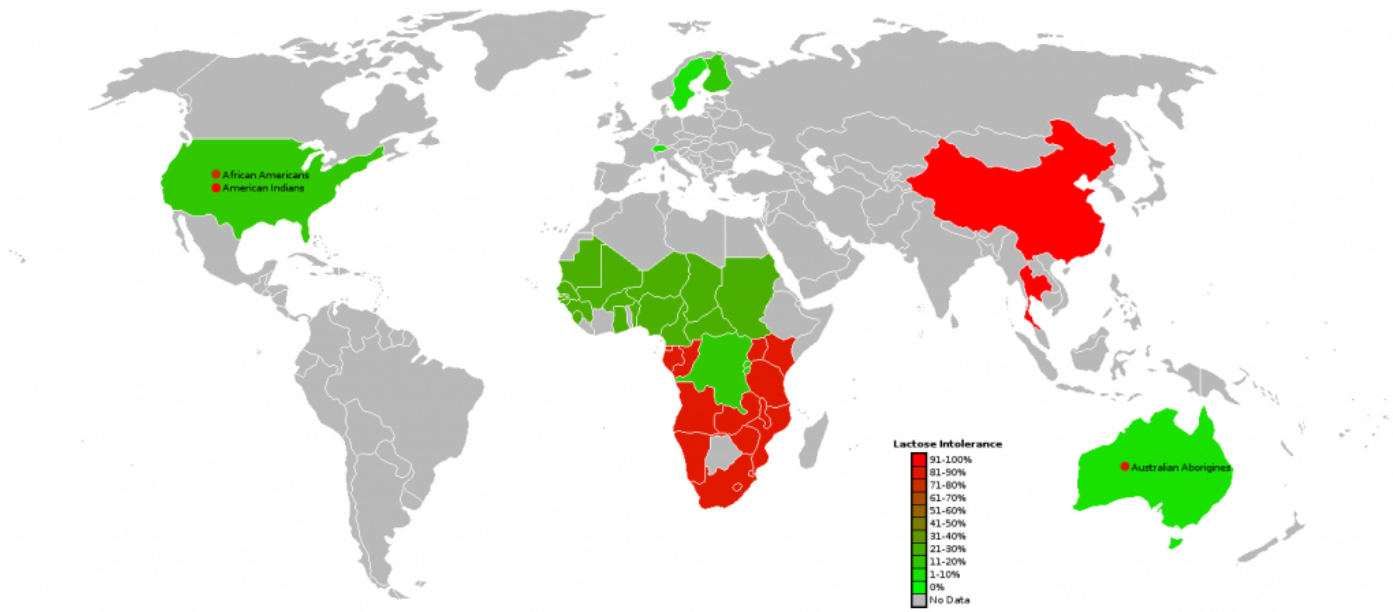
Got milk?



Lactase persistence (LP), the dominant Mendelian trait conferring the ability to digest the milk sugar lactose in adults, has risen to high frequency in central and northern Europeans in the last 20,000 years. This trait is likely to have conferred a selective advantage in individuals who consume appreciable amounts of unfermented milk.

Evolution

Lecture 6 Chapters 22,23,24,25

- The book that forever changed Biology

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

- Darwin presented evidence that the today's organisms are descendants of ancestral species

- Darwin proposed a mechanism for the evolutionary process: **natural selection**

The nature and goals of science: Why study evolution at all?

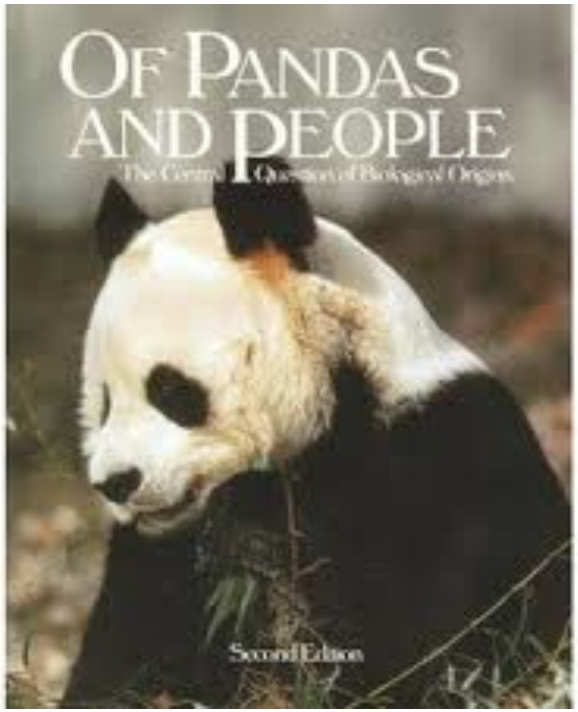
- Essential for the progress of biology
- Evolutionary concepts are major part of modern biology experiments
- Study of virus evolution (influenza/HIV/ H1N1), cancer progression, bacterial drug resistance, etc can save thousands of lives
- Nothing in Biology makes sense except in the light of evolution-Theodor Dobzhansky

Challenges to Teaching Evolution- Controversy

Statement made in the official curriculum of Dover Area School Board, Pennsylvania in the year 2004!

"*Students will be made aware of gaps/problems in Darwin's Theory and of other theories of evolution including, but not limited to, intelligent design.* ***Note: Origins of life will not be taught.***"

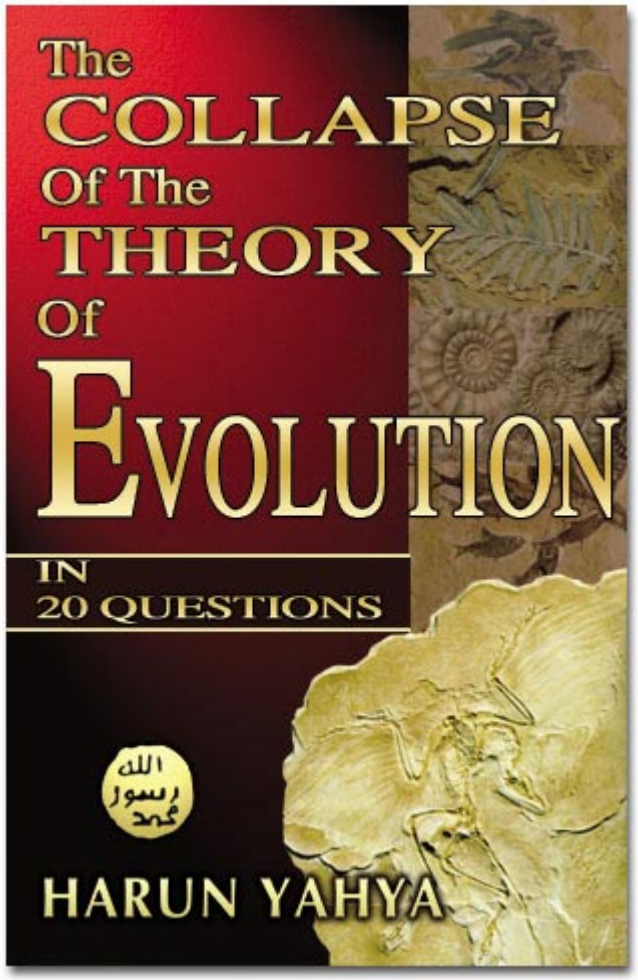
School board approves reference text: "**Of Pandas and of People**" by Percival Davis



It promotes the theory of intelligent design – Whole book is centered around the idea that various forms of **life began abruptly** through the agency of an intelligent creator with their distinctive features already intact. Fish with fins and scales, birds with feathers, beaks, and wings, etc.

You can find many such books still being published and many of them are very popular!

