



VIEVKANANDA COLLEGE
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NAAC ACCREDITED A GRADE

- TOPIC :- Evolutionary Theories
- COURSE TITLE:-CC4, Genetics and Evolutionary Biology
- PAPER :- 4-TH
- SEMESTER :- 4 (General)
- UNIT :- 6
- NAME OF THE TEACHER:- DR. TRIJIT NANDA
- NAME OF THE DEPARTMENT:- U.G. & P.G DEPARMENT OF ZOOLOGY

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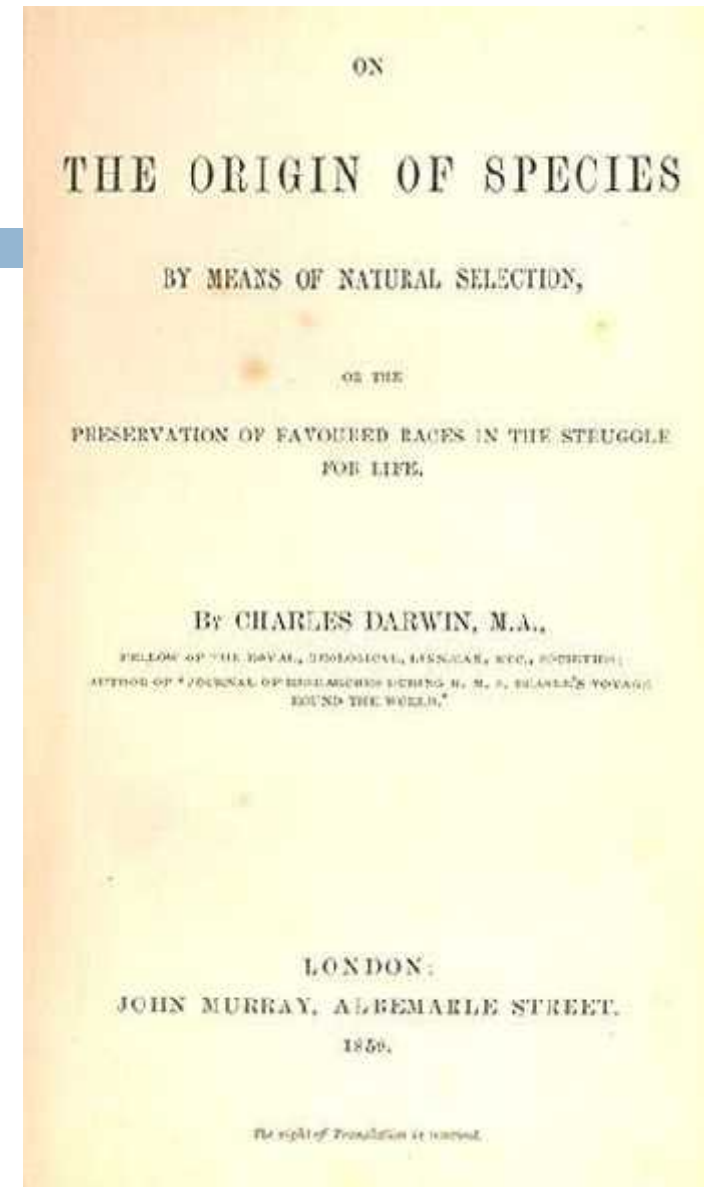
ORIGIN OF SPECIES BY MEANS THE BOOK OF NATURAL SELECTION

Title Page of the 1ST Edition: *On the Origin of Species*.

Chapter Titles in *On the Origin of Species*

1. Variation under Domestication
2. Variation under Nature
3. Struggle for Existence
4. Natural Selection
5. Laws of Variation
6. Difficulties on Theory
7. Instinct
8. Hybridisation
9. On the Imperfection of the Geological Record
10. On the Geological Succession of Organic Beings
11. Geographical Distribution
12. Geographical Distribution continued
13. Mutual Affinities of Organic Beings: Morphology:
Embryology: Rudimentary Organs
14. Recapitulation and Conclusion

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1859 *On the Origin of Species by Means of Natural Selection*

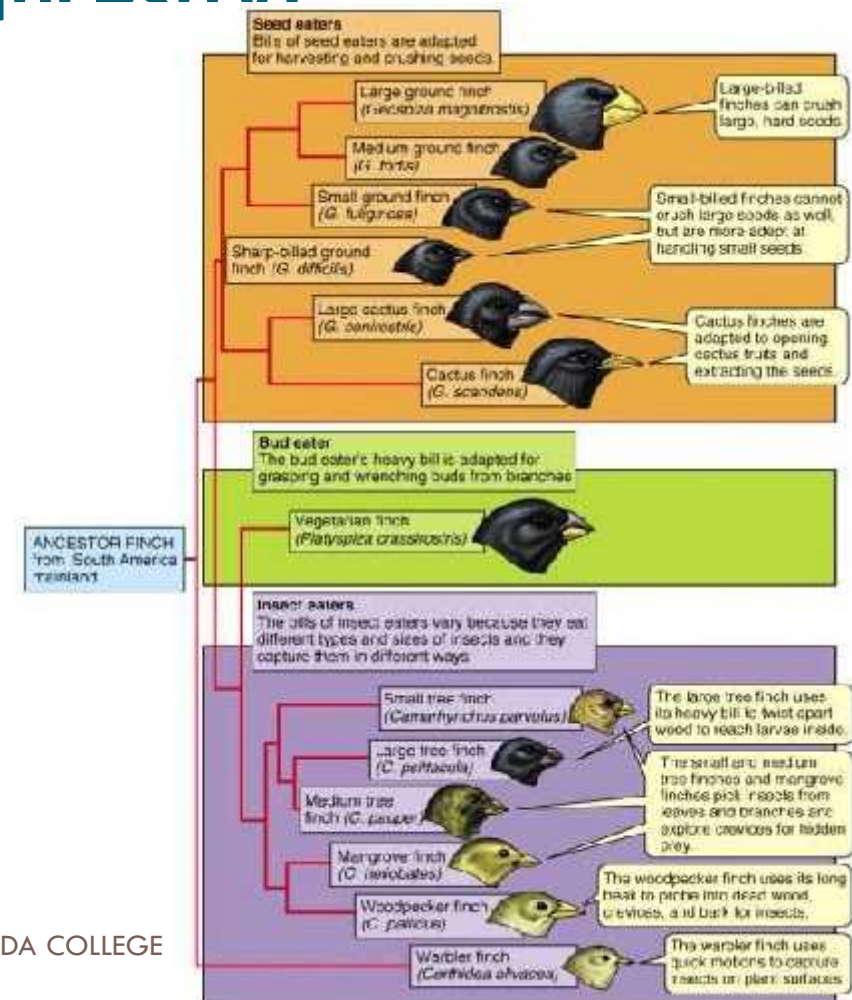
Two theories presented in the book

1. Evolution = change in species over time; descent with modification; new species derived from other species; common ancestry.
2. Natural selection = main mechanism by which evolution occurs.

