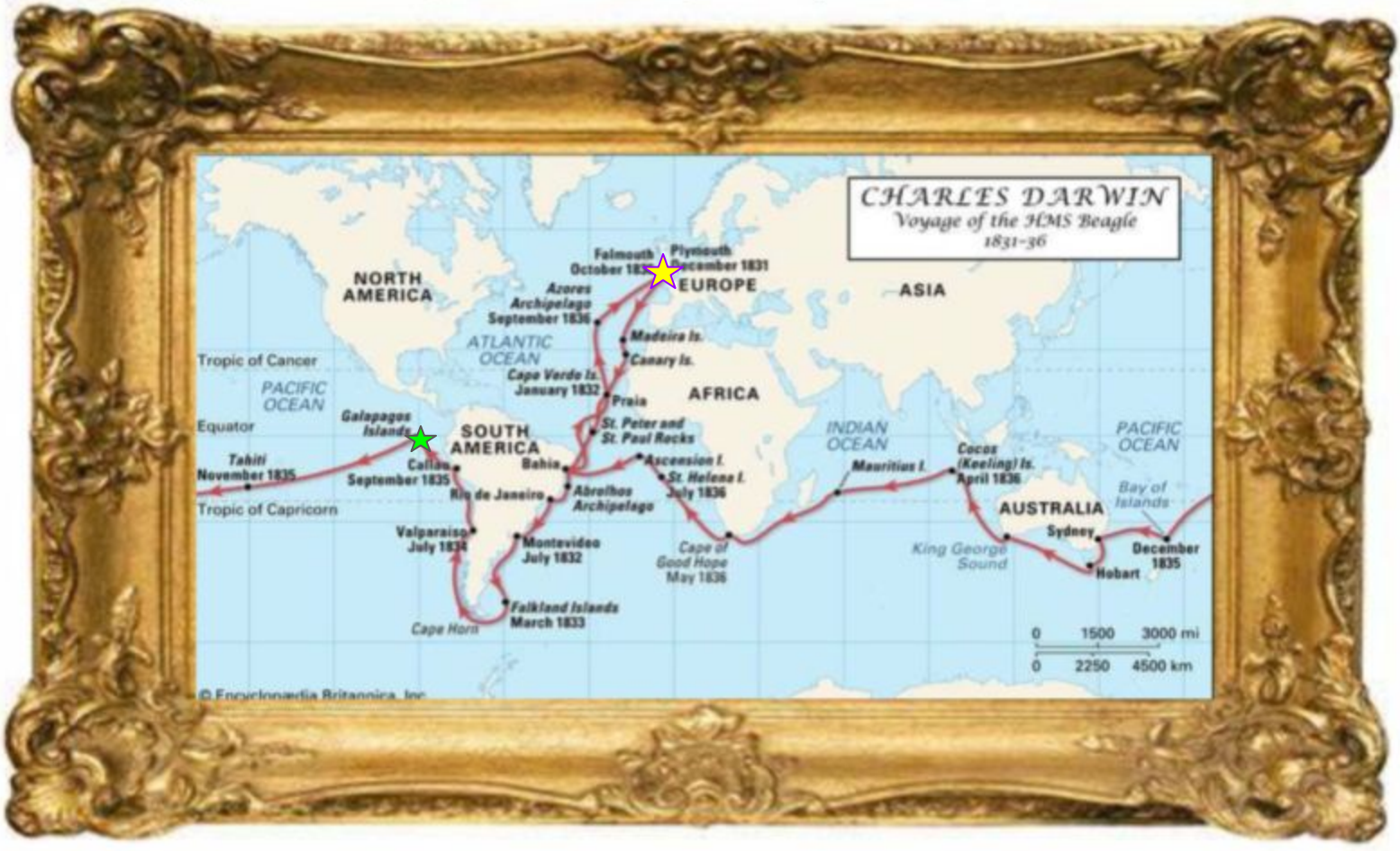
NOTES 6.2

Chapter 6 - The Environment and Changes Over Time
Lesson 2 - Theory of Evolution by Natural Selection

Charles Darwin

In 1831, 22-year-old **Charles Darwin** an English **naturalist**, left England on board the HMS Beagle on a 5-year trip around the world.