One more example



http://www.ukapologetics.net/Apologetics.htm

Department Position on Evolution and "Intelligent Design"

The faculty in the Department of Biological Sciences is committed to the highest standards of scientific integrity and academic function. This commitment carries with it unwavering support for academic freedom and the free exchange of ideas. It also demands the utmost respect for the scientific method, integrity in the conduct of research, and recognition that the validity of any scientific model comes only as a result of rational hypothesis testing, sound experimentation, and findings that can be replicated by others.

The department faculty, then, are unequivocal in their support of evolutionary theory, which has its roots in the seminal work of Charles Darwin and has been supported by findings accumulated over 140 years. The sole dissenter from this position, Prof. Michael Behe, is a well-known proponent of "intelligent design." While we respect Prof. Behe's right to express his views, they are his alone and are in no way endorsed by the department. It is our collective position that intelligent design has no basis in science, has not been tested experimentally, and should not be regarded as scientific.

Prof. Micheal Behe is a professor of Biochemistry at Lehigh University-proponent of "irreducibly complex"

top

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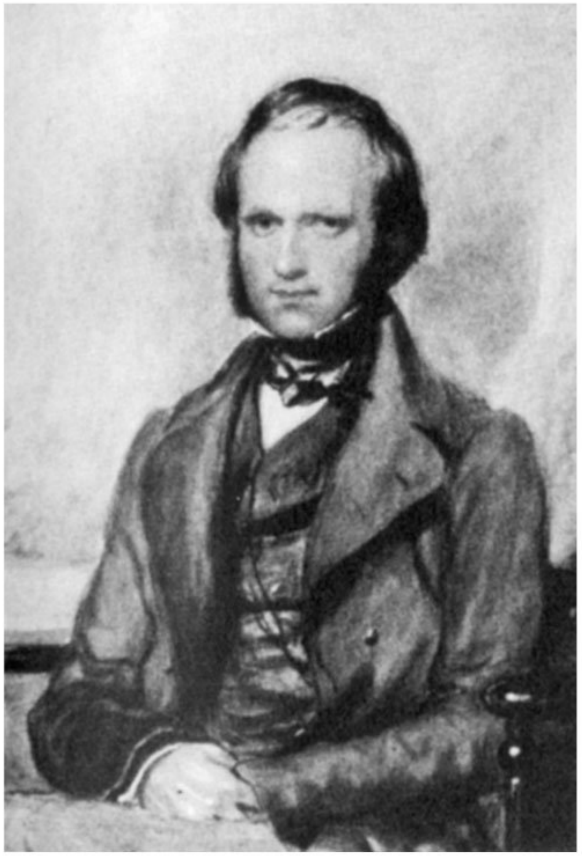
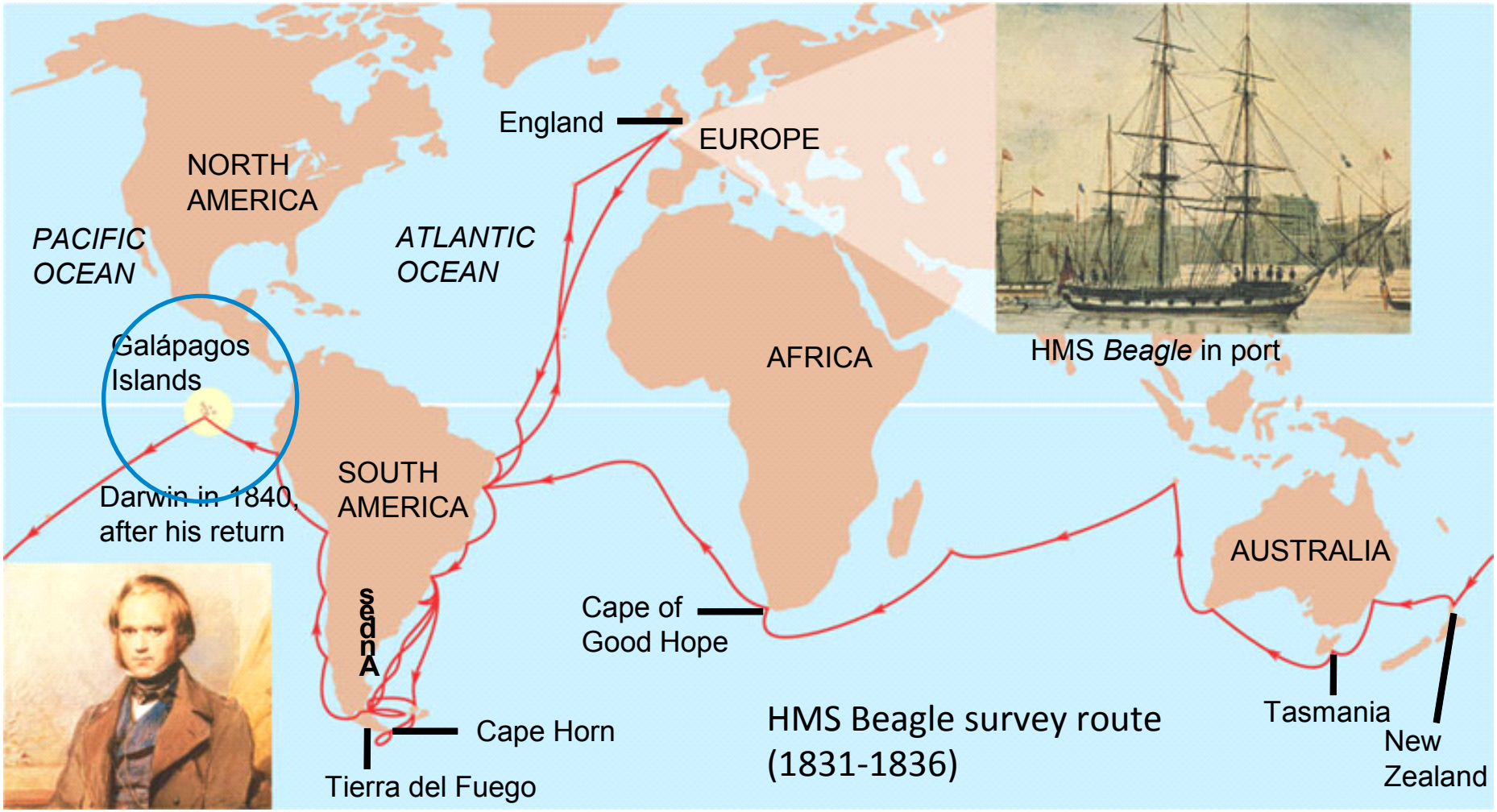
Site maintained by Maria Brace
Department of Biological Sciences
Lehigh University

Charles Darwin (1809-1882)



- Grandson of Erasmus Darwin
- Naturalist from a young age
- Left Medical School and studied marine invertebrates
- In 1831 got an invitation to join the 5 year survey expedition to South America on *HMS Beagle*
- His job title was *"Naturalist"*

