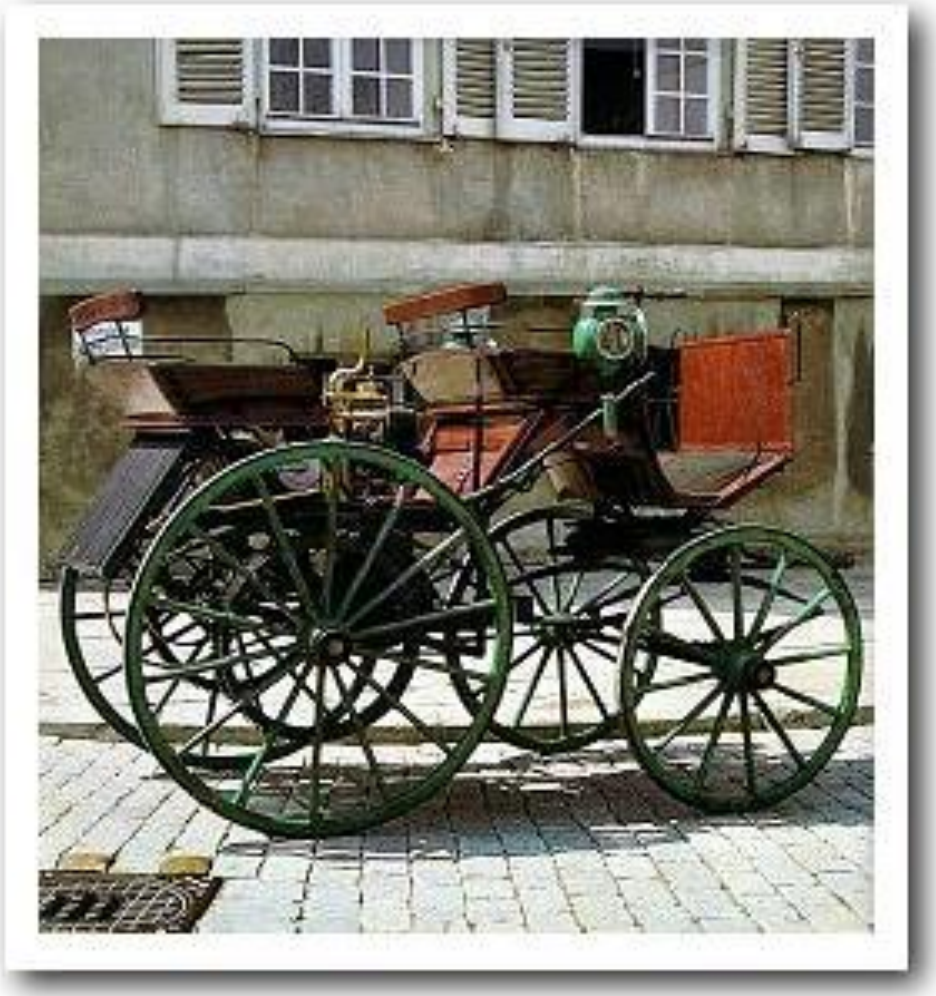
Natural Selection

Charles Darwin's Theory that Shapes the Scientific Study of Life

Purpose

- Understand the basics:
  - Evolution = change in a species over time
  - ONLY HAPPENS IN POPULATIONS **NOT** IN INDIVIDUALS!
- And understand *how* this happens:
  - Process of Natural Selection

Example of Evolution – The man made variety



Henry Fords first car. 1896

20 m.p.h.

4 hp

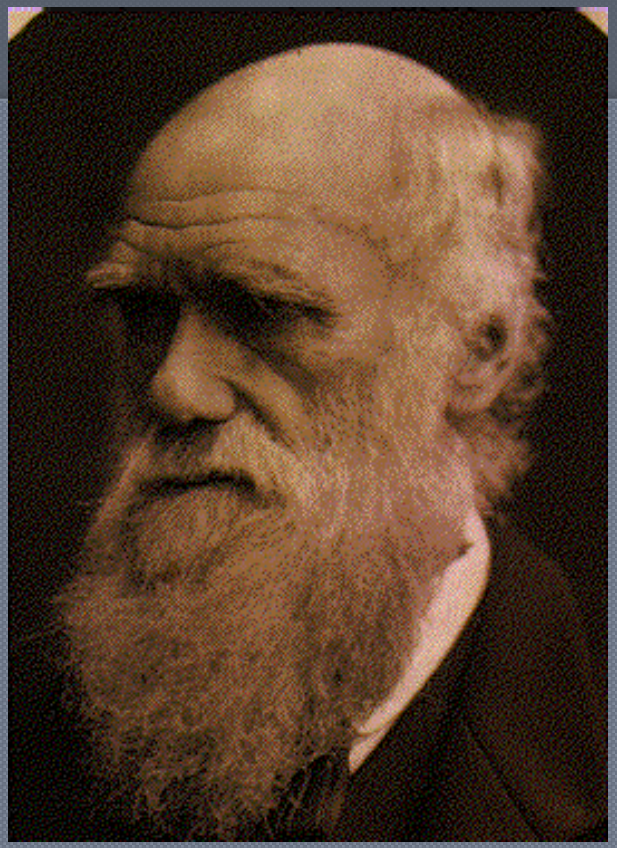
Bugatti Veyron Super Sport

267 m.p.h.

0-60 m.p.h in 2.4 secs

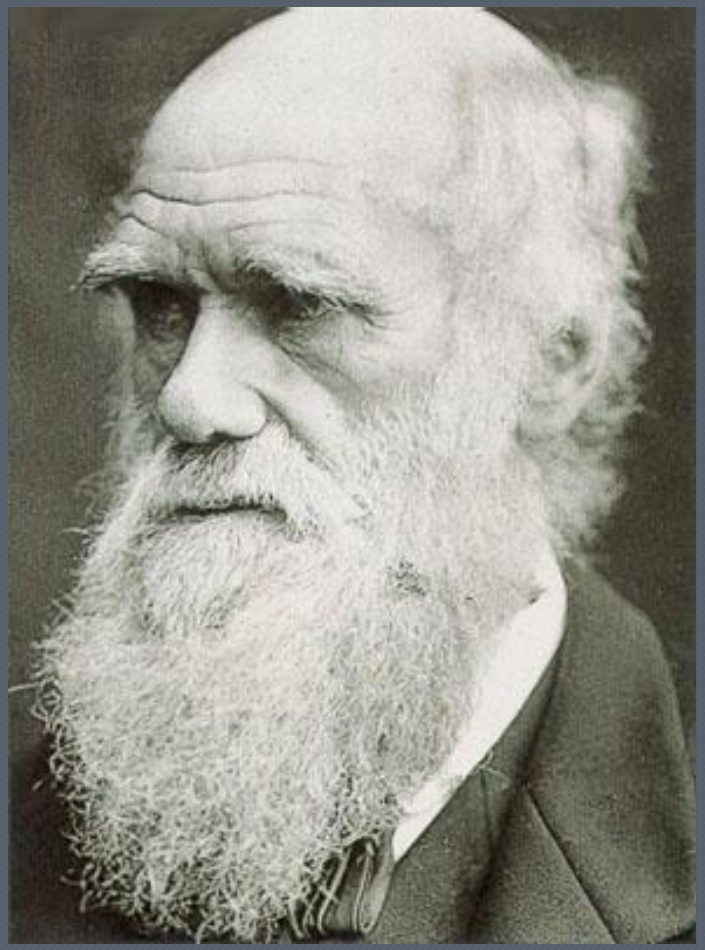
1200 hp

Charles Darwin: The Man Behind the Theory



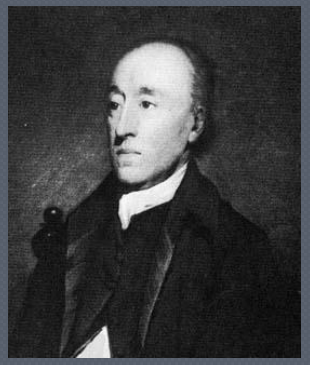
Charles Darwin

- Finished college and joined crew of H.M.S. Beagle
- Sailed around the world
- Made observations and collected evidence
- Formed theory of how life changes over time

