The Theory of Biological Evolution

The Theory of Evolution, defined:

"All living species are descendants of ancestral species and are **different** from present day ones due to the cumulative change in the **genetic composition** of a population"

- Sooo in a nutshell, **populations** of living things look and behave differently because over time, their DNA has changed… *but how?*

Charles Darwin (1809-1882)

- Father of the theory of Evolution
- Suggested that **natural selection** is the mechanism by which species evolve over geologic time.
- Proposed **Descent with Modification**:
  - *All organisms on Earth are related through some unknown ancestral type that lived long ago.*

History of the Theory

- **Evolutionary theory** was developed through many generations of scientists interpreting **new evidence** to refine and expand our understanding of biological change across time.
  - Darwin and Wallace (Evolution)
  - Gregor Mendel (Genetics)
  - Franklin, Watson & Crick (Genetics)

The Nuts and Bolts of Evolution

- **Evolution**: A cumulative change in the inherited characteristics of population.
- **Population**!! Is what changes.
- **Evolution is like a tree** – many branches emerged from a common beginning, some branches died off (extinction), others branched multiple times (present-day diversity)

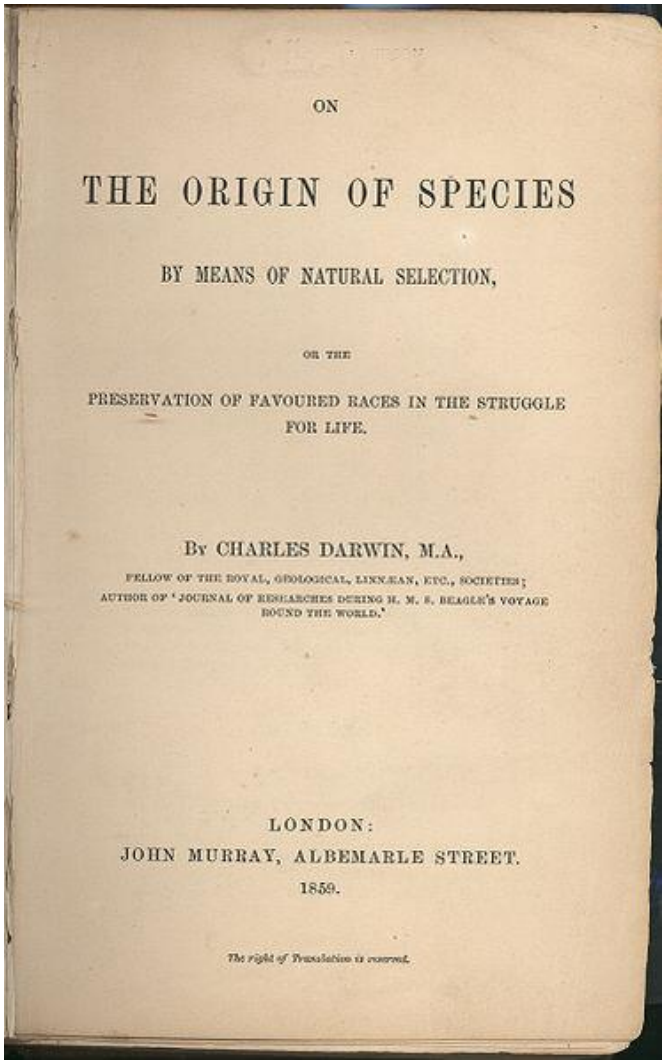
The Nuts and Bolts of Evolution

- The great diversity of living organisms is the result of over 3.5 billion years of evolution, filling every available **niche** with life forms.
- **Niche**: The area within a habitat occupied by an organism OR the ecological role of an organism within its community.
  - *"I've found my niche in society, I am a social worker"*
  - *"The arctic fish have found their niche in cold waters due to the adaptations in their cell membranes"*

The Origin of Species

Darwin developed two main ideas:

- Evolution explains life's **unity and diversity**
- **Natural selection** is a cause of adaptive evolution



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.