Voyage of the Beagle



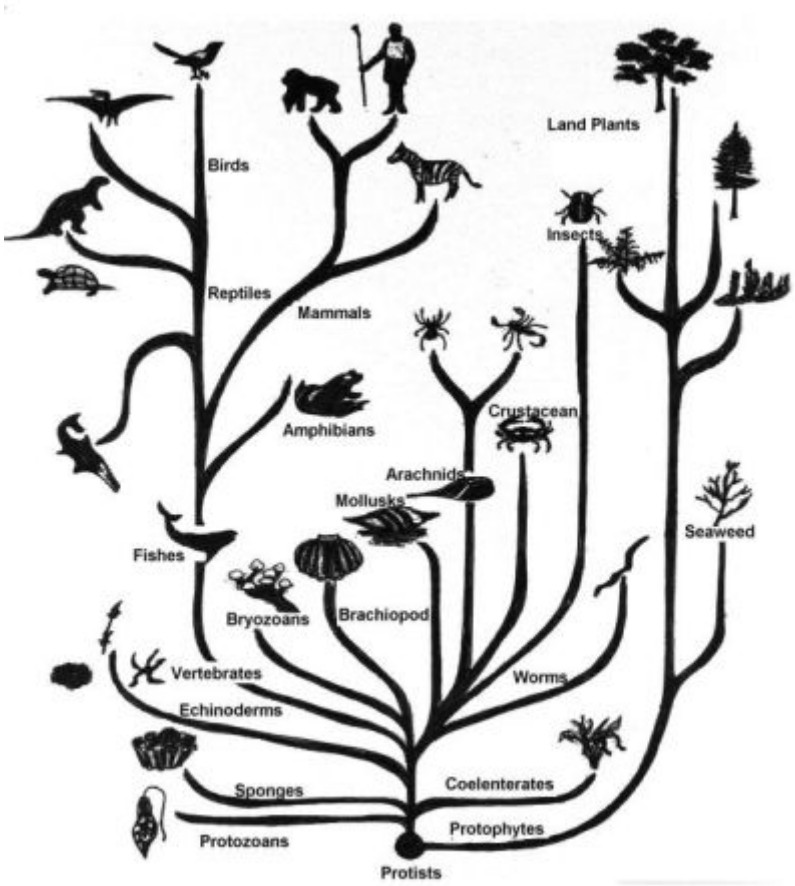
Darwin collected birds, insects, spiders, plants etc and fossils
Because of his travels these specimens came from all over the world

Facts known before Darwin

- Earth is ancient
- Fossils
- Similarities between species
- Organisms had descended through inheritance
- Mendel's findings were still a few decades away

Darwin proposed the idea of evolution

Evolution is the change in the inherited characteristics of biological populations over successive generations.



It gave rise to the revolutionary idea that all life on this planet arose from a common ancestor.

Darwin proposed the idea of natural selection

Darwin's process of natural selection has four components.

1) Variation. Organisms (within populations) exhibit individual variation in appearance and behavior. These variations may involve body size, hair color, facial markings, voice properties, or number of offspring. On the other hand, some traits show little to no variation among individuals—for example, number of eyes in vertebrates.

2) Inheritance. Some traits are consistently passed on from parent to offspring. Such traits are heritable, whereas other traits are strongly influenced by environmental conditions and show weak heritability.

3) High rate of population growth. Most populations have more offspring each year than local resources can support leading to a struggle for resources. Each generation experiences substantial mortality.

4) Differential survival and reproduction. Individuals possessing traits well suited for the struggle for local resources will contribute more offspring to the next generation.

Galapagos island has not changed much since Darwin's visit

Many endemic species

- Vertebrates
- Invertebrates
- Mammals
- Plants

The Great Frigate Bird

The land iguana

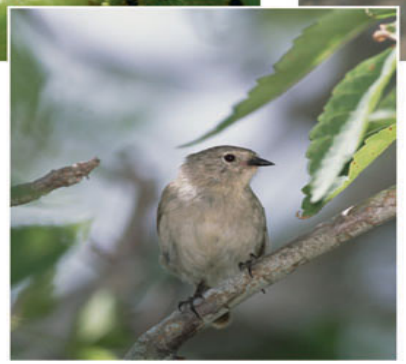
The Giant tortoise

Darwin's Focus on Adaptation

- As Darwin reassessed all that he had observed during the voyage of the Beagle
  - He began to perceive **adaptation to the environment** and the **origin of new species** as closely related processes
- Biologists have concluded that this is indeed what happened to the Galápagos finches

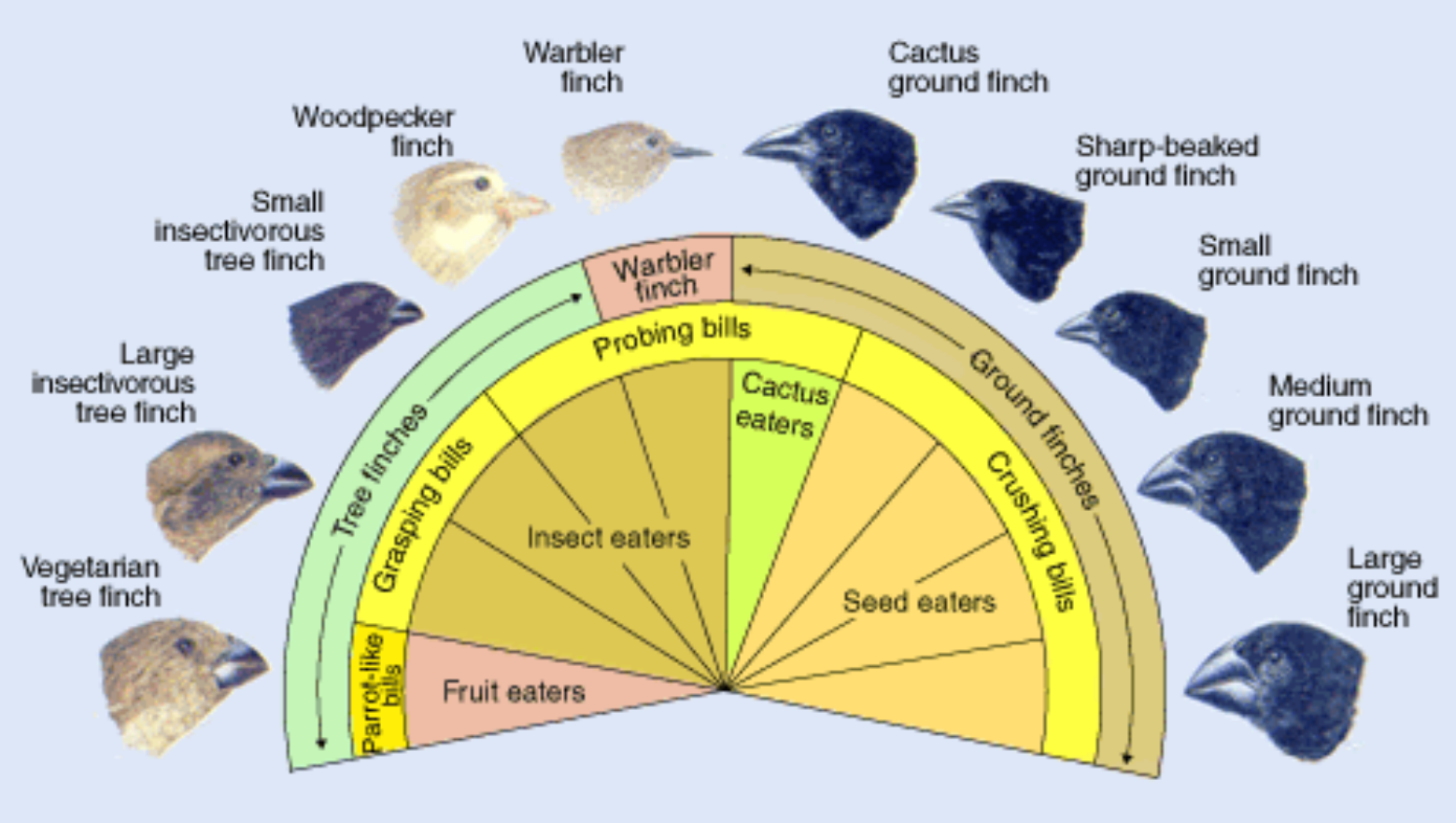
Cactus eater. The long, sharp beak of the cactus ground finch (*Geospiza scandens*) helps it tear and eat cactus flowers and pulp

Seed eater. The large ground finch (*Geospiza magnirostris*) has a large beak adapted for cracking seeds that fall from plants to the ground.