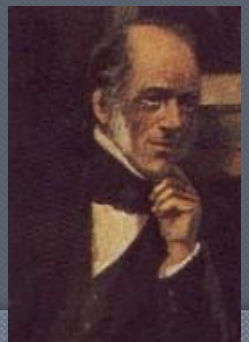


People who influenced Darwin

- **James Hutton**: Because geological forces that have shaped the earth take a long time, the earth must be very old.



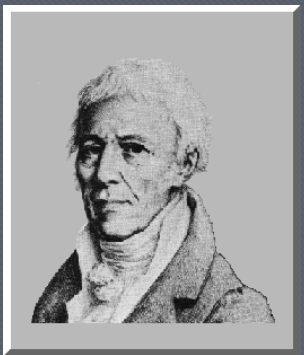
- **Charles Lyell**: Processes that are happening now have shaped the earth for a very long time.



People who influenced Darwin

- **Thomas Malthus:** Predicted that human population will grow faster than space & food supplies needed to keep it going.

- **Jean-Baptiste Lamarck:** Proposed theory of inheritance of acquired traits -- flawed, but still important because he was the first to try to explain *how* a species changed over time.



People who influenced Darwin

- **Alfred Wallace:** Shared similar ideas about natural selection -- helped motivate Darwin to publish his findings.

Idea that influenced Darwin

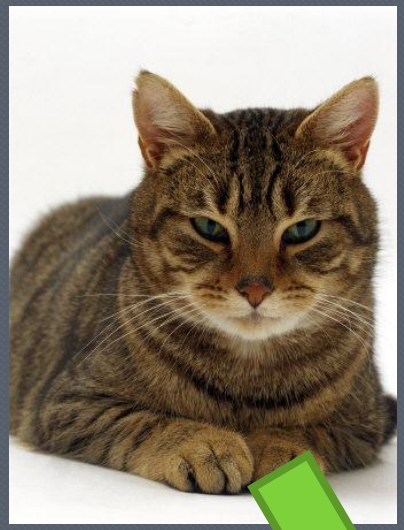
- **Artificial Selection:** Nature provided variations and HUMANS selected which traits they found most useful. Then humans bred individuals with those traits.

Example of Artificial Selection

- Labradoodle:
  - Mixes a Labrador Retriever and a Poodle
  - Poodle: Low shedding coat
  - Labrador Retriever: Gentle demeanor and trainability

Example of Artificial Selection

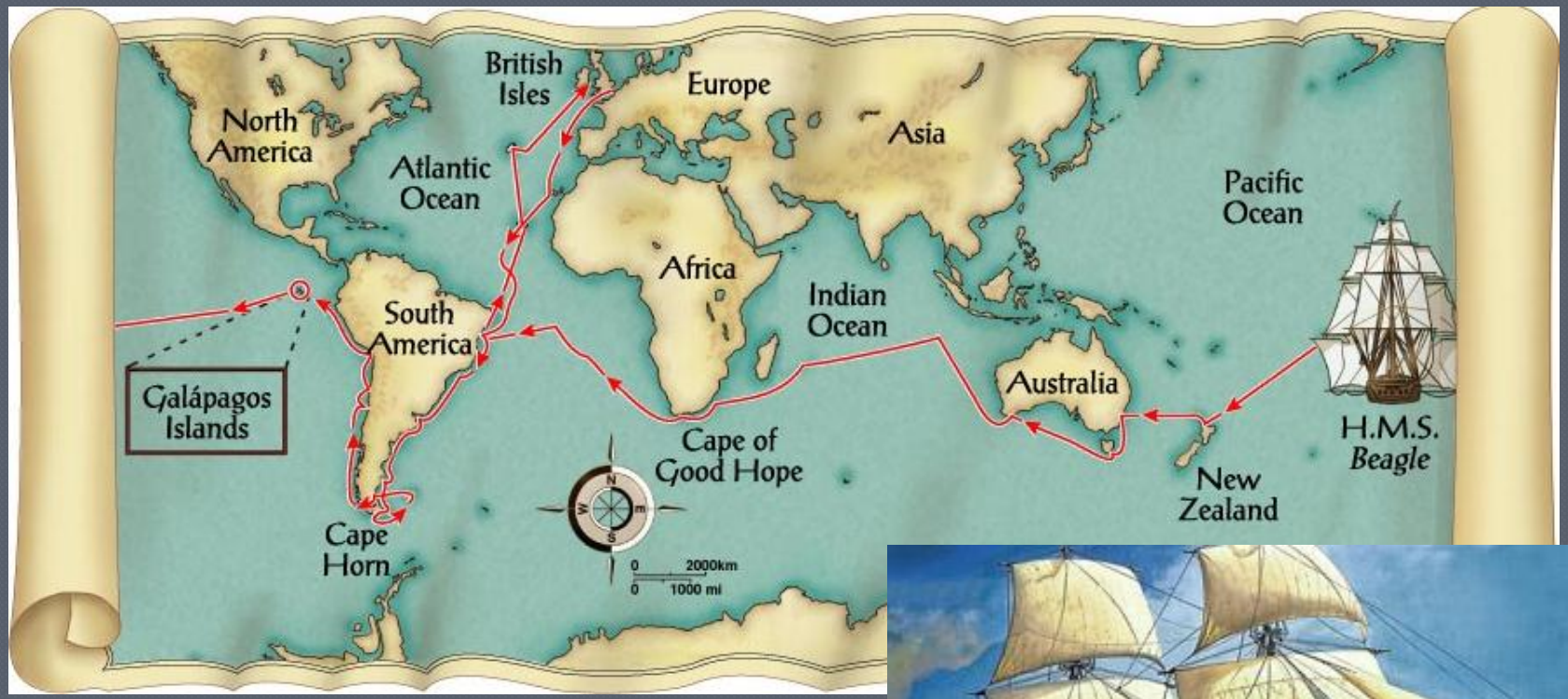
- Bengal Cat
  - Mixes a domestic cat with a wild Asian Leopard Cat
  - Domestic cat: Demeanor
  - ALC: Spotting and coloring