Darwin's evidence for evolution in his writing (species derived from common ancestry)

- Geographical distribution & unique adaptations (13 similar species of Galapagos finches)
- Fossils & long geological history.
- Vestigial organs.
- Taxonomic relations.

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Darwin's Finches: each had different bills & different diets.



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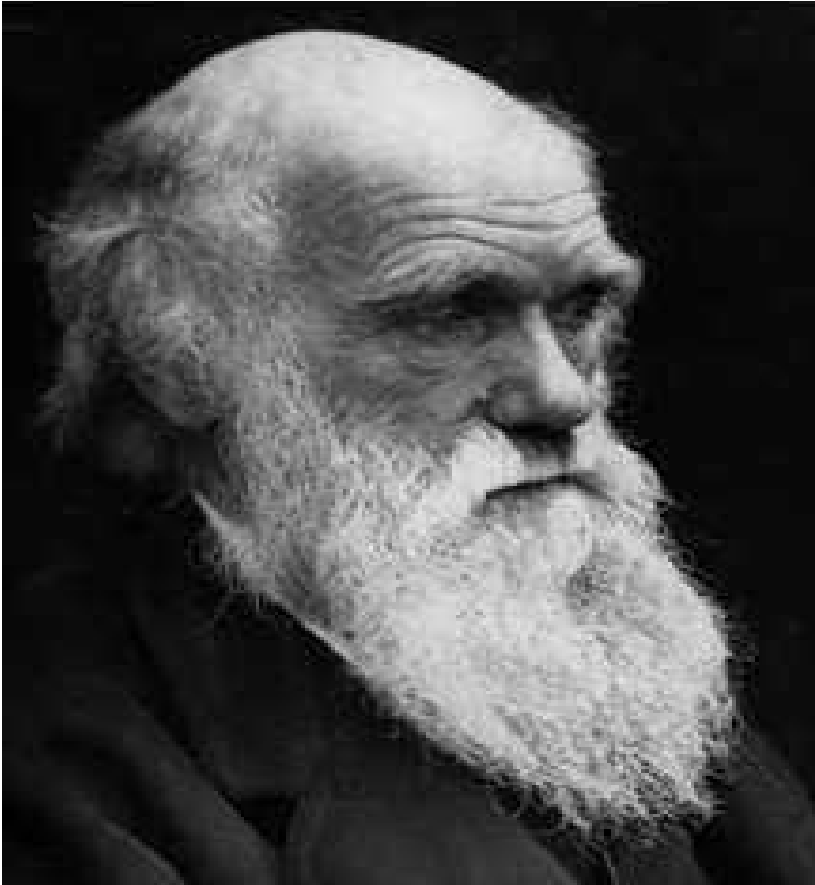
(c)

(d)

The giant tortoises on each island had slightly different shells and ate slightly different plants.



Charles Darwin



- BORN :-1809
- PUBLISHED :- 1859 tried to speculate that life forms derived from the single ancestor--- Diversity is the resultant of natural selection, migration, extinction, genetic mutation.

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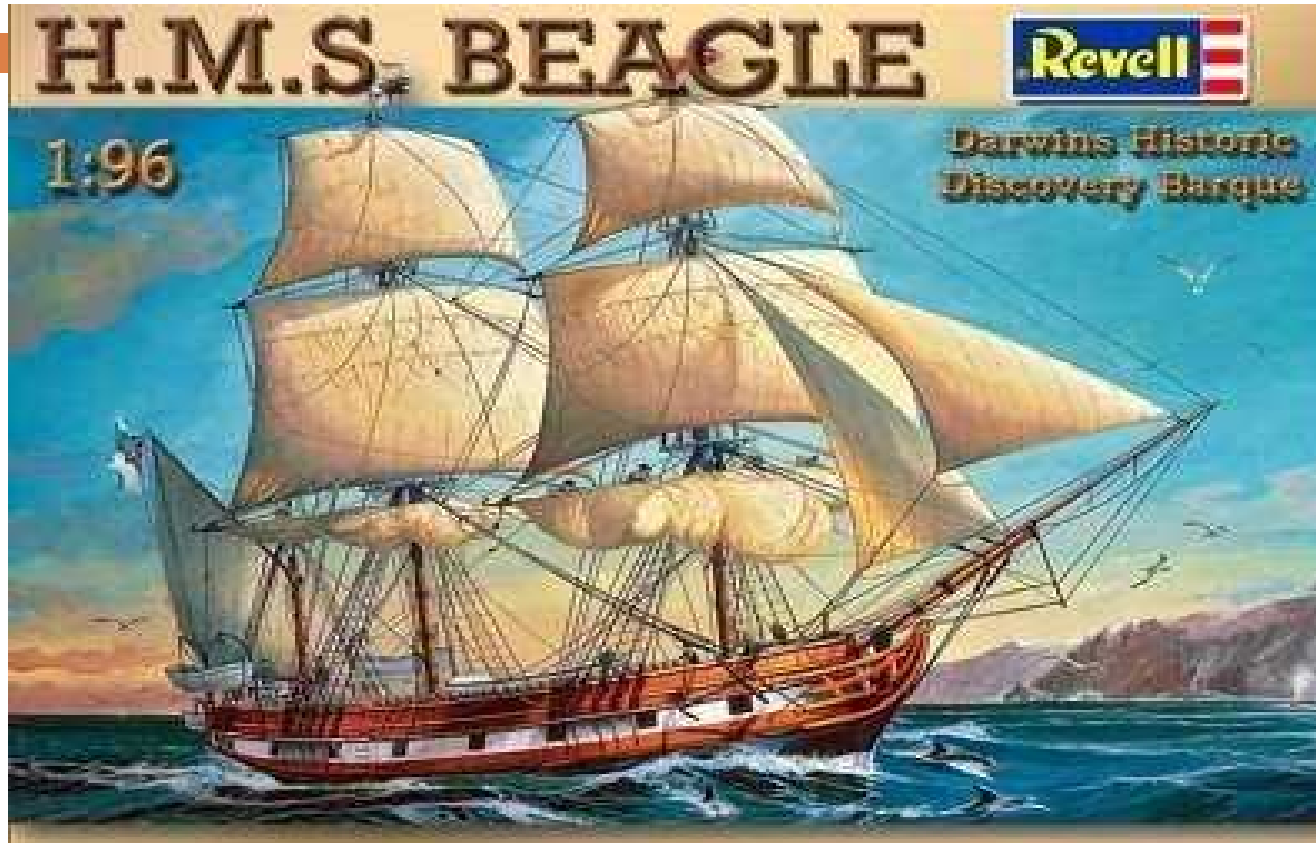
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Darwin's Theory of Evolution