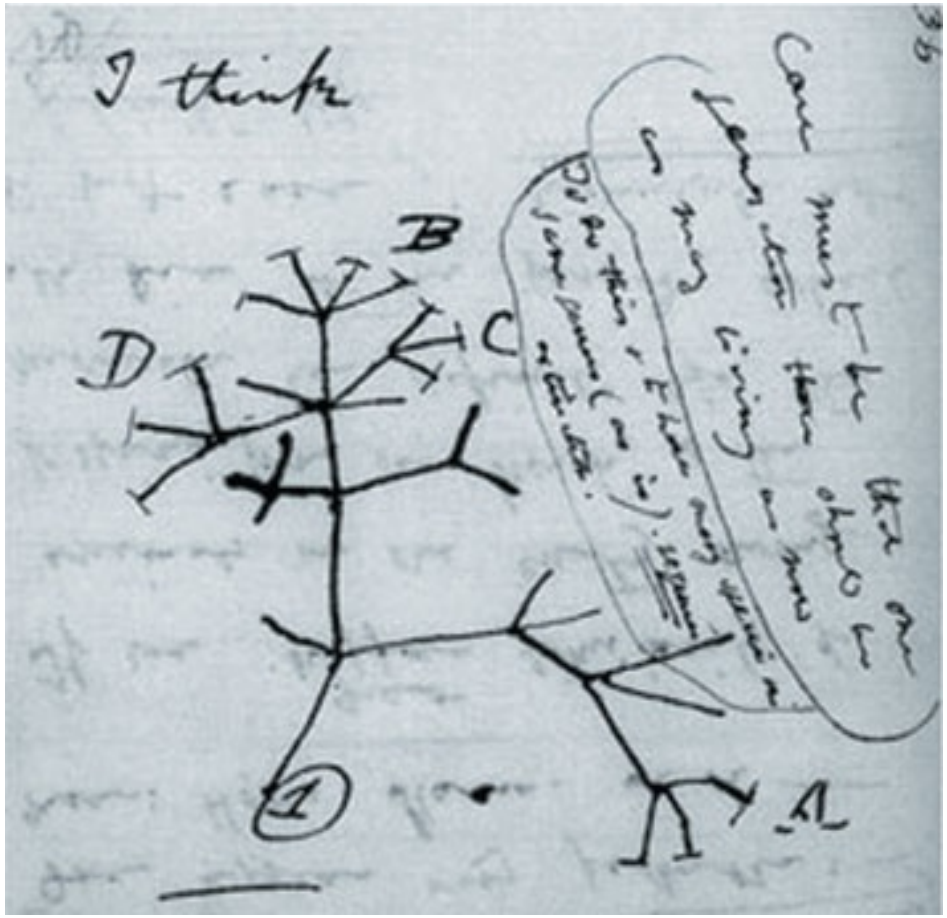
Insect eater. The green warbler finch (*Certhidea olivacea*) uses its narrow, pointed beak to grasp insects.

Adaptive radiation



This diagram presents 10 species of finches on the Galapagos Islands, each exploit different resources on various islands. All of them evolved from one ancestral species, which colonized the islands only a few million years ago. This process, whereby species evolve rapidly to exploit empty ecospace, is known as *adaptive radiation*.

In the Darwinian view, the history of life is like a tree



Darwin's famous "I think. . ." tree.

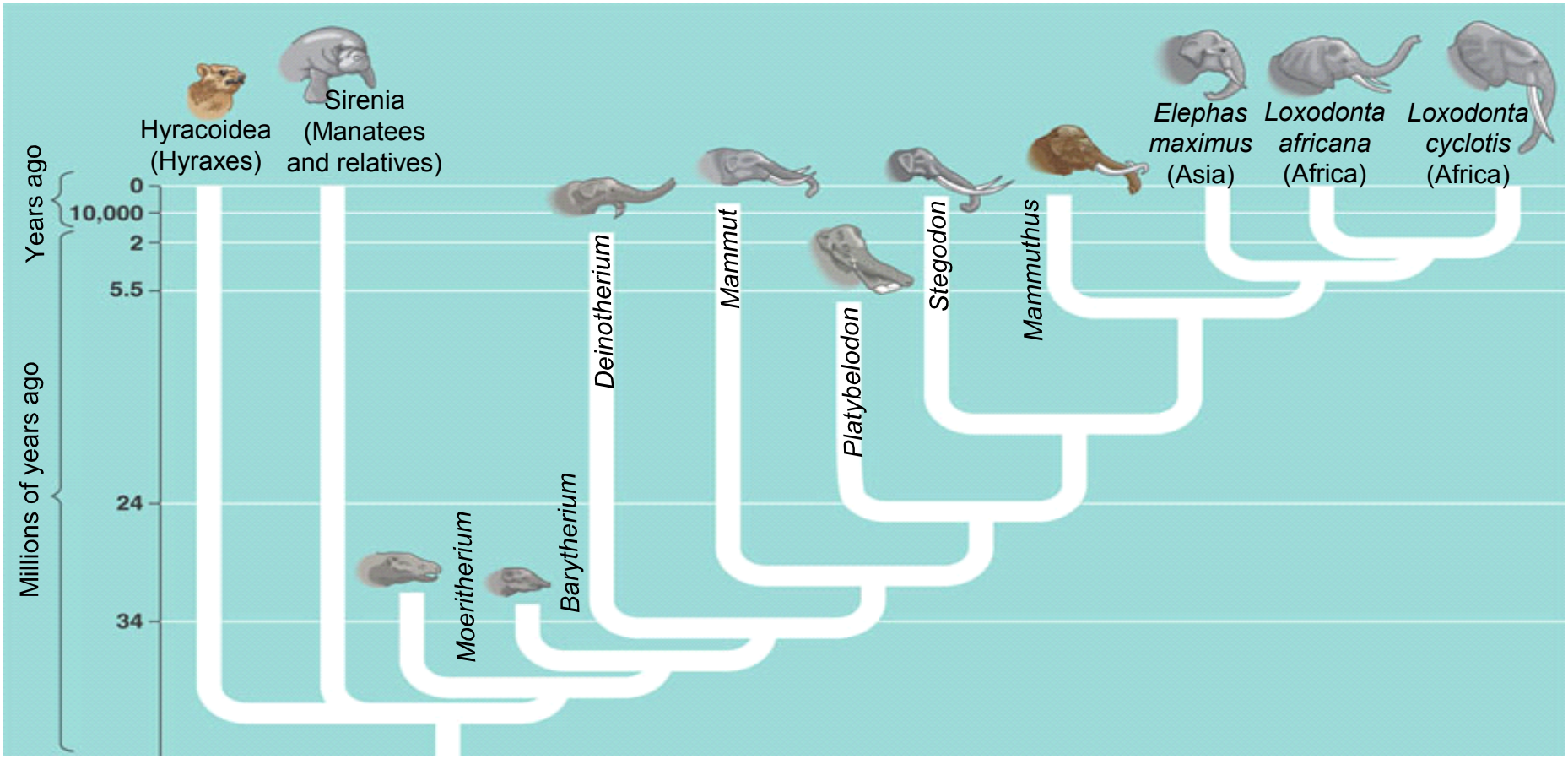
In this 1837 sketch, Darwin envisioned the branching pattern of evolution.