Example of Artificial Selection

Horse Breeding

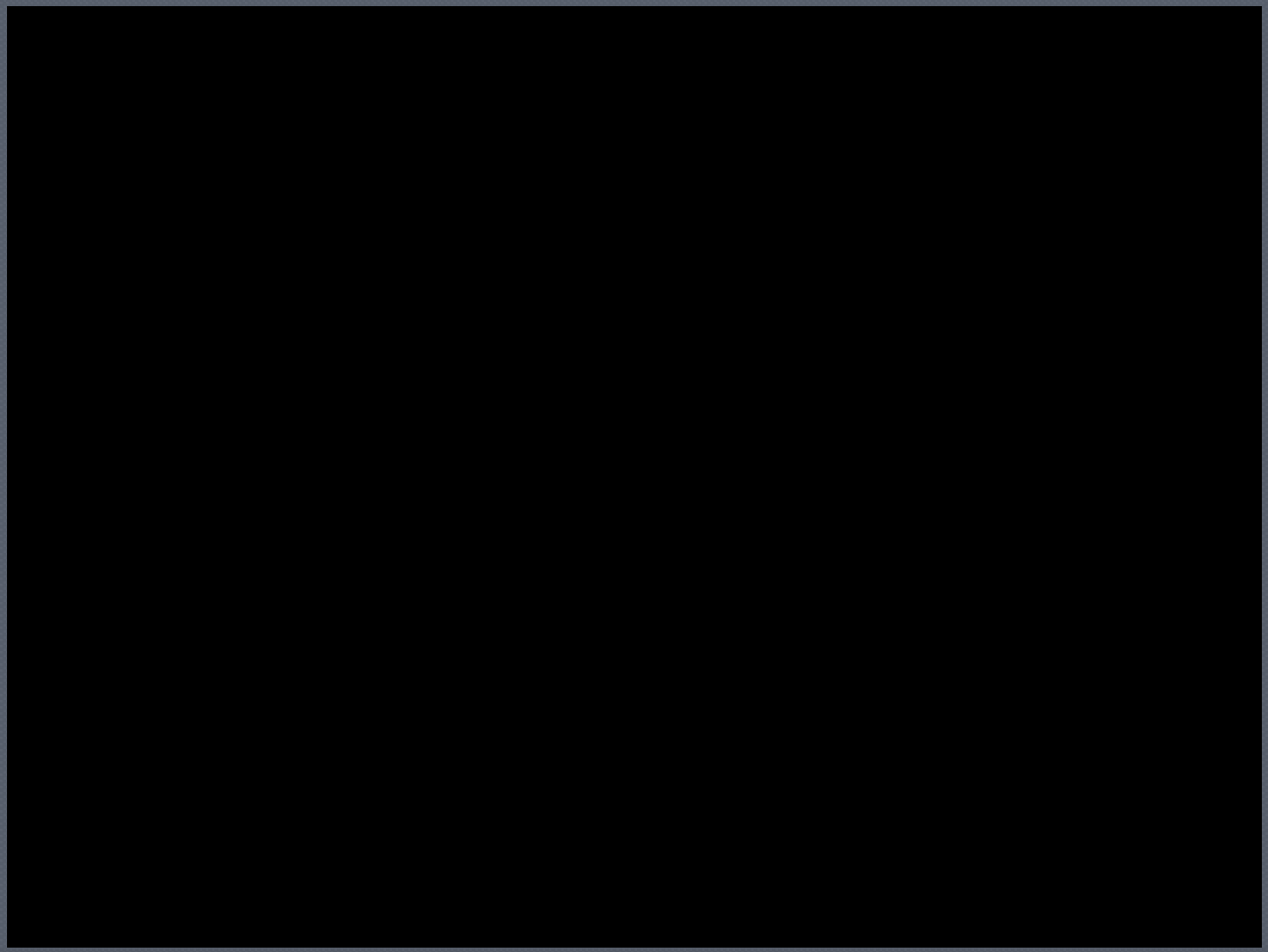
Darwin's Trip



Darwin's Findings

- Diversity
  - Darwin was amazed by the number of different strategies for survival and reproduction
  - He noticed that all of these different plants and animals seemed very well suited for their specific environment

Some Modern Diversity…



Darwin's Findings

- Fossils
  - On his voyage, Darwin collected many fossils – some of which resembled living things, and others that looked completely different
    - How did so many of these species disappear?
    - How were they related to living things?

Some Fossils…

Darwin's Findings

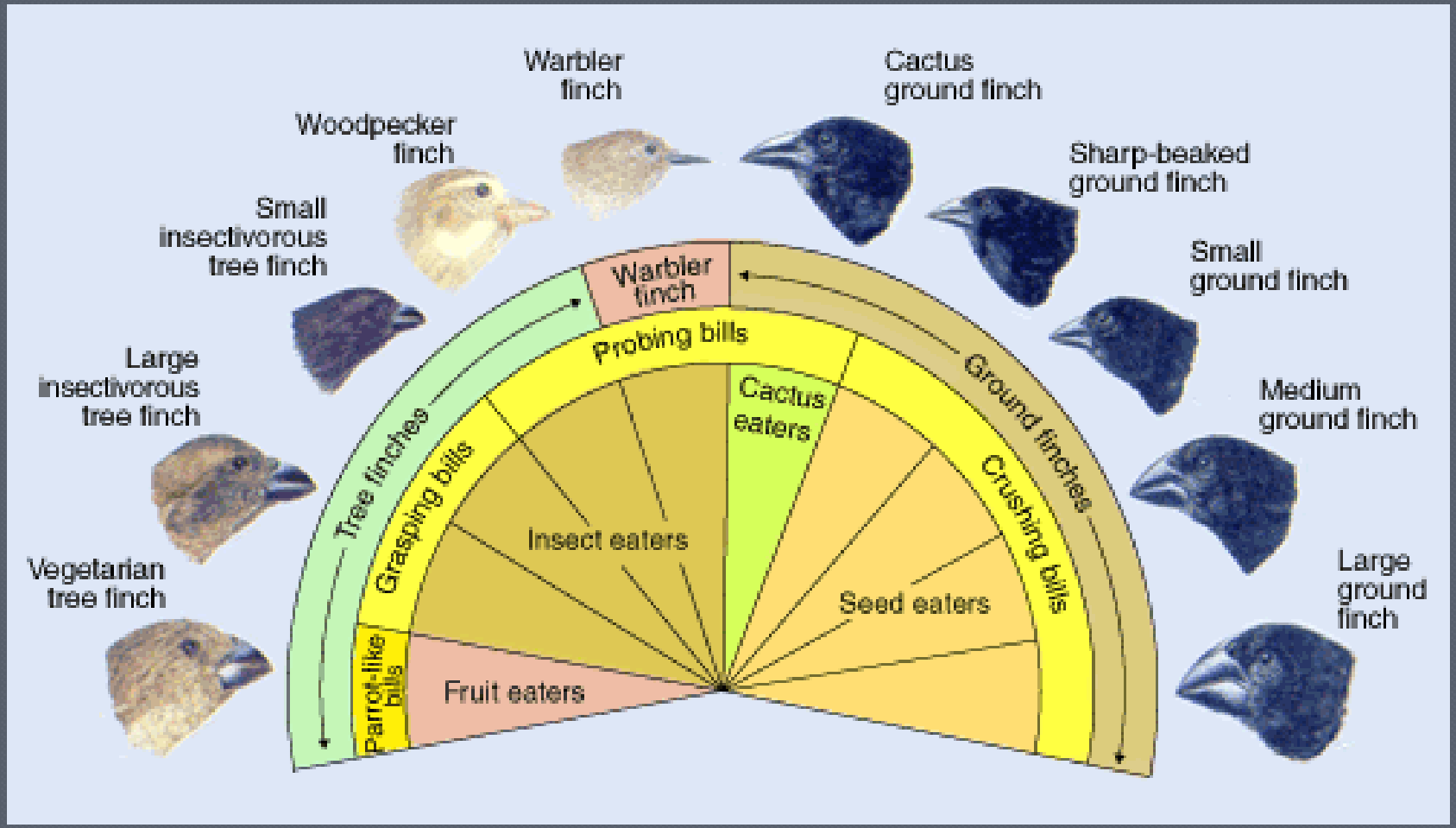
- The Galapagos Islands
  - These small islands off the western coast of South America had the greatest influence on Darwin's theory
  - Each had a slightly different environment
  - Let's examine 2 specific findings there