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To Darwin, the history of life is like a tree.

→multiple branchings from a common trunk to the tips of the youngest twigs that represent the diversity of living organisms

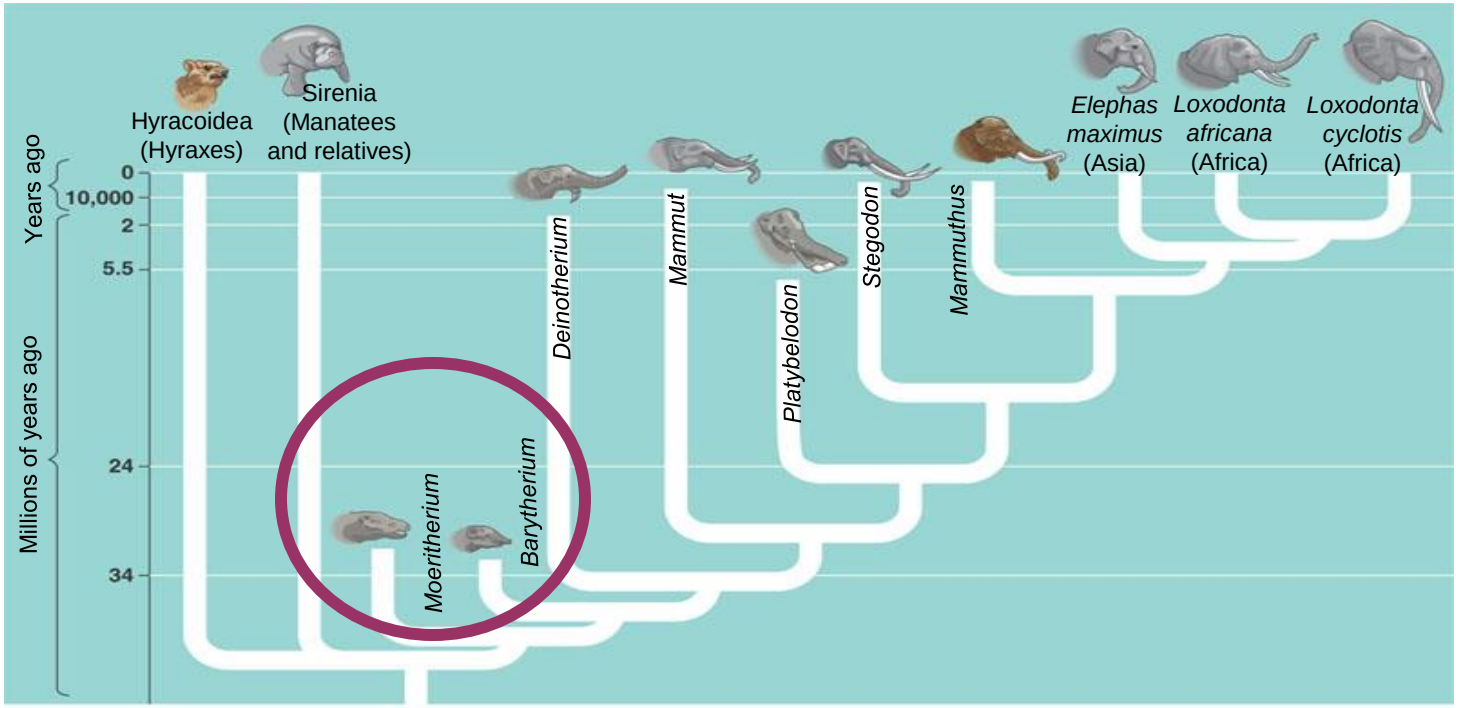


Figure 22.7

The Six Main Points of Darwin's **Theory of Evolution**

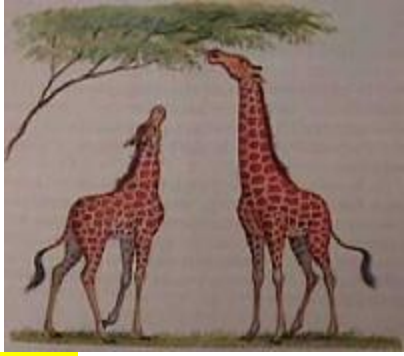
Observations and Inferences

Natural selection does not grant organisms what they "need".