Darwin's Ideas

- In the book *Origin of Species* Darwin developed two main ideas
  - Evolution explains life's unity and diversity
  - Natural selection is the cause of adaptive evolution

- The phrase *descent with modification* summarized Darwin's perception of the unity of life
  - All organisms are related through descent from an ancestor that lived in the remote past

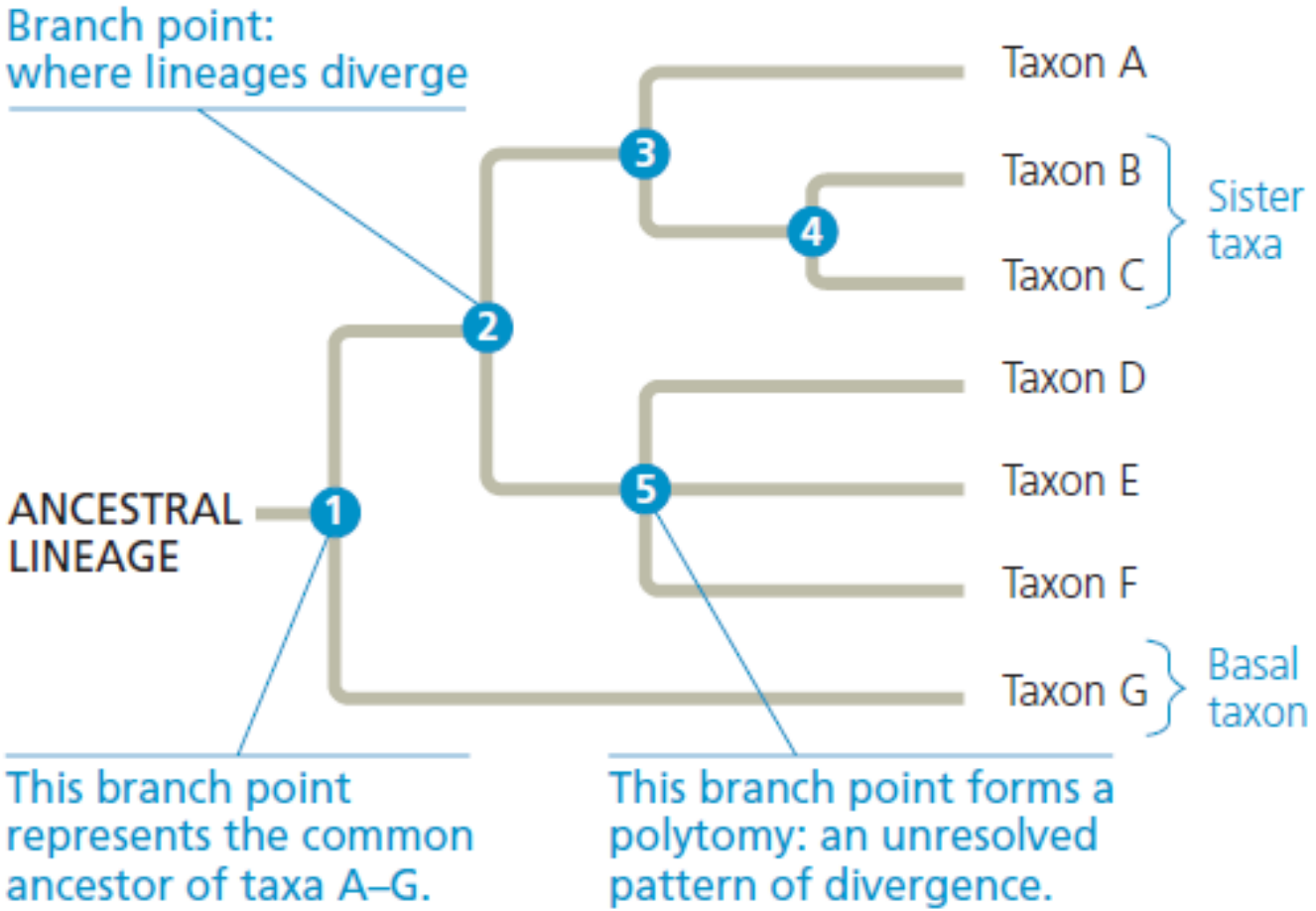
Phylogenetic Tree



Modern day elephants are related to manatees and shrews.