Darwin's Findings

- The Galapagos Islands – The Finches
  - Darwin observed and collected many birds that were different on each island
  - He discovered that these birds were all finches
  - He noticed that each type was well suited to its own specific environment

Diversity in Finches

Diversity in Finches

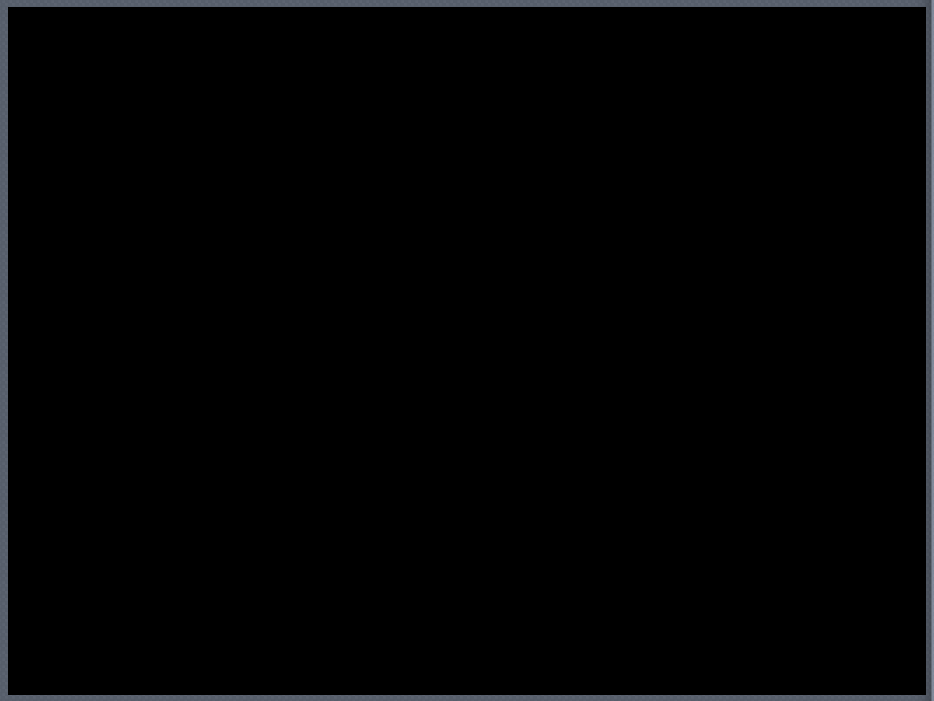


Darwin's Findings

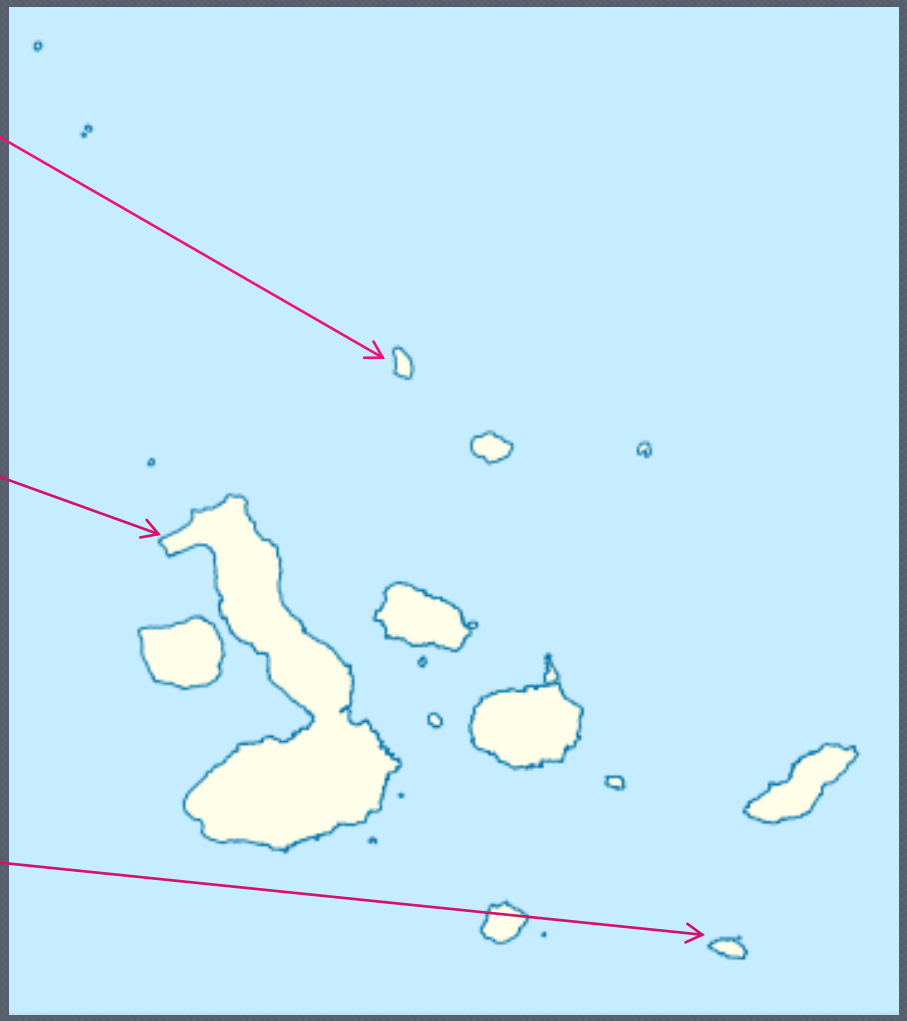
- The Galapagos Islands – The Finches
  - Key Point:
    - Each different type of beak was optimal for each different finch's survival needs
    - A finch that eats only seeds has a large beak that allows that finch to successfully crush and eat the seeds
    - A finch that eats only insects has a longer and more slender beak that allows that finch to successfully probe/reach for/grasp the insects

Darwin's Findings

- The Galapagos Islands – The Tortoises
  - Darwin observed tortoises on different islands
  - He noticed that tortoises from different islands had slight differences in the shape of their shells