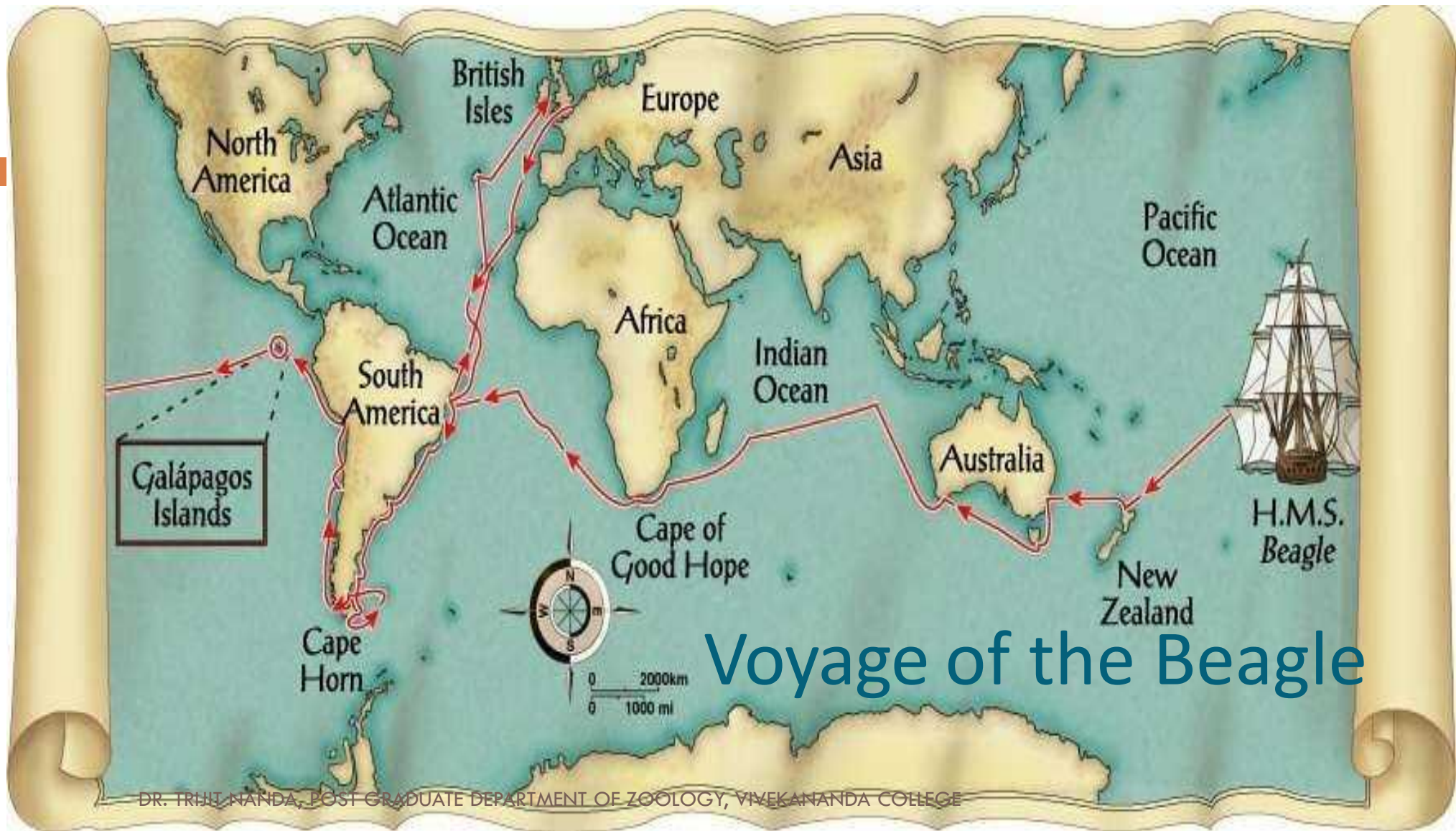
- **EVOLUTION**, OR CHANGE OVER TIME, IS THE PROCESS BY WHICH MODERN ORGANISMS HAVE DESCENDED FROM ANCIENT ORGANISMS.
- A SCIENTIFIC **THEORY** IS A WELL-SUPPORTED TESTABLE EXPLANATION OF PHENOMENA THAT HAVE OCCURRED IN THE NATURAL WORLD.

How do you think Darwin came up with his theory?

Voyage of the Beagle



- **Dates:** February 12th, 1831
- **Captain:** Charles Darwin
- **Ship:** H.M.S. Beagle
- **Destination:** Voyage around the world.
- **Findings:** evidence to propose a revolutionary hypothesis about how life changes overtime



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Patterns of Diversity

- Darwin visited Argentina and Australia which had similar grassland ecosystems.
 - those grasslands were inhabited by very different animals.
 - neither Argentina nor Australia was home to the sorts of animals that lived in European grasslands.
- Darwin posed challenging questions.
 - Why were there no rabbits in Australia, despite the presence of habitats that seemed perfect for them?
 - Why were there no kangaroos in England?

Living Organisms and Fossils

- Darwin collected the preserved remains of ancient organisms, called **fossils**.
- Some of those fossils resembled organisms that were still alive today. Others looked completely unlike any creature he had ever seen.
- As Darwin studied fossils, new questions arose.
 - Why had so many of these species disappeared?
 - How were they related to living species?



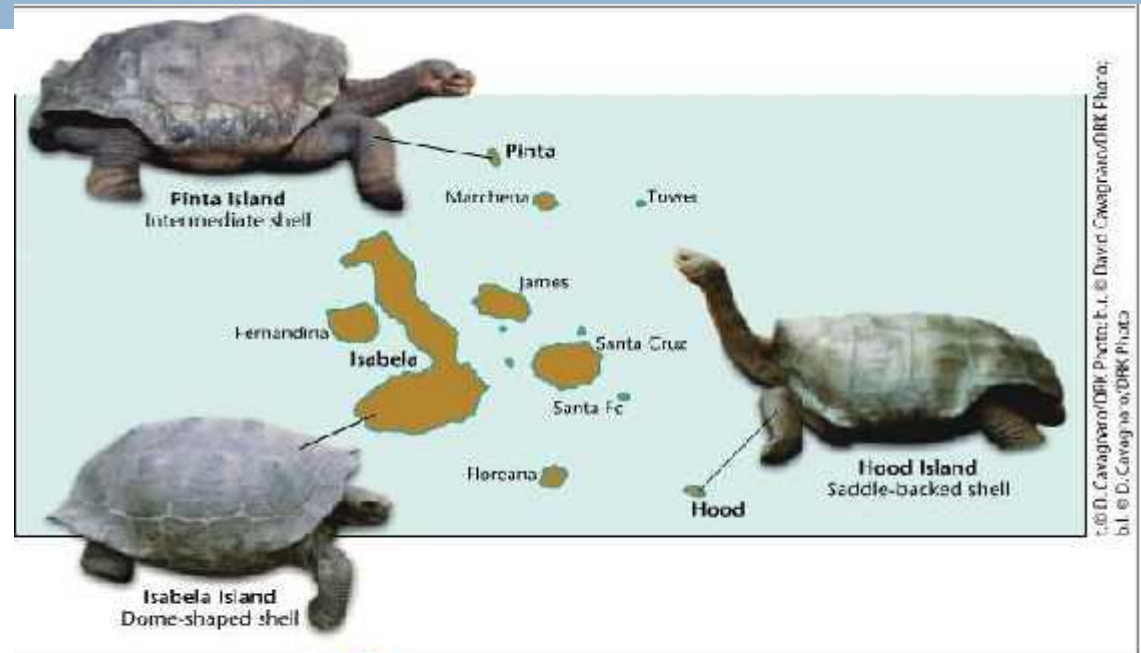
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The Galapagos Islands

- The smallest, lowest islands were hot, dry, and nearly barren-Hood Island-sparse vegetation
- The higher islands had greater rainfall and a different assortment of plants and animals-Isabela-Island had rich vegetation.
- Darwin was fascinated in particular by the land tortoises and marine iguanas in the Galápagos.
- Giant tortoises varied in predictable ways from one island to another.
- The shape of a tortoise's shell could be used to identify which island a particular tortoise inhabited.