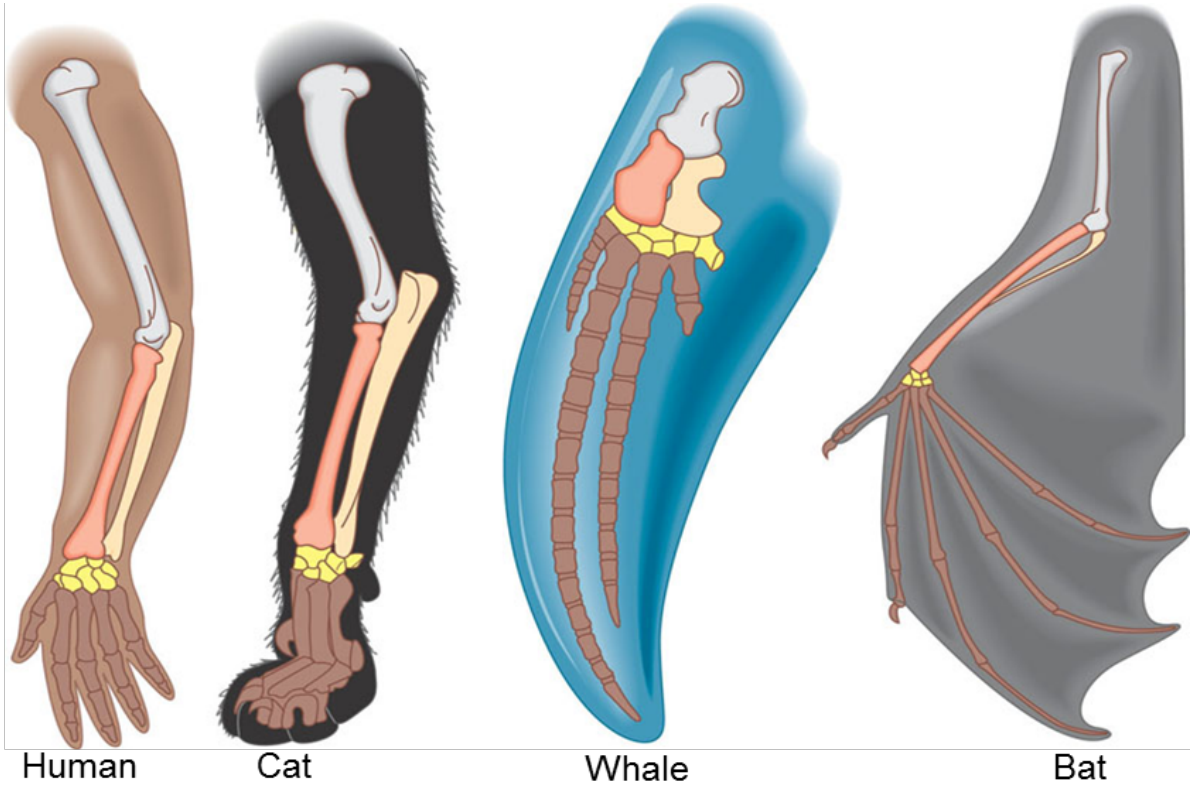
How to read a phylogenetic tree

A phylogenetic tree represents a hypothesis about evolutionary relationships



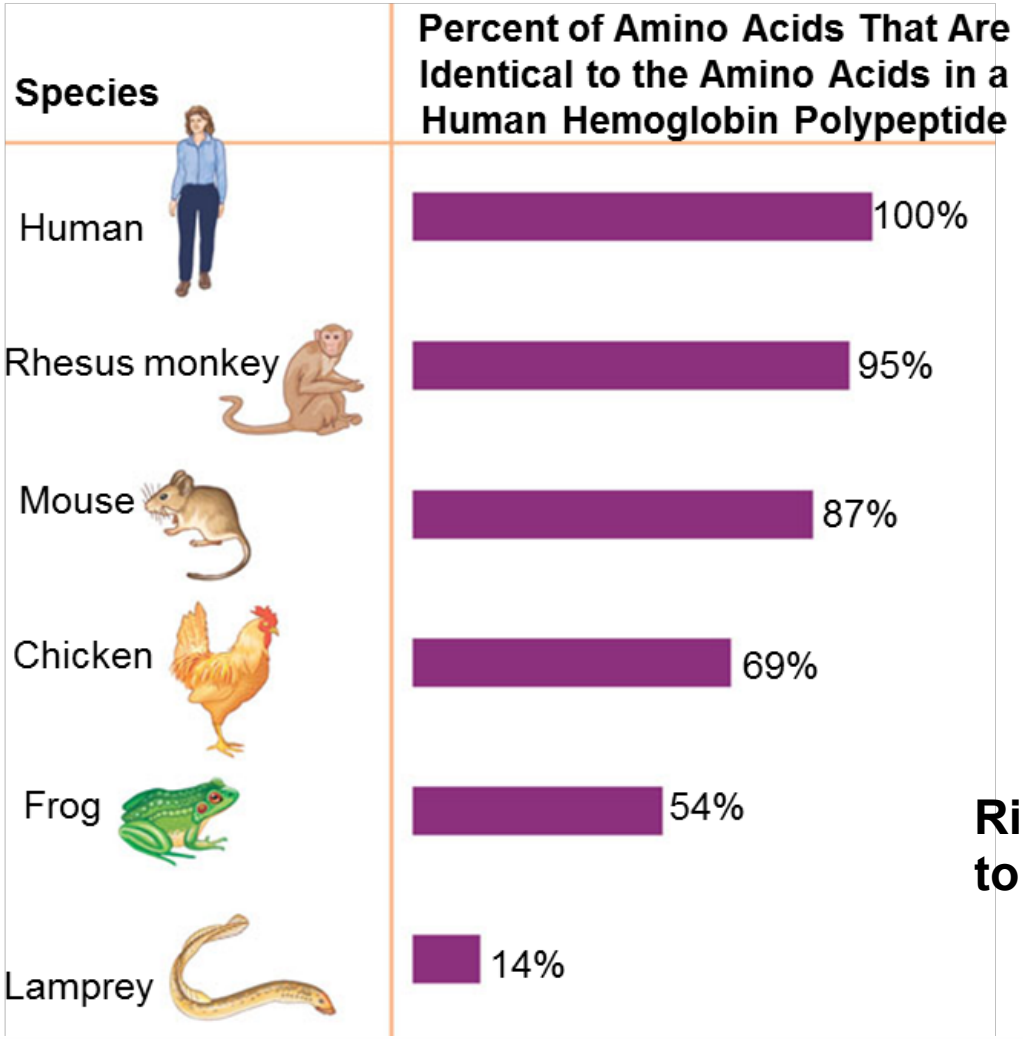
Homology, Biogeography, and the Fossil Record

- **Homology** is similarity resulting from common ancestry
  - Anatomical homologies are anatomical resemblances that represent variations on a structural theme that was present in a common ancestor



Today relationships between species ….

… are generally reflected in their molecules, their genes, and their gene products (proteins)



Ribosomal RNA genes are used to construct phylogenetic trees

Natural Selection

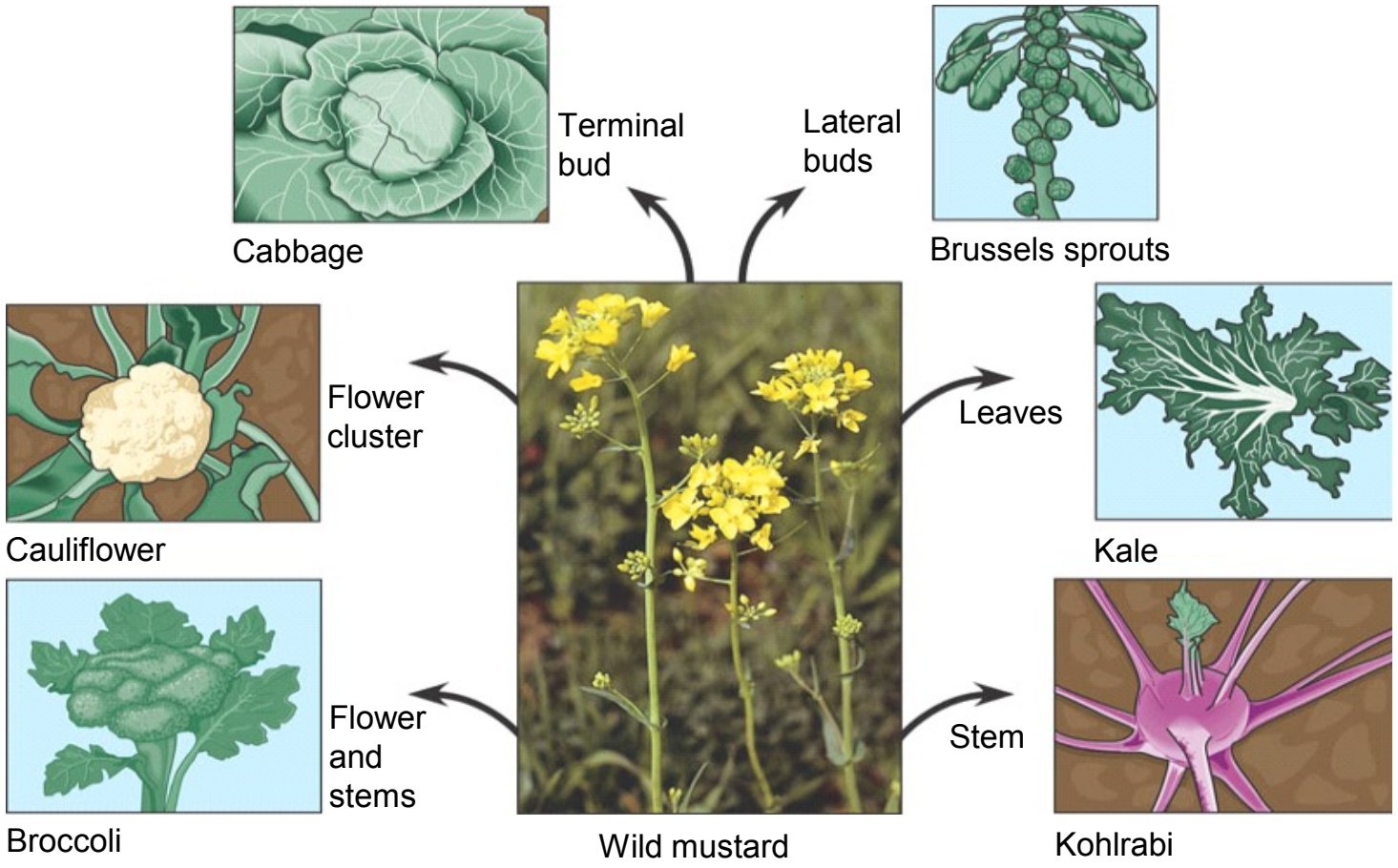
Natural selection can produce any kind of variation resulting in the adaptation of organisms to their environment

A flower mantid in Malaysia

A stick mantid in Africa

Artificial Selection

- Humans have modified other species over many generations by selecting and breeding individuals that possess desired traits
  - **Example** farmers have cultivated numerous popular crops from the wild mustard, by artificially selecting for certain attributes



Darwin's Theory of Evolution through Natural Selection

- Descent with modification
- Common ancestor
- Natural selection- *the survival of certain traits because they better adapt the organism for its survival*.

- Natural selection doesn't just select against inferior organisms, it selects for superior organisms and leads to even more superior organisms.