Q: What is a naturalist?
A: a person who studies plants and animals by observing them



Darwin's observations led him to develop one of the most important scientific theories of all time: the

Theory of Evolution by Natural Selection

On the ship's 1st stop in Argentina, on the coast of South America, Darwin was amazed by the tremendous diversity, or variety, of living things he saw.

Today, scientists have identified more than 1.7 million **species** of organisms.

Q: What is a species?
A: a group of similar organisms that can mate with each other and produce fertile offspring

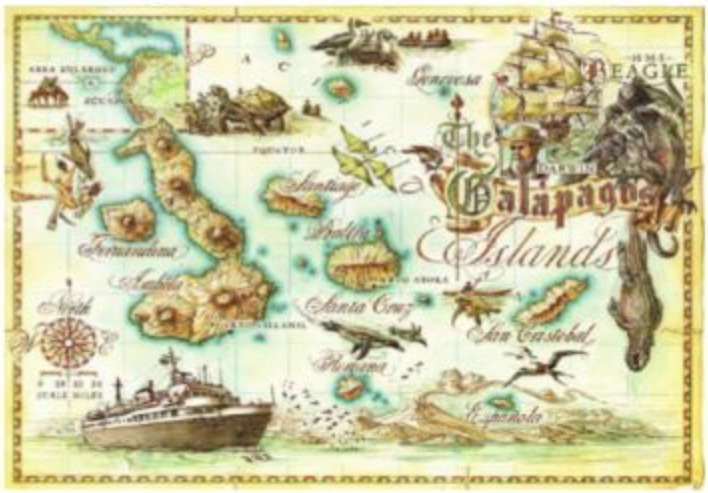
While in Argentina, Darwin saw something else that puzzled him: the bones of animals that had died long ago. He wondered what had happened to these creatures from the past.

In 1835, the Beagle reached the Galapagos Islands in the Pacific Ocean. Darwin was surprised that many of the plants and animals on the Galapagos Islands were similar to organisms in South America.

Ex. birds, plants etc.

However, there were also important differences.

Ex. birds who were able to fly on land but not on the island, iguanas with large claws on the island but with small claws on land



Darwin inferred that a small number of different species had come to the islands from the mainland. Eventually, their offspring became different from the mainland relatives.

Q: How did Darwin think plants and animals had originally come to the Galapagos Islands?

A: By boat, floated, swam

Adaptations

Darwin noted finally on the many differences among similar organisms as he traveled from one Galapagos island to the next.

Ex. tortoises with different shaped shells and eating habits

The tortoises on the Galapagos Islands were noticeably different from one island to another. The most obvious differences were the varied sizes and shapes of the tortoises' shells also known as an adaptations.

Q: What is an adaptation?
A: a characteristic of a species that enables the species to survive in its environment and reproduce

Ex. tortoises that ate tall plants had long necks; tortoises that ate short plants had short necks

Q1: Which species appear to be adapted to eating short plants?

A1: Domed tortoise

Q2: Which species appear to be adapted to eating tall plants?

A2: Saddleback tortoise

Q3: Which species appear to be adapted to eating both tall and short plants?

A3: Intermediate tortoise

Adaptations can be classified into 3 main types - structural, behavioral, and functional.

1. **Structural** adaptations - involve color, shape, and other physical characteristics

   Ex. the shape of a tortoise's neck, using camouflage to hide from predators or mimicry

Q: What is camouflage?
A: an adaptation that enables species to blend in with their environments

Q: What is mimicry?
A: the resemblance of one species to another species

copperhead   katydid

2. **Behavioral** adaptations - involve the way an organism behaves or acts

   Ex. hunting at night and moving in herds

3. **Functional** adaptations - involve chemical changes in body systems known as biochemistry or the study of chemical processes in living organisms

   Ex. a drop in body temperature during hibernation

Darwin's Theory

After returning home to England, Darwin continued to think about what he had observed on his voyage.