Variation Among Tortoises Darwin observed that the characteristics of many animals and plants varied noticeably among the different Galapagos Islands. Among the tortoises, the shape of the shell corresponds to different habitats. The Hood Island tortoise (right) has a long neck and a shell that is curved and open around the neck and legs, allowing the tortoise to reach the sparse vegetation on Hood Island. The tortoise from Isabela Island (lower left) has a dome-shaped shell and a shorter neck. Vegetation on this island is more abundant and closer to the ground. The tortoise from Pinta Island has a shell that is intermediate between these two forms.

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Animals found in the Galapagos

- Land Tortoises



- Darwin Finches

- Blue-Footed Booby



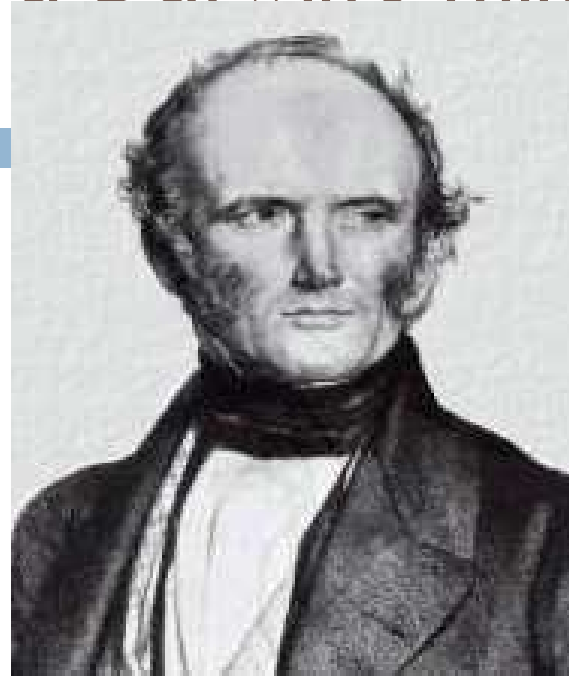
- Marine Iguanas



The Journey Home

- Darwin Observed that characteristics of many plants and animals vary greatly among the islands
- **Hypothesis:** Separate species may have arose from an original ancestor

Ideas that shaped Darwin's Thinking



James Hutton:

1795 *Theory of Geological change*

- Forces change earth's surface shape
- Changes are slow

Charles Lyell

Book: *Principles of Geology*

- Geographical features can be built up or torn down
- Darwin thought if earth changed over time, what about life?

Lamarck's Theory of Evolution

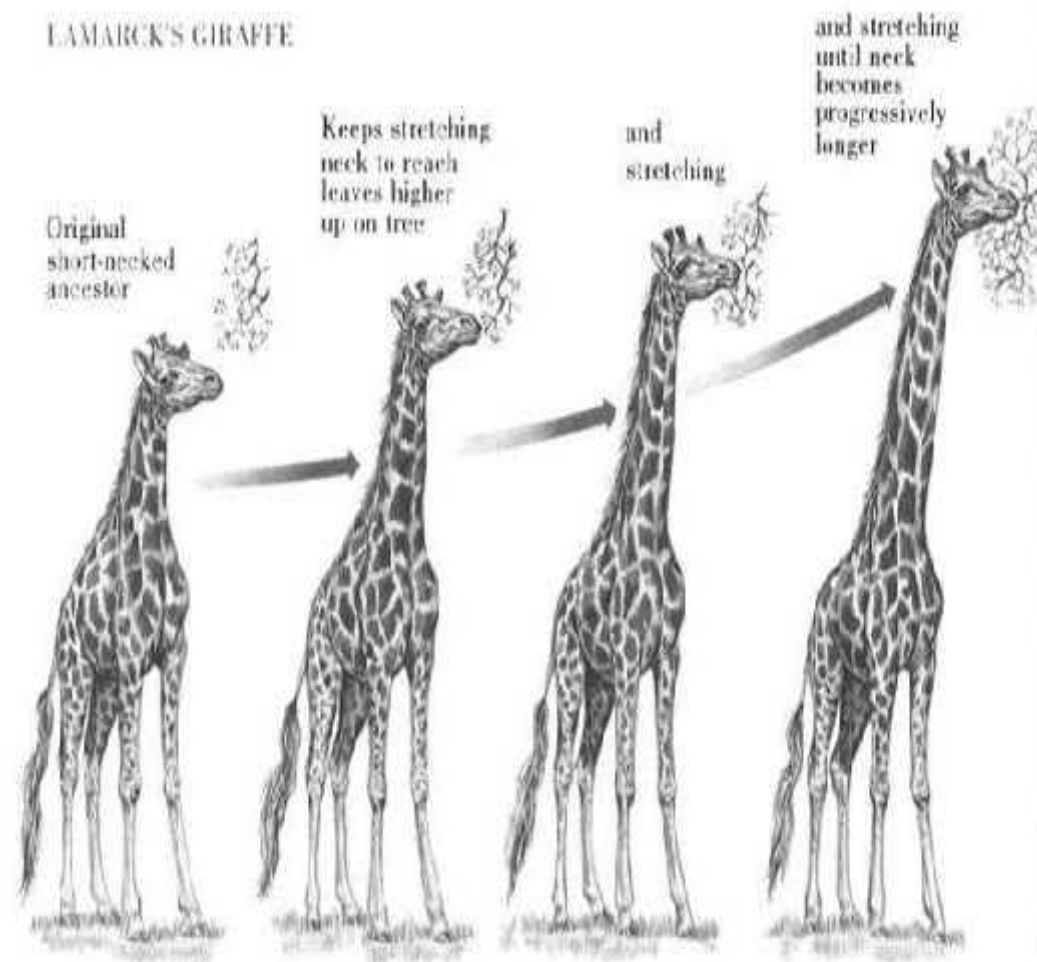
- Tendency toward Perfection (Giraffe necks)
- Use and Disuse (bird's using forearms)
- Inheritance of Acquired Traits

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LAMARCK'S DRAWBACKS: DARWIN'S BENEFIT