1. **Overproduction***

- Most species produce far more offspring than are needed to maintain the population.
- Species populations remain more or less constant ("stable") because a small fraction of offspring live long enough to reproduce.

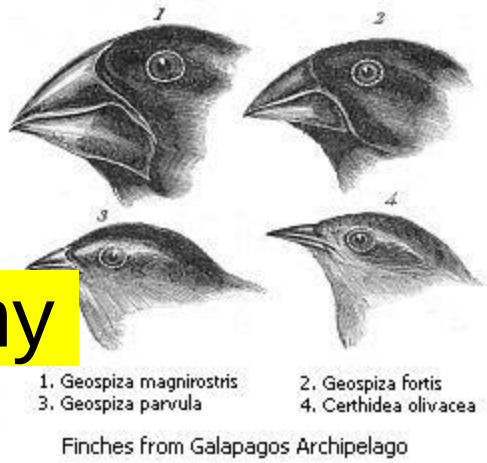
2. **Competition***



- Living space and food are limited, so offspring from each generation must compete among themselves in order to live.

- Only a small fraction can possibly survive long enough to reproduce.

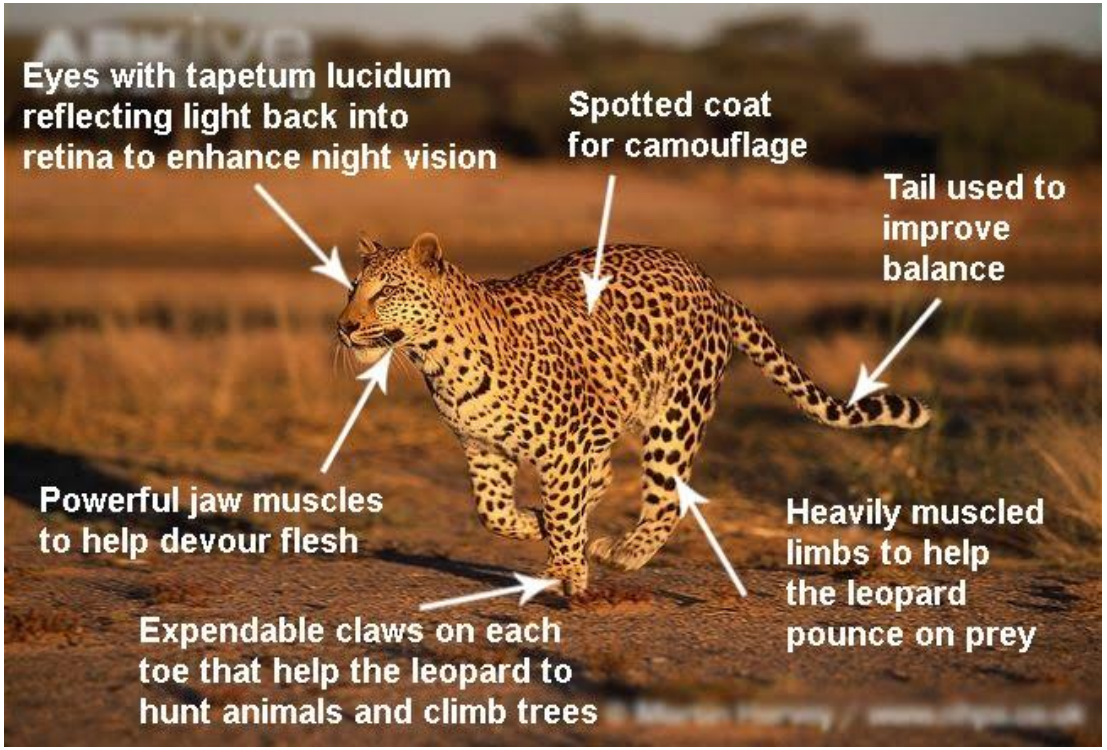
3. **Genetic Variation***



- Characteristics in individuals in any species are not exactly alike.
  - Ex: Differences for *Homo sapiens* (humans) can be exact size or shape of body, strength in running, or resistance to disease.