Diversity in Tortoises



Darwin's Findings

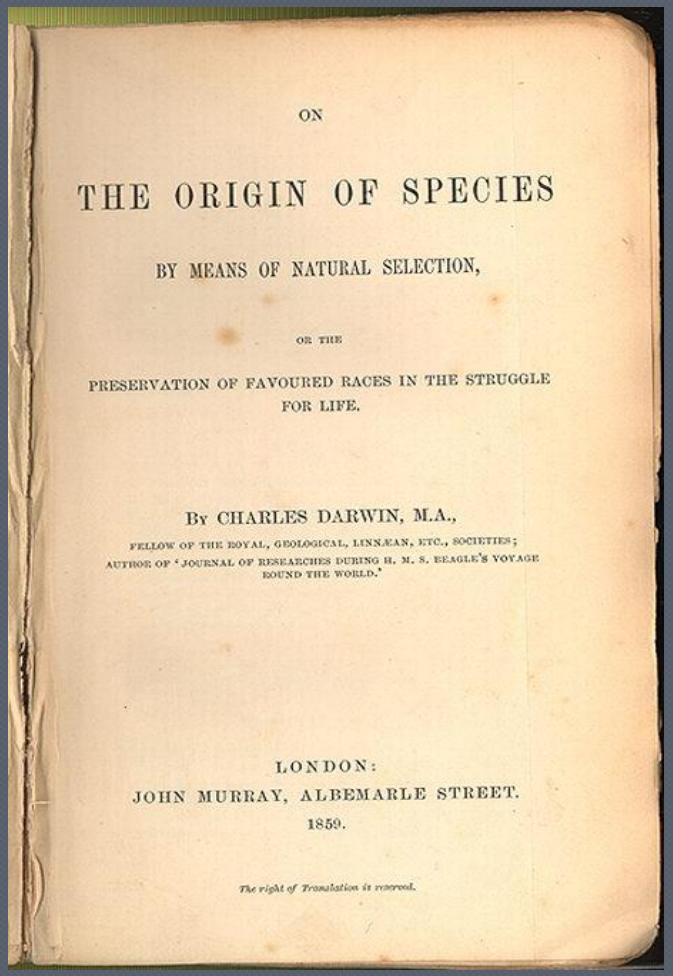
- The Galapagos Islands – The Tortoises
  - Key Point:
    - Each different type of shell was optimal for each different tortoise's survival needs
    - A tortoise that lives in an environment with little vegetation that is hard to reach has a longer neck and curved shell that is more open around the neck
    - A tortoise that lives in an environment with lots of ground level vegetation has a shorter neck and dome shaped shell

Figuring it Out

- Darwin noticed how organisms were so well suited for their own specific habitat
- Key question: how did they get like that?
- Answer: the process of natural selection

Publishing his Ideas

- In 1858, Charles Darwin published his ideas in On the Origin of Species
- In this book, Darwin explained his theory of natural selection



ON

THE ORIGIN OF SPECIES

BY MEANS OF NATURAL SELECTION,

OR THE

PRESERVATION OF FAVOURED RACES IN THE STRUGGLE FOR LIFE.

By CHARLES DARWIN, M.A.,

FELLOW OF THE ROYAL, GEOLOGICAL, LINNÆAN, ETC., SOCIETIES;
AUTHOR OF 'JOURNAL OF RESEARCHES DURING H. M. S. BEAGLE'S VOYAGE ROUND THE WORLD.'

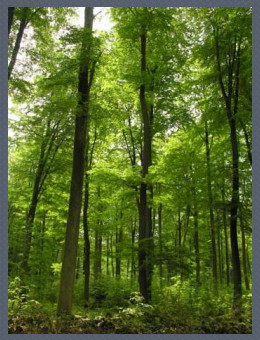
LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1859.

Natural Selection

- "Survival of the fittest"
  - Those individuals that are best suited for their environment survive and reproduce most successfully

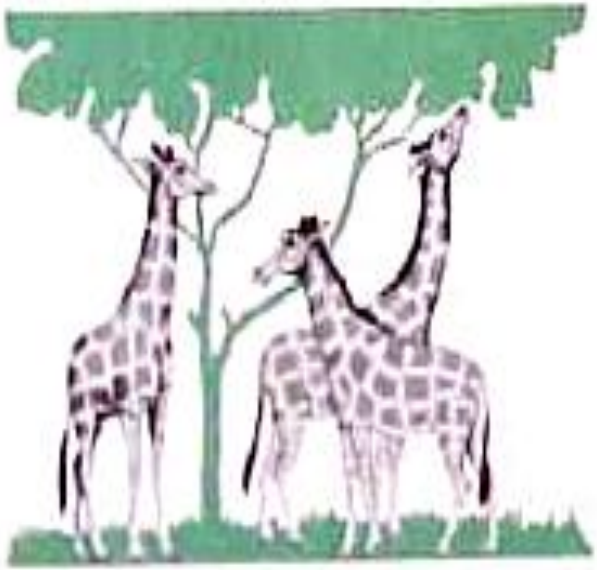
Natural Selection

- Individuals regularly compete over food, living space, and other resources

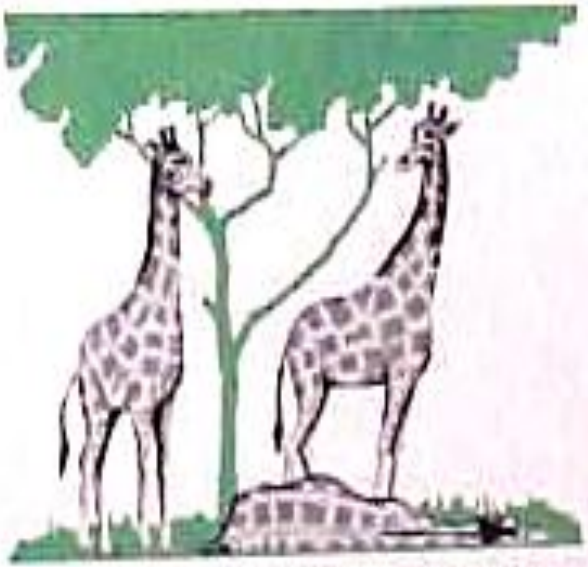



- Whichever individuals are most fit will survive and reproduce, passing on their unique characteristics to the next generation.
- Whichever individuals are less fit will probably die and not reproduce, and their unique characteristics will become less and less common in later generations.

b. Darwin's hypothesis



Ancestral giraffes probably had necks that varied in length. The variations were hereditary.