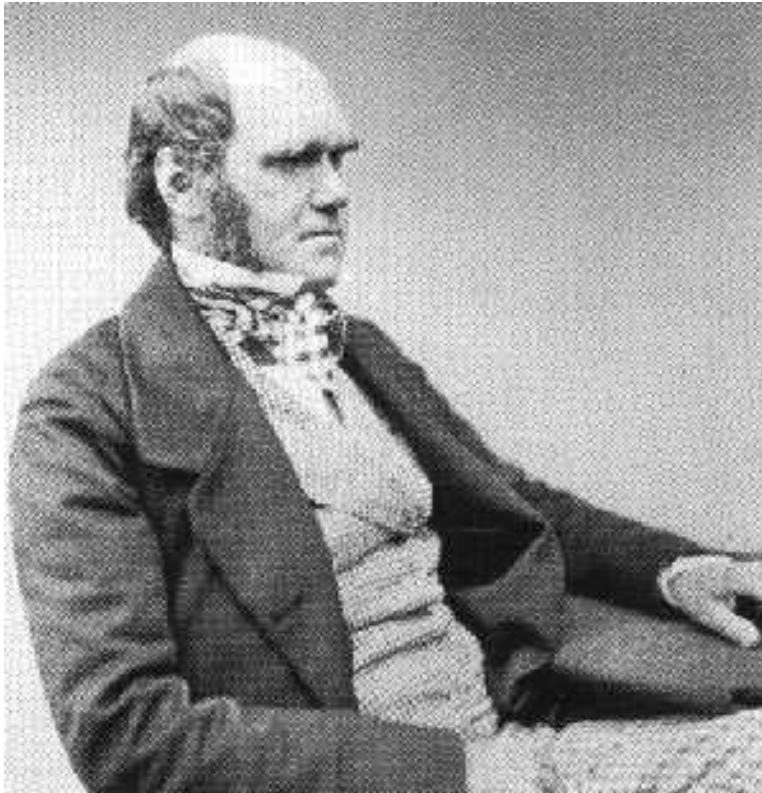
Population Growth



- **Thomas Malthus**-19th century English economist
- If population grew (more Babies born than die)
 - Insufficient living space
 - Food runs out
 - Darwin applied this theory to animals

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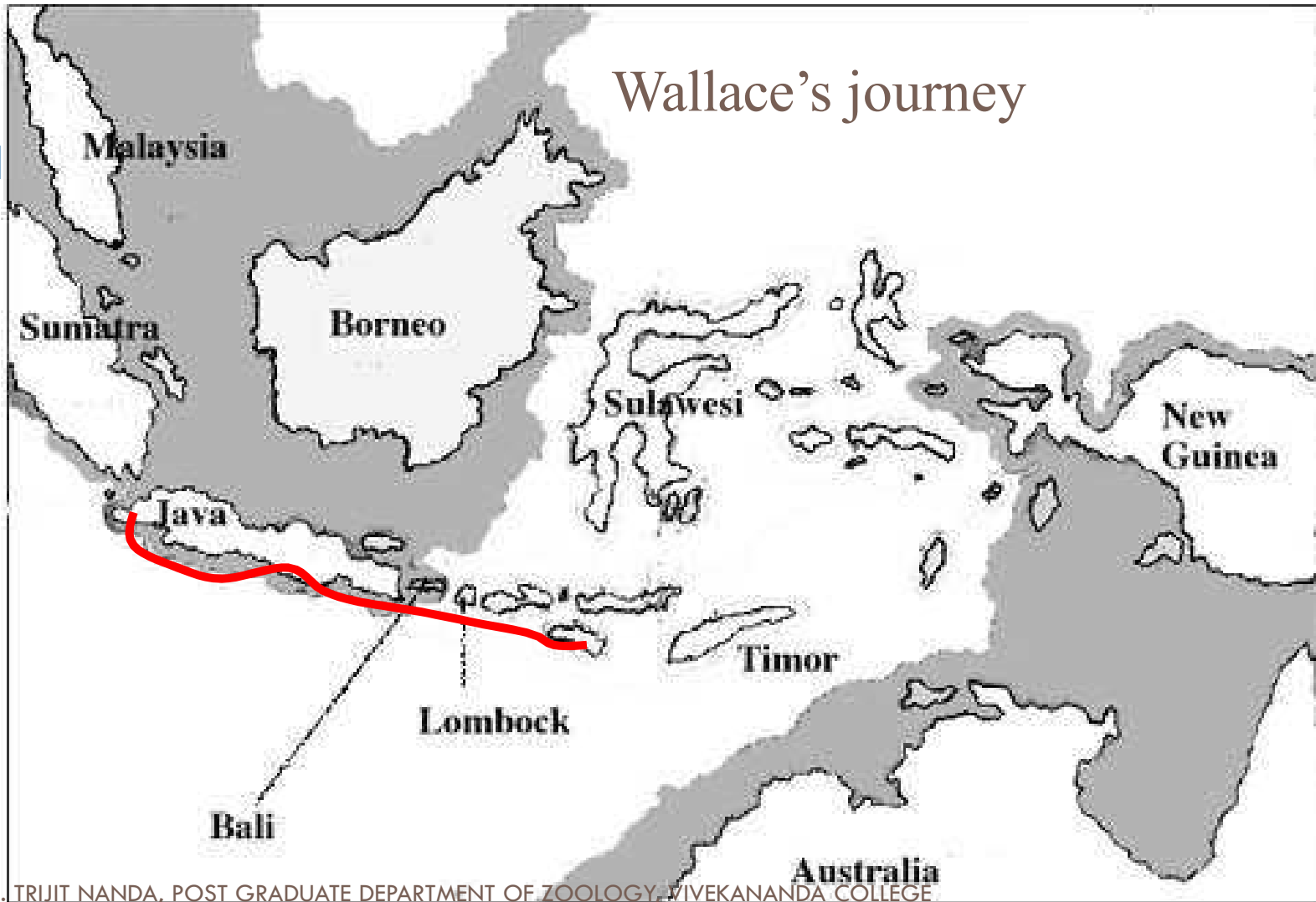
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Darwin and Wallace in 1855

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Wallace's journey



As Darwin thought, and experimented back in England, **Alfred Russell Wallace** was busy at work during the 1850's in **Brazil**.

Unfortunately, all of his collected materials were destroyed when his boat **sank** in 1852.