- These differences are considered to be the variations ***within*** a species. *What causes slight variations between individuals?*

4. **Adaptation**

An adaptation is an **inherited trait** that **increases** an organisms' chance of survival and reproduction in a given environment.

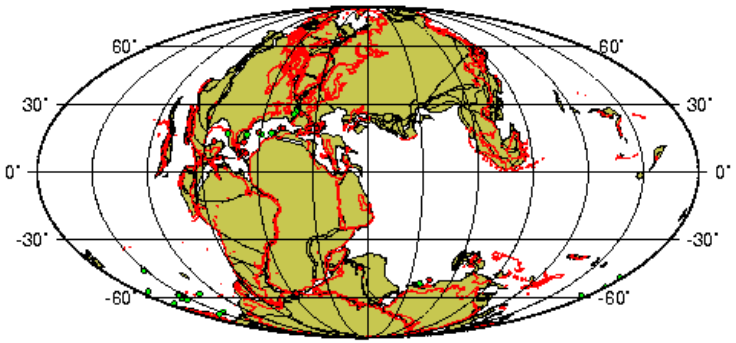


5. **Natural Selection***

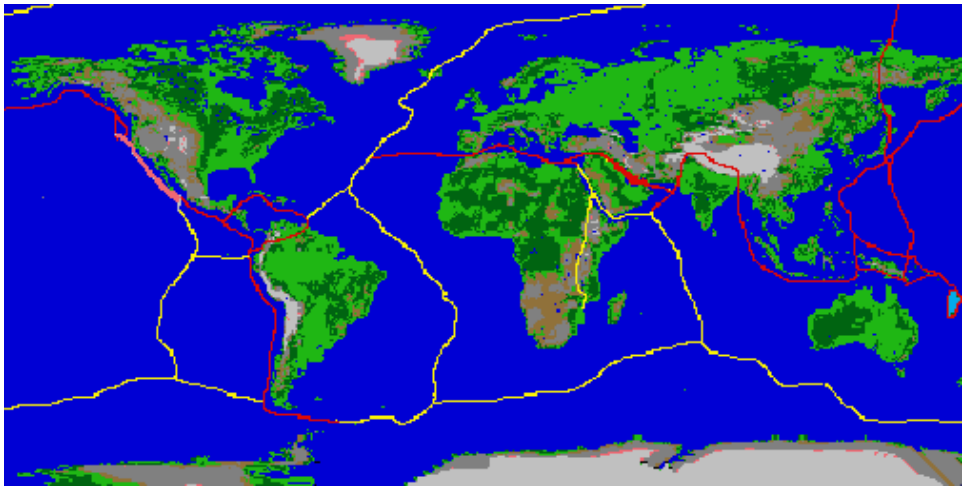
- **Nature**/environment **selects** for living organisms with better suited **inherited** traits to survive and reproduce.
- Offspring inherit these better traits, and **as a whole** the population improves *for that particular environment*.

5. **Natural Selection**, cont.

- Natural Selection does not move in a pre-determined direction! The changing earth determines what will and can survive.