Adaptation is the result of Natural selection on Mendelian variation

(1)Mendelian genetics is conducive to natural selection

- Heritable variation is "preserved"
- No direct influence of environment on variation
- Mutation is random with respect to adaptation, there is bias towards well adapted variations

(2) Adaptation is solely due to natural selection

- Many processes (genetic drift, migration, mutation) affect evolution, none of these tends to produce organisms with better survival and reproduction capability
- All minor differences are also influenced by selection & weaker selection can also be very effective

Evolution of the first life: Initial events in the emergence of life

Formation of Earth

↓

Inorganic substances

↓

Primordial soup (simple organic compounds)

↓

Polymerization (complex organic substances)

↓

Self-replicating systems (RNA based)

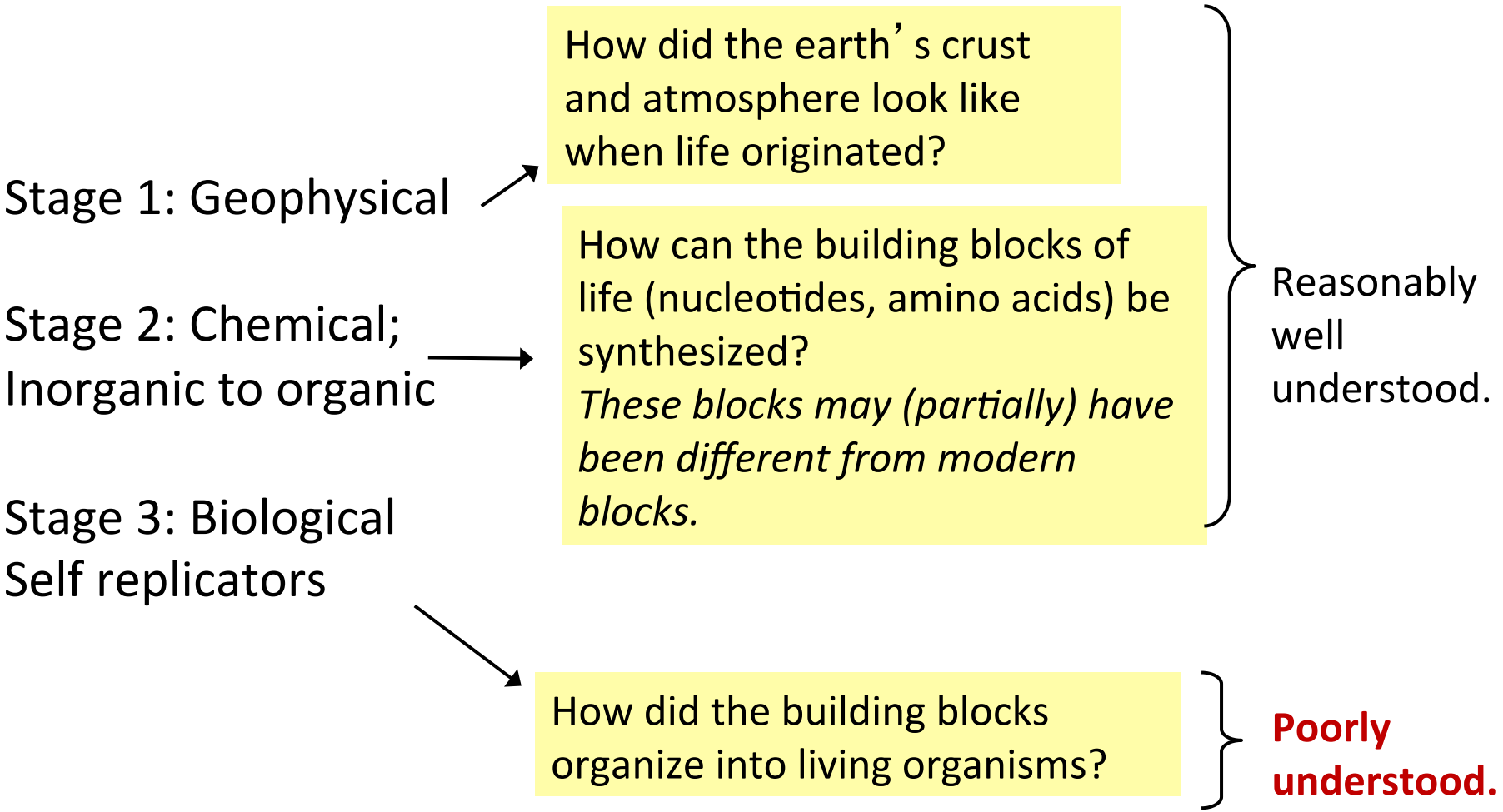
↓

Protocells (RNA based)

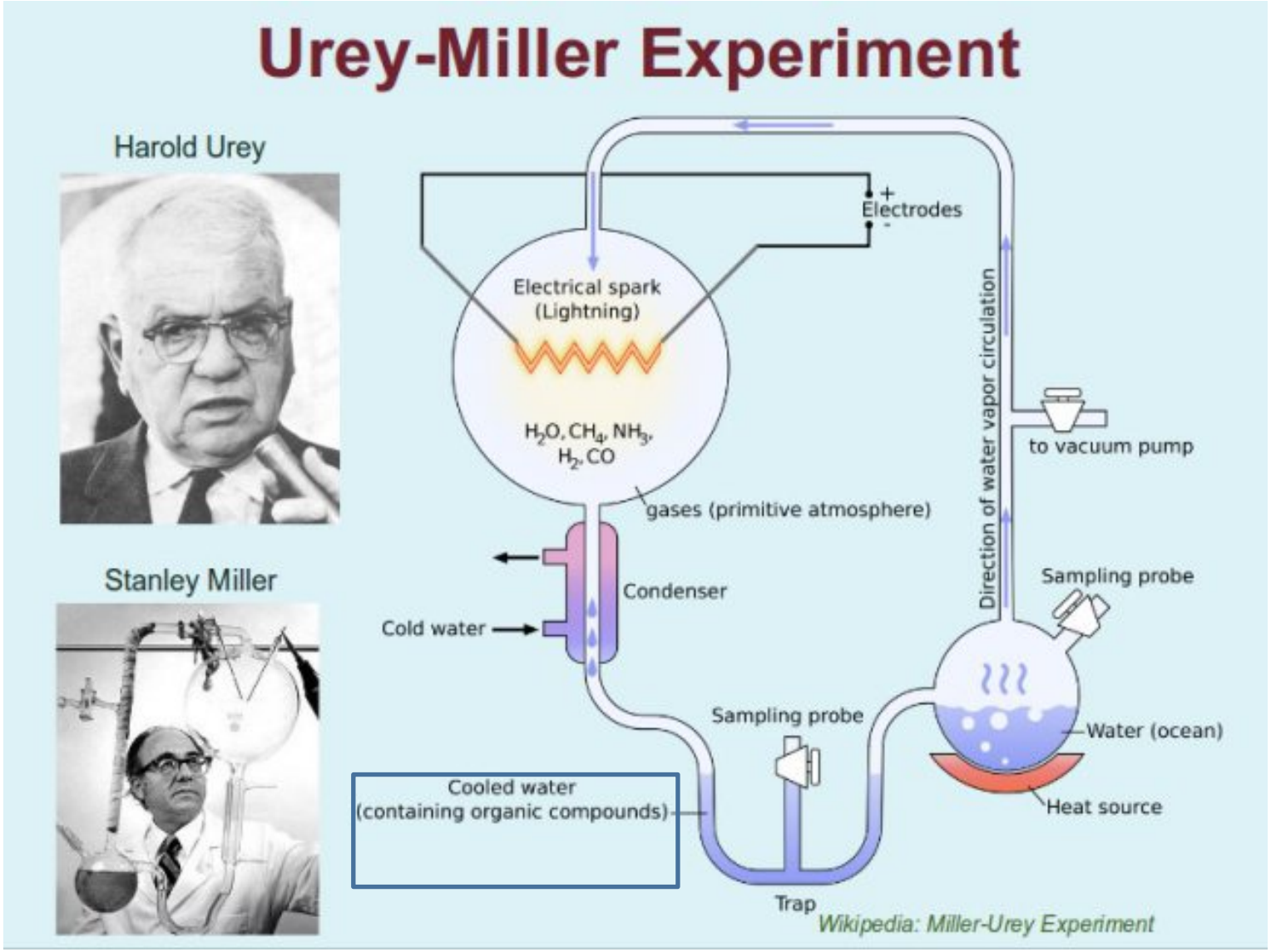
↓

Complex cells (DNA/proteins based)