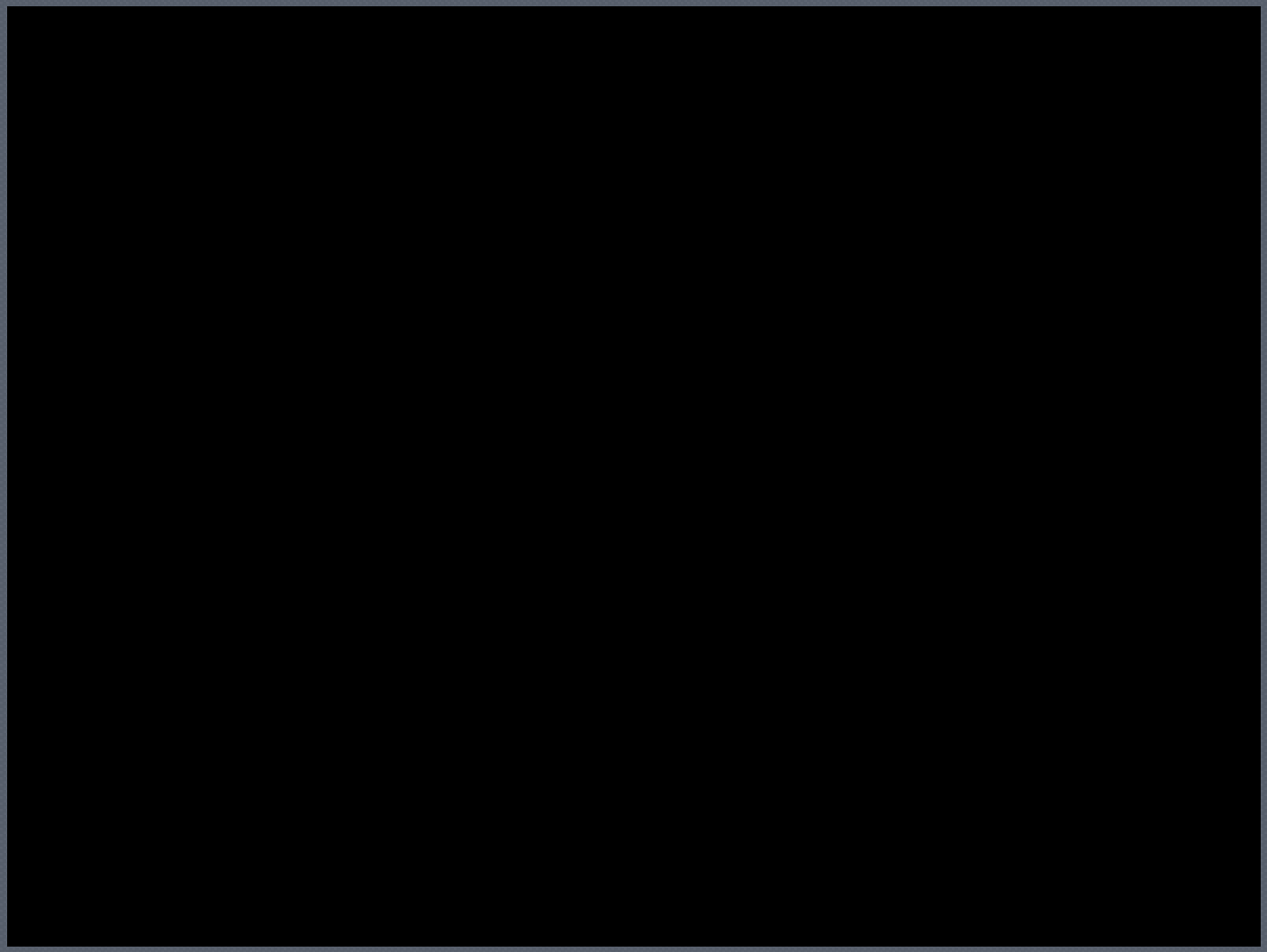


Natural selection led to survival of longer-necked offspring.

Existing data support this hypothesis.

Eventually only long-necked giraffes survived.

Natural Selection



Factors Contributing to Natural Selection

- **Variation:** Organisms within a species have differences due to mutations, crossing over and chance assortment
- **Differences in Fitness:** Some organisms have a better chance of survival
- **Inherited Characteristics:** These characteristics are passed down through the generations

Adaptations

- Darwin considered an organism's fitness (its ability to survive and reproduce) to be the result of adaptations.

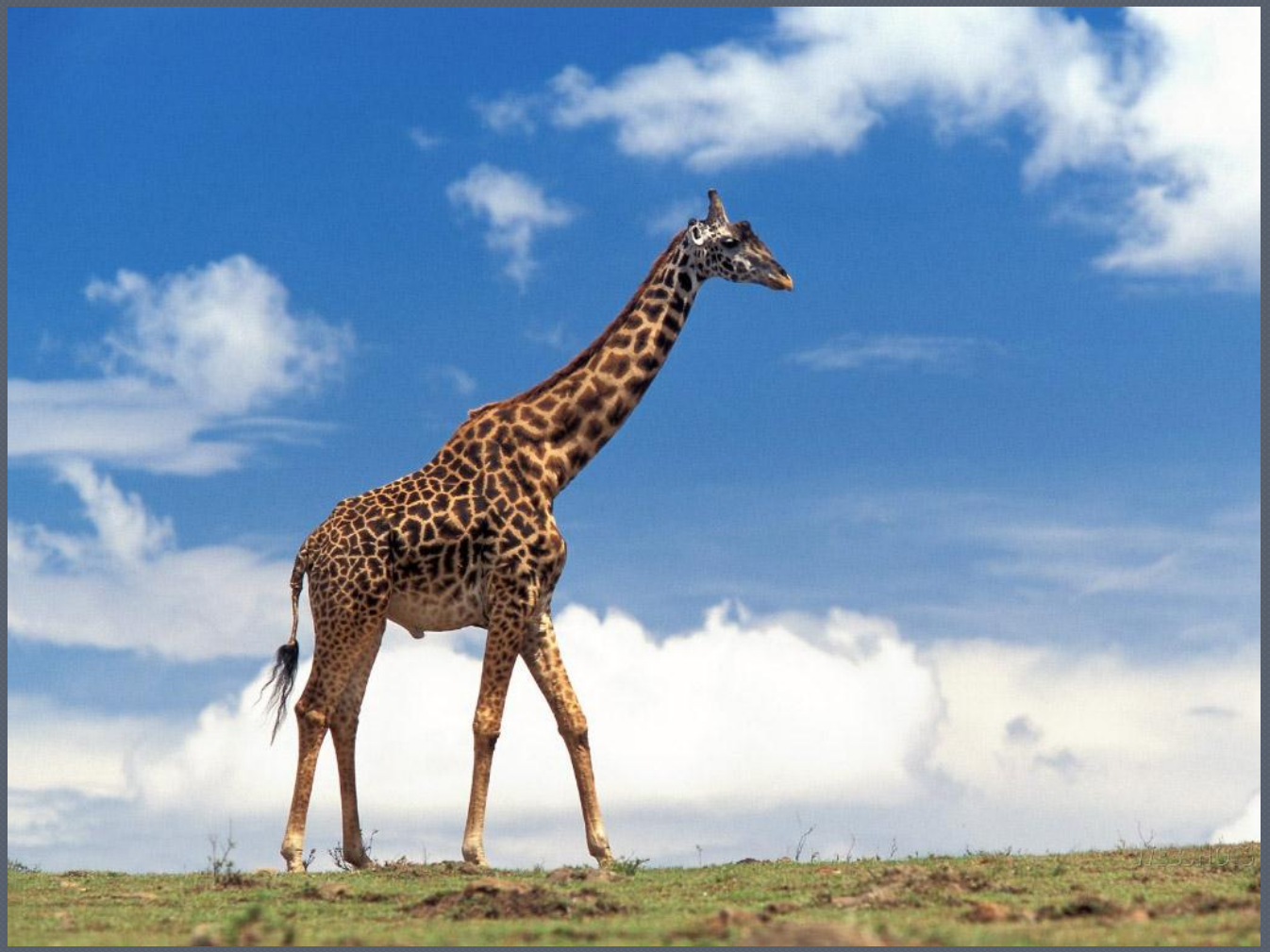
- Adaptation
  - Any inherited characteristic that increases an organism's chance for survival

Types of Adaptations

- Type
  - Morphological/Physical
  - Chemical
  - Behavioral
- Example
  - Beak Shape
  - Poison
  - Mating Calls

Amazing Adaptations!