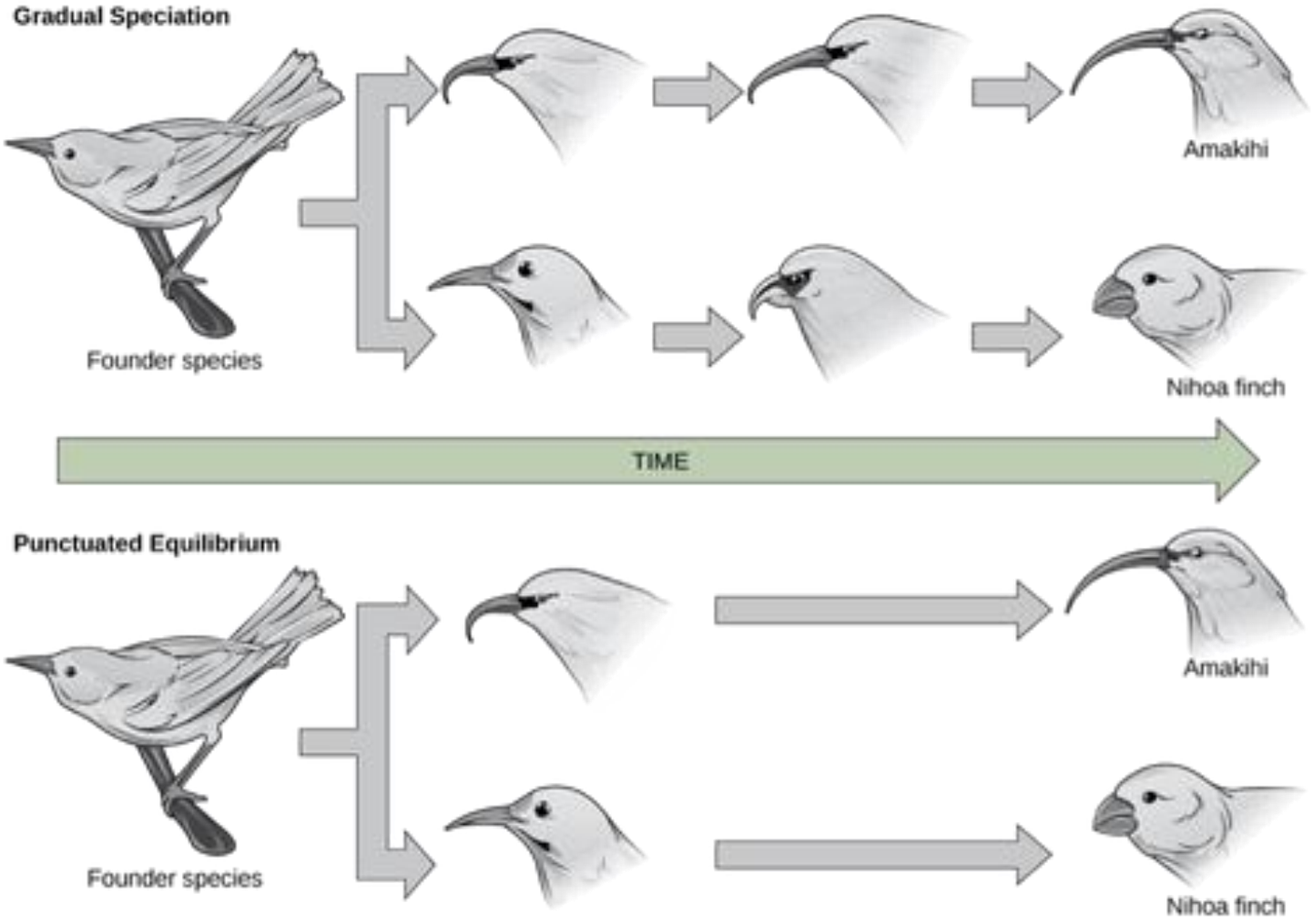
150 My Reconstruction



6. **Speciation**

- Over many generations, favorable adaptations (in a *particular* environment) gradually accumulate in a species and “bad” ones (in a *particular* environment) disappear.
- Eventually, accumulated changes become so great, the result is a **new species**.
- Formation of a new species is called “Speciation” and it takes *many, many* generations to do.