Stages of prebiotic evolution

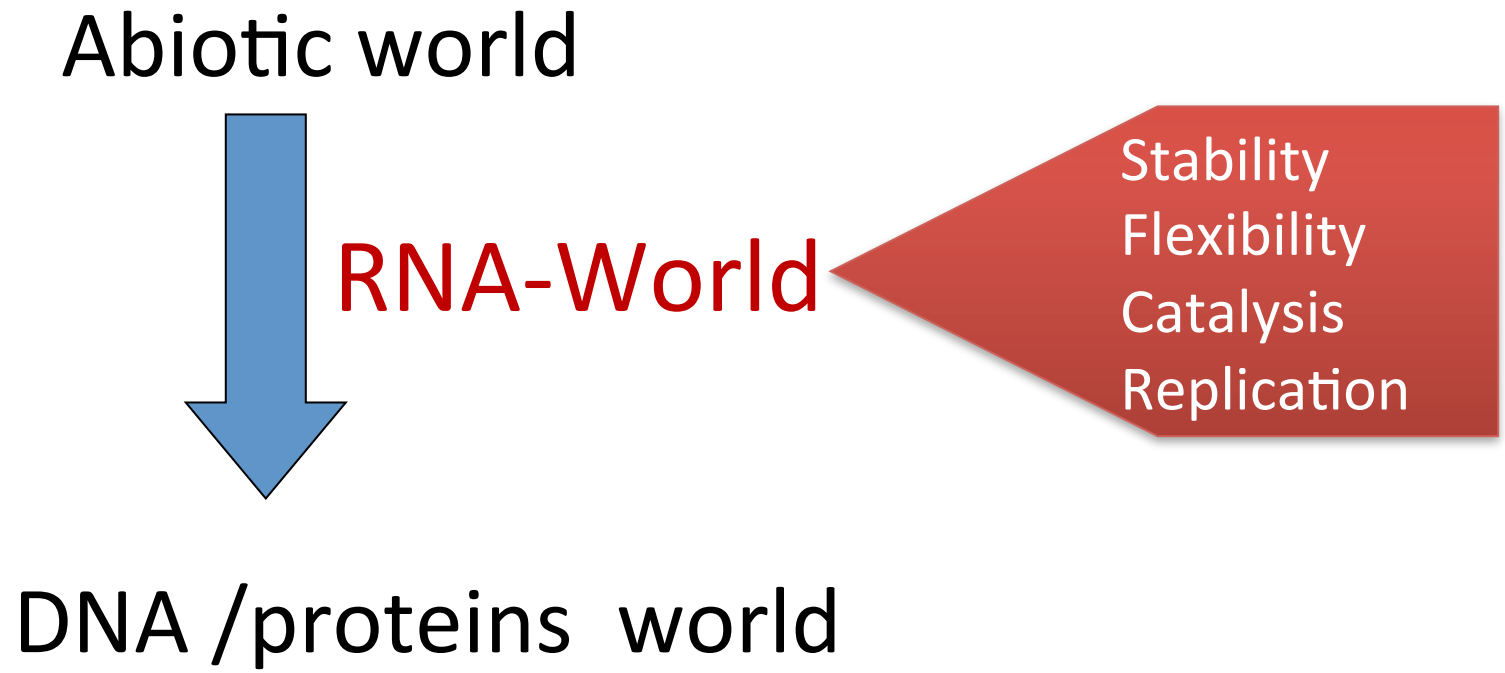


Simulation of the pre-biotic environment: formation of simple bio-molecules

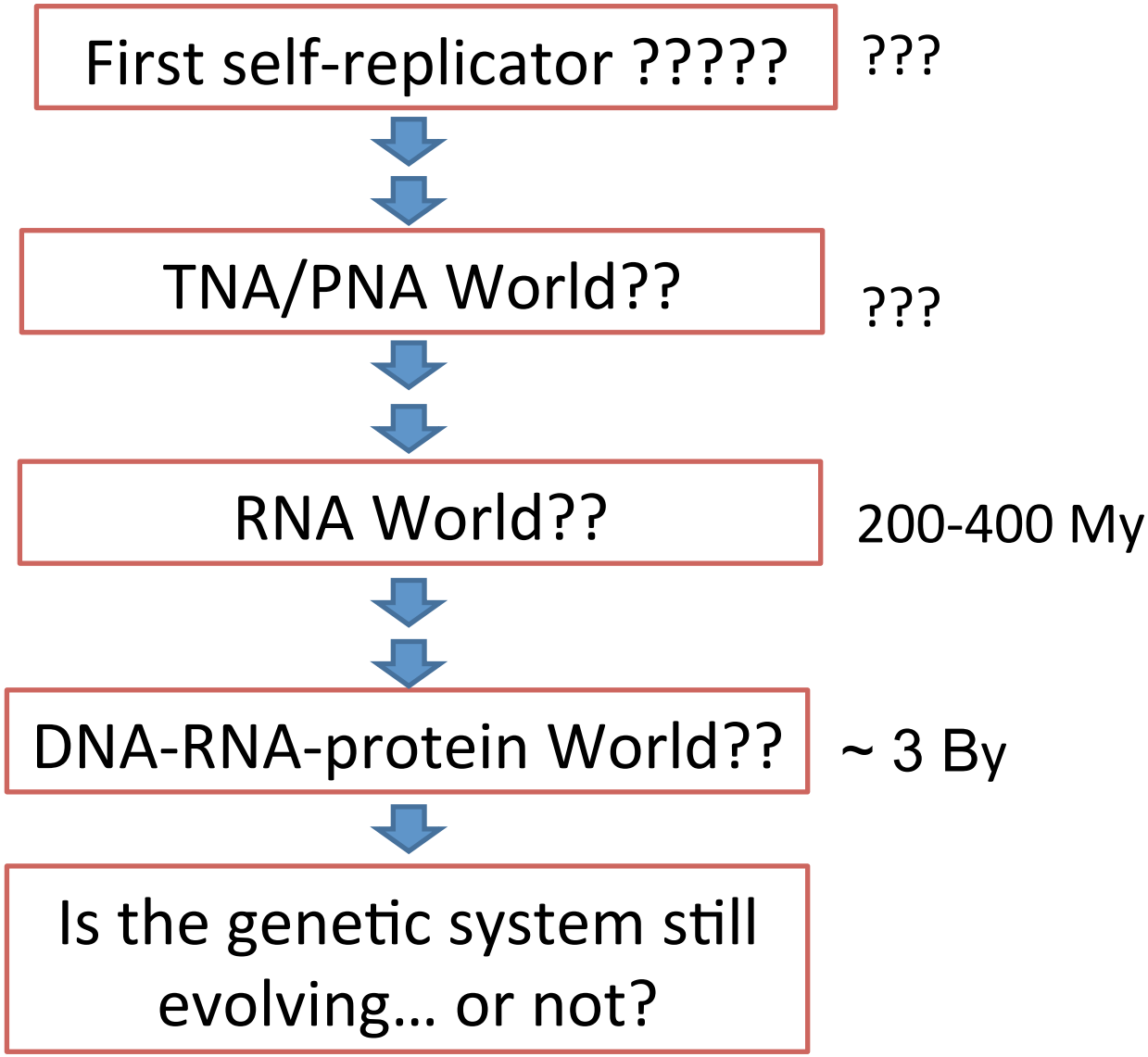


Two percent of the carbon had formed amino acids that are used to make proteins in living cells, with glycine as the most abundant. Sugars were also formed.

The Biological stage : Path to DNA/proteins System



The Biological stage : Path to DNA/proteins System



Overview and conclusions