- Height



Amazing Adaptations!

- Color/ camouflage

Amazing Adaptations!

- Camouflage

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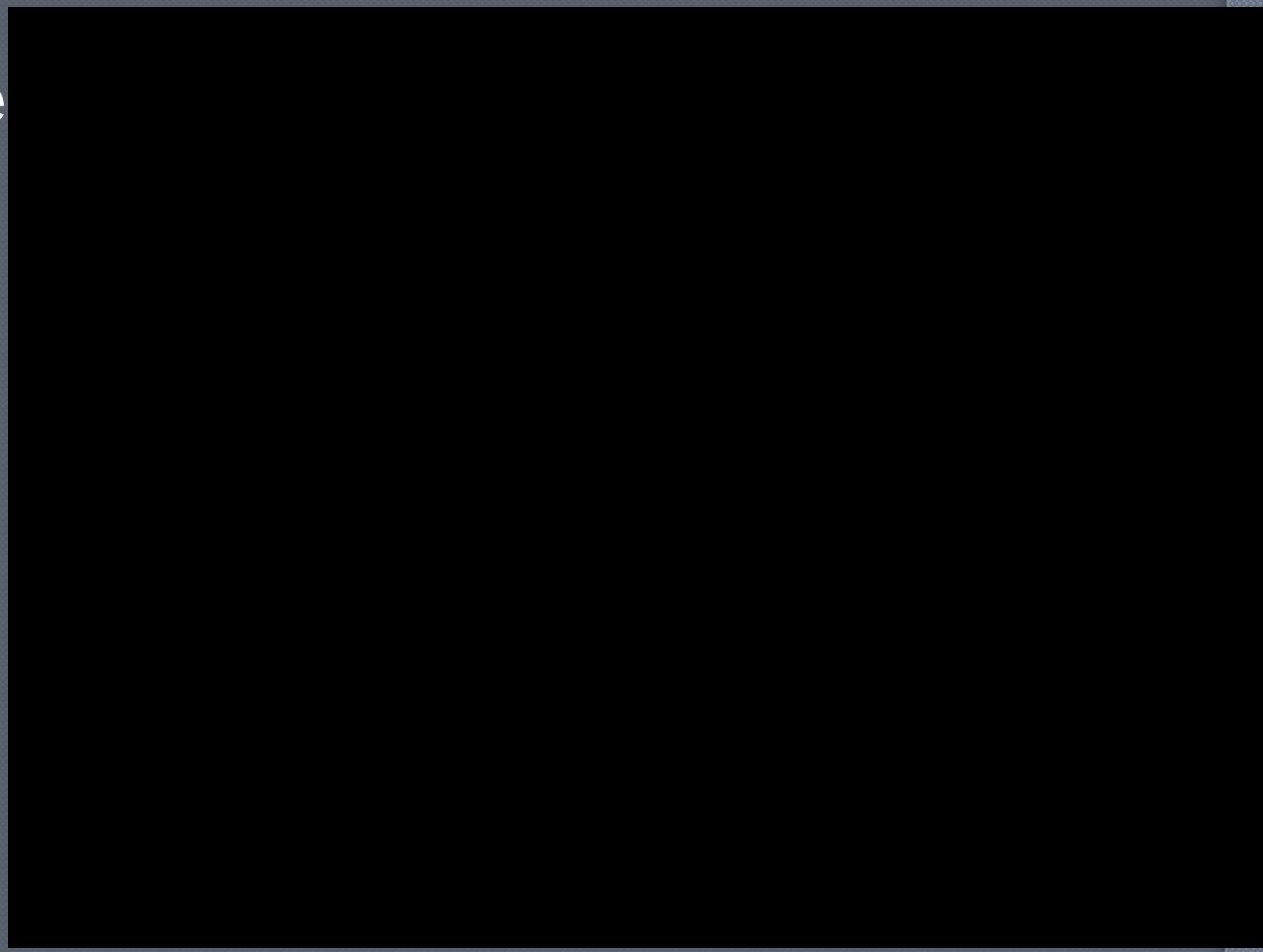
- Camouflage

Amazing Adaptations

- Camouflage

Amazing Adaptations!