Others would have given up, Wallace just went off to **Indonesia** to start again

What Wallace observed

Sailing 1000km from Java to Bali, saw only **hornbills** eating large fruit with big seeds



After crossing 32km of ocean, at Lombok, saw only **cockatoos** eating large fruit with big seeds

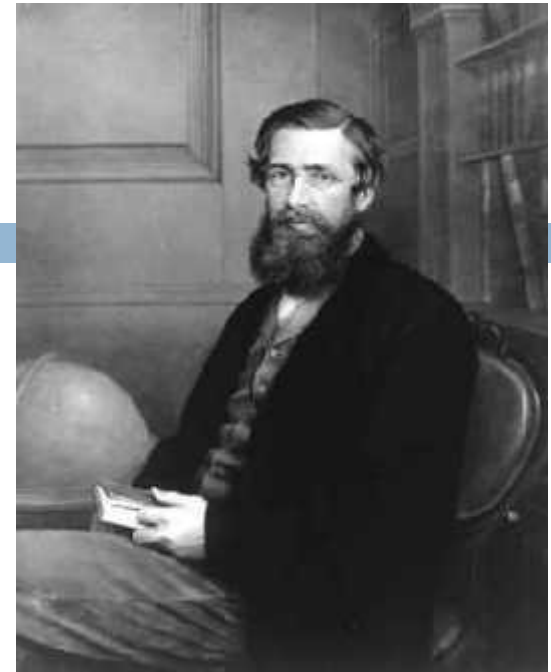




Charles Darwin
(1809 - 1882)

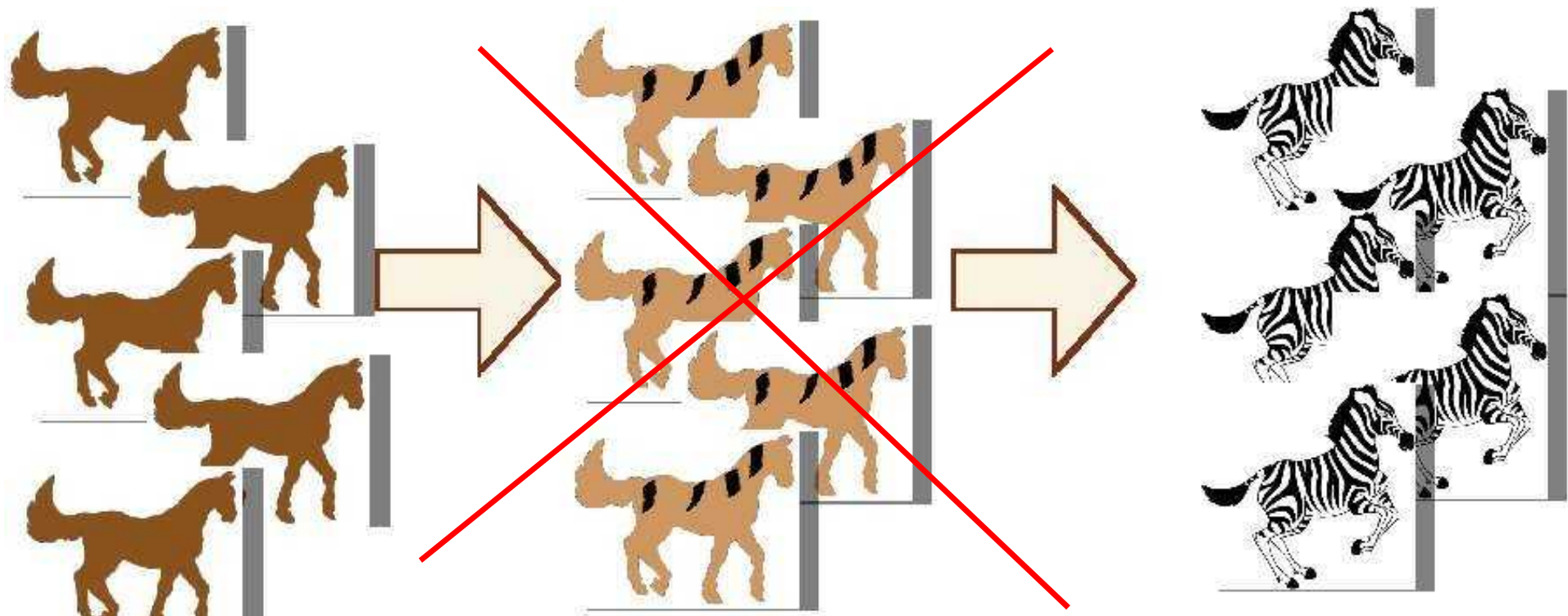
and

Alfred Russell
Wallace
(1823 - 1913)

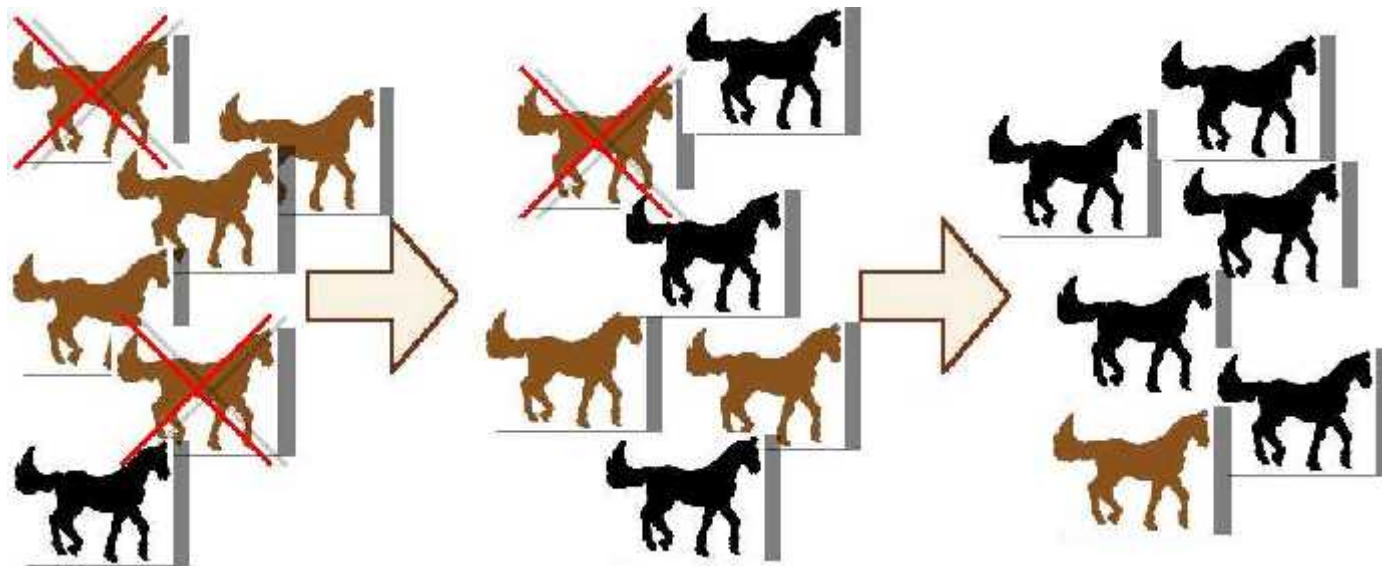


- Darwin and Wallace, working separately, devised a model for organic change that was based on their observations of living and fossil organisms over many years.
- **Natural Selection** was the first evidence-based mechanism for evolution that was proposed.

Darwin and Wallace observed that change did not happen equally to all members of a population, as Buffon and Lamarck thought.