Darwin reasoned that plants and animals on the islands faced conditions that were different from those on the mainland.

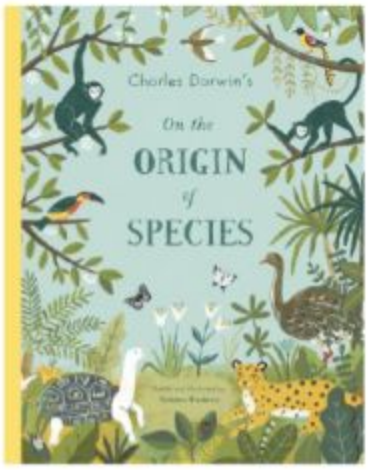
Perhaps, Darwin thought, the species gradually changed over many generations and became better adapted to the new conditions known as **evolution**

Q: What is evolution?
A: the gradual change in a species over time

Darwin's ideas are often referred to as the **theory** of evolution.

Q: What is a scientific theory?
A: a well-tested concept that explains a wide range of observations

In his book The Origin of Species, Darwin explained that evolution occurs by means of **natural selection**



Q: What is natural selection?
A: the process by which populations of organisms with variations that help them survive in their environments live longer, compete better, and reproduce more than those that do not have the variations

4 factors affect the process of natural selection –

1. **Reproduction** – most species produce far more offspring than will survive
   Ex. sea turtles
2. **Variation**
   Q: What is a variation?
   A: a slight difference in an inherited trait of individual members of a species as a result of reproduction
3. **Competition** - indirect struggle for food, resources, space, predation. etc
4. **Selection** - a variation is inherited by more and more offspring

Some variations make certain individuals better adapted to their environment because of helpful traits they possess.

Over a long period of time, natural selection can lead to evolution or a change in phenotype.

- ☑ Helpful variations gradually accumulate in a species, while unfavorable ones disappear.
- ☑ Without variations, all members of a species would have the same traits.
- ☑ Therefore, evolution by natural selection would not occur because all individuals would have an equal chance of surviving and reproducing.

Q: But where do variations come from?
A: from genes of course!

Only traits that are inherited, or controlled by genes, can be acted upon by natural selection.

Darwin's theory of evolution by natural selection explains how variations can lead to changes in species.

Q: But how does an entirely new species evolve?
A: by geographic isolation

Q: What is geographic isolation?
A: complete geographic separation that occurs when some members of a species become cut off from the rest of the species

A new species can form when a group of individuals remains separated from the rest of its species long enough to evolve different traits.

Hundred's of millions of years ago, all of the Earth's landmasses were connected as one landmass, known as *Pangea*.

Pangea gradually split apart in a process known as

continental drift

As these new continents formed, the species on them became isolated from one another and began evolve independently.

Geographic isolation has occurred in the past because of continental drift.

Artificial Selection

Humans can mimic natural selection in a process known as **selective breeding**

Q: What is selective breeding?
A: the process of selecting a few organisms with desired traits to serve as parents of the next generation

Ex. plants (corn, fruits/veggies bred to resist disease and insect pests) or animals (cows → milk)

2 types of selective breeding - inbreeding and hybridization

Q: What is inbreeding?
A: when 2 individuals with identical or similar sets of alleles are crossed

Ex. Mendel's purebred pea plants

Pros +

produces breeds of animals with specific traits

Ex. horses, Labs, & German Shepherds

Cons -

reduces an offspring's chances of inheriting new allele combinations that may lead to genetic disorders

Ex. hip problems & cancer in purebred dogs

Q: What is hybridization?
A: when 2 genetically different individuals are crossed to produce organisms with the best traits from both parents (used mainly in horticulture)

Ex. corn that produces many kernels and is resistant to disease