- Camouflage

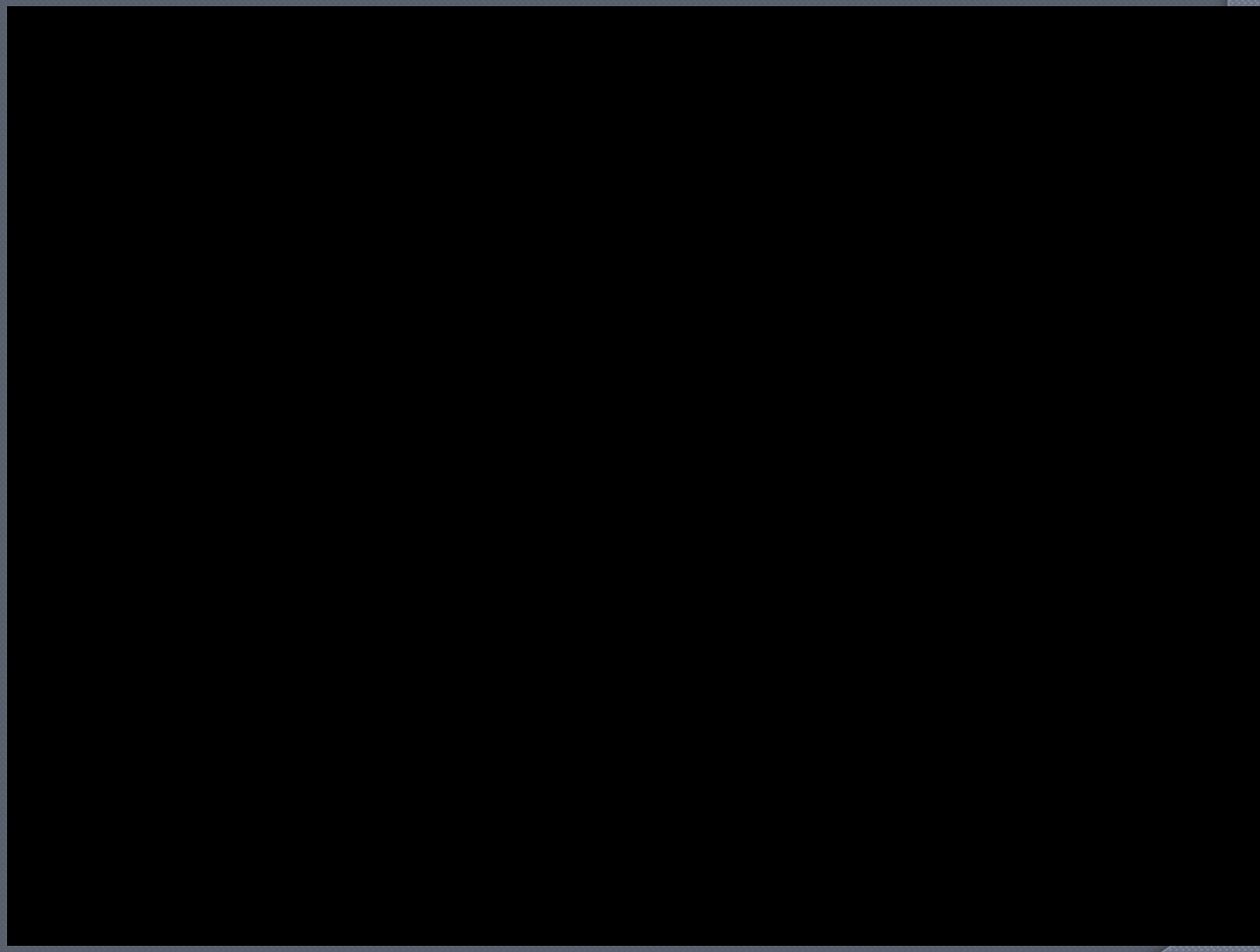


Amazing Adaptations

- Mimicry

Amazing Adaptations

- Mimicry



Amazing Adaptations

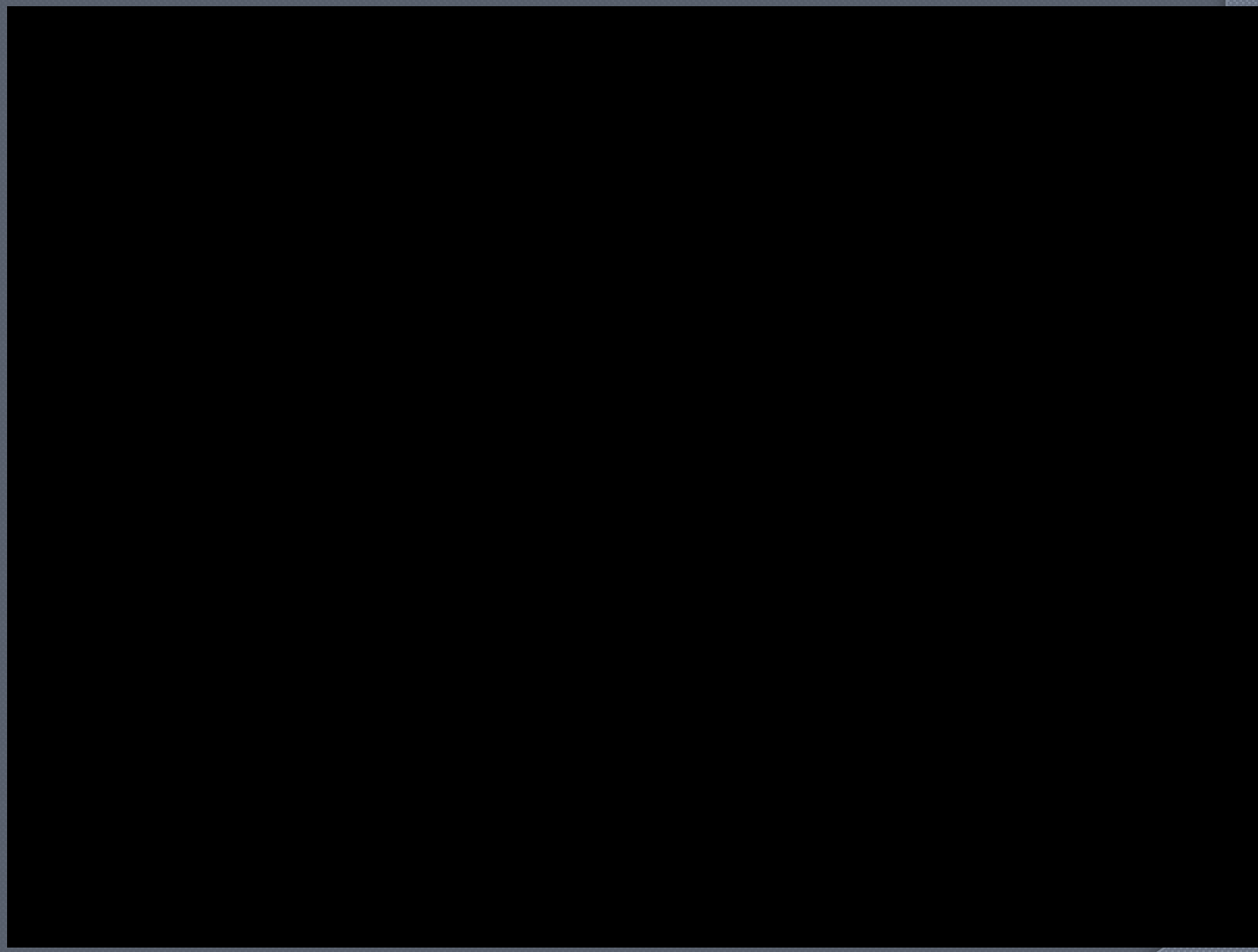
- Defense

Amazing Adaptations

- Defense

Amazing Adaptations!

- Speed



New Observations

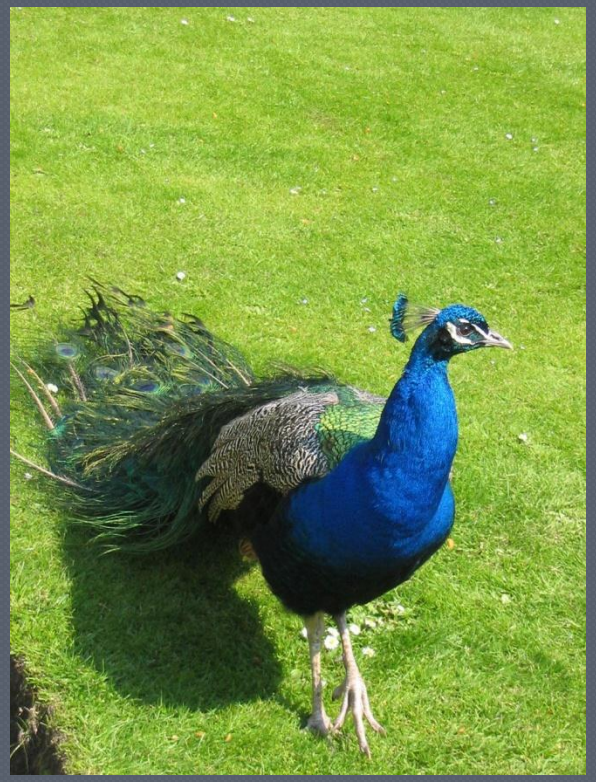
- Darwin would later make observations that would cause him to question his own theory!
  - Let's look at each of these observations…

New Observations

- The long tailed widowbird
  - Does that tail look advantageous for evading predators?

New Observations

- The peacock
  - Does this look like an animal that is most fit to survive in the environment?



New Observations

- Darwin observed that these confusing characteristics occurred only in the males, and had a strong connection to the individual's ability to mate

New Observations

- In the long tailed widowbird, the longer the tail, the more likely it was that the individual would mate
- In the peacock, the larger the feather spread and the more spots, the more likely it was that the individual would mate

Sexual Selection

- Darwin noticed:
  - Females prefer some characteristics in males over other characteristics
- Darwin theorized:
  - Certain characteristics are selected for NOT as an environmental adaptations, but rather as preferences of females

Sexual Selection