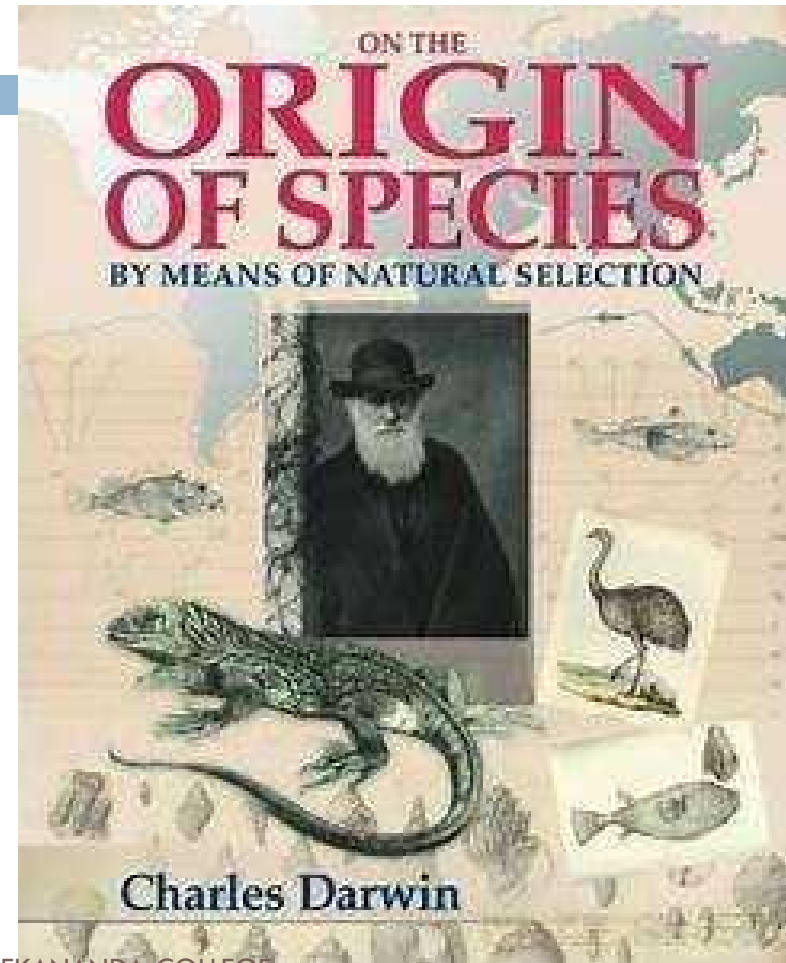
Instead, Darwin and Wallace proposed that selection happens each generation. Some individuals have traits that help them survive and reproduce, while others have traits that put them at a disadvantage.



Over generations, the number of individuals with **favorable traits** increases while those with **unfavorable traits** decrease.

Publication of Origin of Species

- Russel Wallace wrote an essay summarizing evolutionary change from his field work in Malaysia
- Gave Darwin the drive to publish his findings



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Consequences of publication of “Origin of Species”

- **Darwin** fled to his country house and would see no visitors. **Thomas Huxley** was a friend who agreed to speak for Darwin. He became known as “Darwin’s **Bulldog**” because he loved to argue about evolution [with anyone]
- There was a famous evolution **debate** on June 30, 1860 between Huxley and Bishop **Wilberforce**.
- Bishop Wilberforce was **winning** the debate until he strayed into Human Evolution. At some point he challenged Huxley about his **ancestry**.
- Huxley responded that “I would rather be descended from an **ape** than from a **pompous ass** like you!”.
- And the audience ended the debate with applause for **Huxley**. Evolution had won its first trial. It would face many more



Evidence for Evolution

- Both Darwin and Wallace were convinced that evolution -- change in the traits of a population over time -- did happen.
- Darwin spent over 20 years collecting evidence and reading research by others before he wrote *On the Origin of Species*. He found many features of organisms that suggested they were related by ancestry.

Fossils

Fossils showed that species existed in the past that no longer exist today, and species exist today that did not exist in the past.

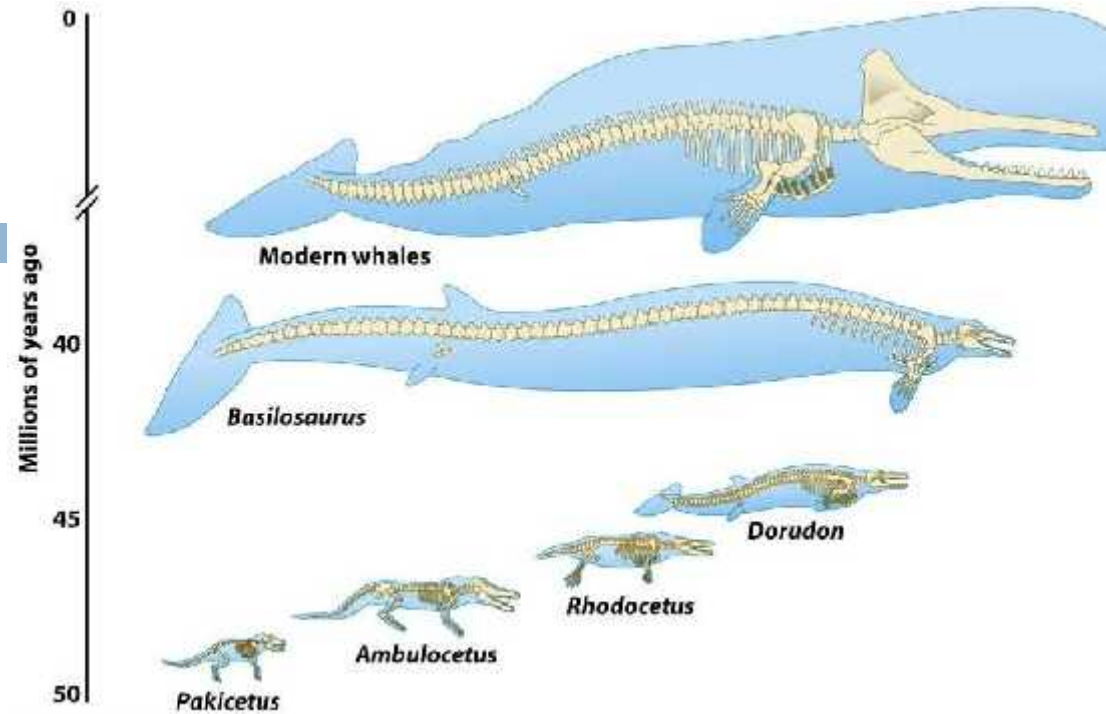
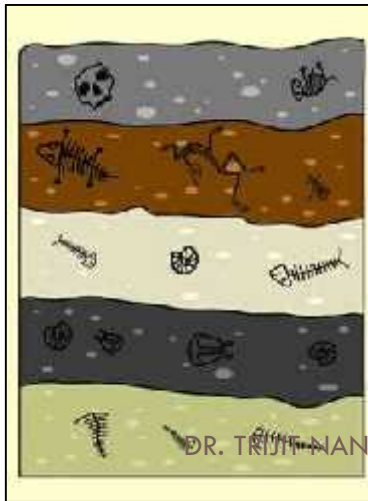


Figure 14-6 Biology: Life on Earth, 8/e
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In many groups of organisms, fossils demonstrated change from one form to another over long periods of time.

Analogous Structures



Figure 14-6a Biology: Life on Earth, 8/e
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Figure 14-6b Biology: Life on Earth, 8/e
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The influence of **the environment** is seen in analogous structures, where less-related species living in similar environments have similar body forms, though often involving different body parts. From variations in a population, **the environment** selects those that best help an organisms survive in that environment.

Embryological Evidence

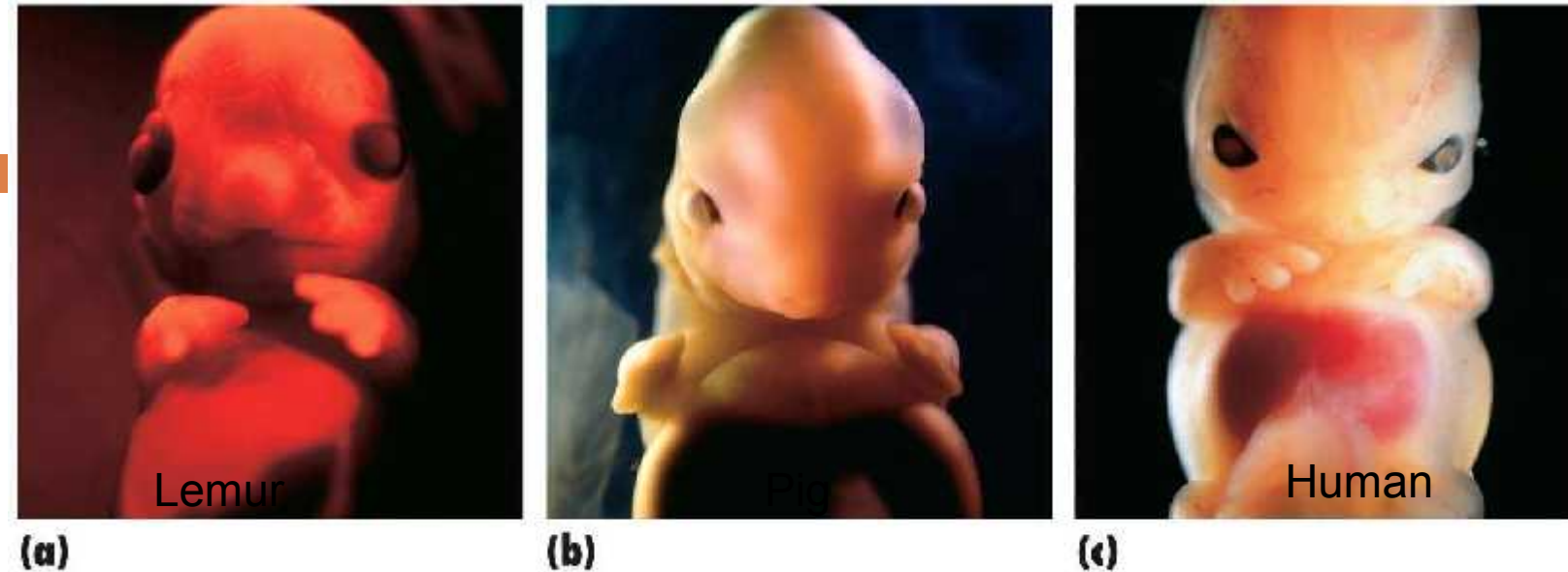


Figure 14-10 Biology: Life on Earth, 8/e
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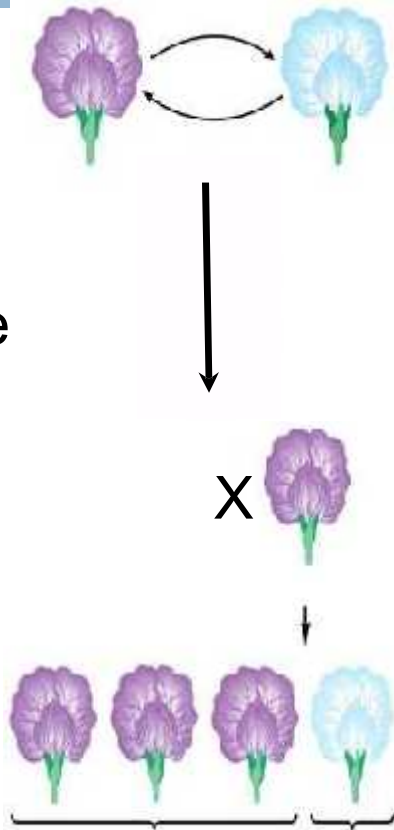
Similar structures and similar developmental processes in embryos demonstrate a shared set of **genes** between groups of organisms, suggesting common ancestry.

Note: Humans do not *become* fish or grow gills during development. We do share several embryological features with other vertebrate animals.

Natural Selection

Inheritance

Some differences between individuals are inheritable, and can be passed from parent to offspring.



Differences in survival and reproduction

In most populations, more young are born than can survive. Many of the young will die. A few will live long enough to reproduce.



Natural Selection

Success is not random

While random accidents do happen, an individual's survival depends mainly on the individual's traits. Those that live and reproduce may pass their traits to the next generation.



Selection favors organisms that are best adapted to the environment.

Selection does NOT produce new traits, nor does it make organisms "perfect." Selection is all about survival, and those organisms with traits that help them survive are more likely to reproduce.



Evidence for Selection

- In order to construct his theory, Darwin had to gather and examine evidence to discover whether selection happens in nature.
- Research continues to refine our ideas of how selection happens and what effects it has on species.

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Artificial Selection

Darwin knew from his studies of pigeon breeding that selection can change organisms, sometimes rapidly.



Human selection created many breeds of dogs from wild dogs or wolves as humans chose to breed those animals with traits that the humans wanted.

Selection acts on variations

Studies have shown that guppies living in ponds with few predators are more brightly colored than those living with many predators.

In both populations there are guppies with genes for bright colors. Why are dull colors favored in ponds with many predators? Why are bright colors favored in ponds with few predators?



Figure 14-14 *Biology: Life on Earth, 8/e*
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Selection does not cause new variations.

Studies on Anole lizards showed that long, fast-moving legs were

- trees were flimsier, favored where trees had thicker branches, while shorter, more agile legs were favored where
- lizards from places where trees had thin branches had thick branches, those with the longest legs
- Each generation had more individuals with long legs *were already in the population.*



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Figure 14-15 Biology: Life on Earth, 8/e
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Summary of Darwin's Theory

- Individuals in nature differ from one another
- Organisms in nature produce more offspring than can survive, and many of those who do not survive do not reproduce.
- Because more organisms are produced than can survive, each species must struggle for resources
- Each organism is unique, each has advantages and disadvantages in the struggle for existence
- Individuals best suited for the environment survive and reproduce most successfully
- Species change over time
- Species alive today descended with modification from species that lived in the past
- All organisms on earth are united into a single family tree of life by common descent