Speciation


Gradual Speciation
Amakihi
Founder species
Nihoa finch
TIME
Punctuated Equilibrium
Amakihi
Founder species
Nihoa finch

The four factors*

1. Overproduction
2. Competition
3. Genetic Variation
4. Natural Selection

Biological Evolution is a consequence of these 4 factors - they work together to impact any living population

Which one of **Darwin's Six Points** do the following pictures show?

Diagram 1

Competition or Overpopulation

Diagram 2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Variation

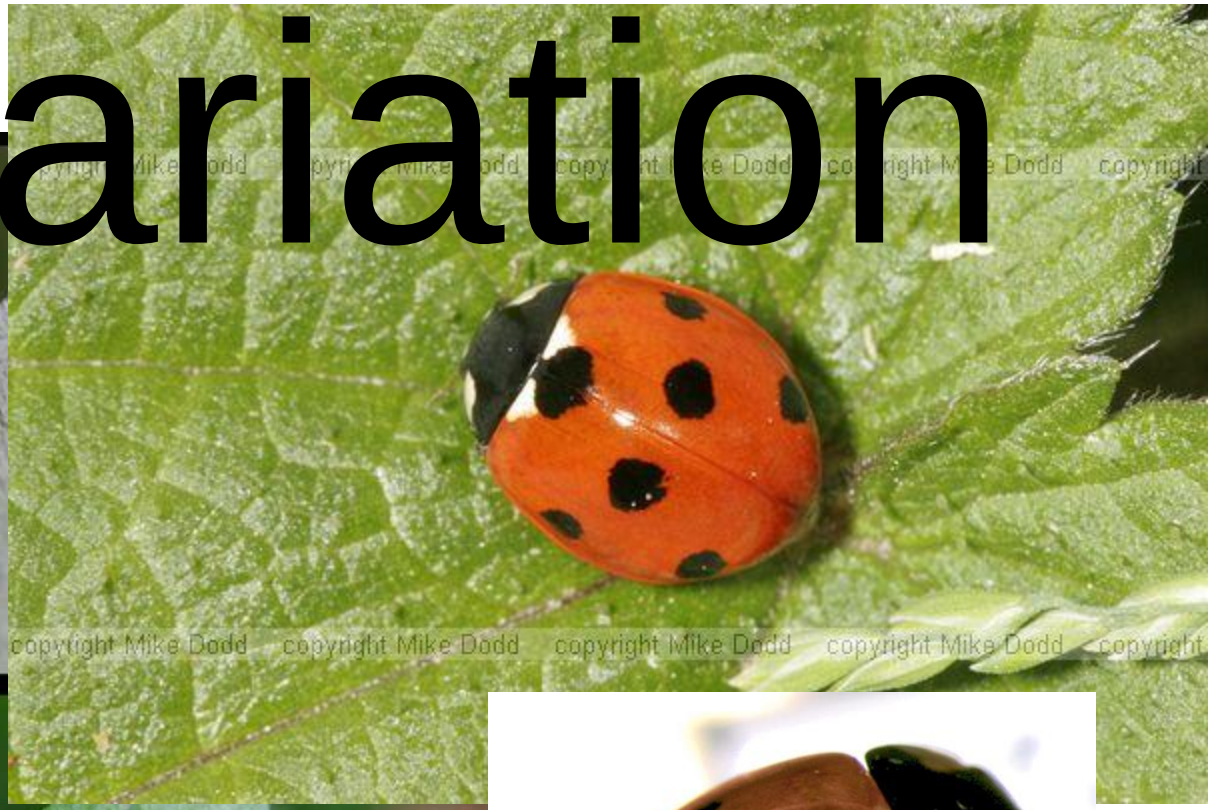
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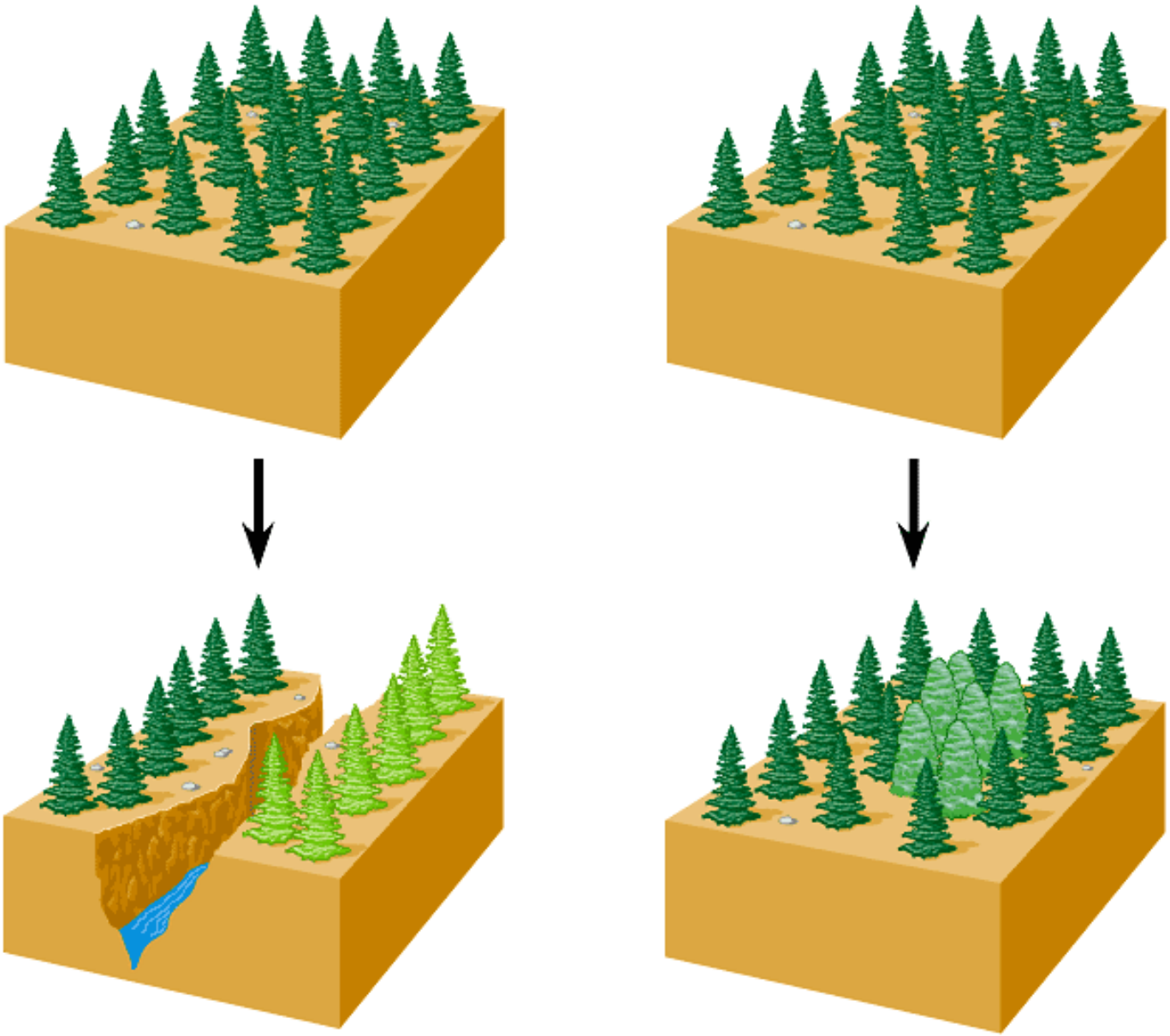
Diagram 3



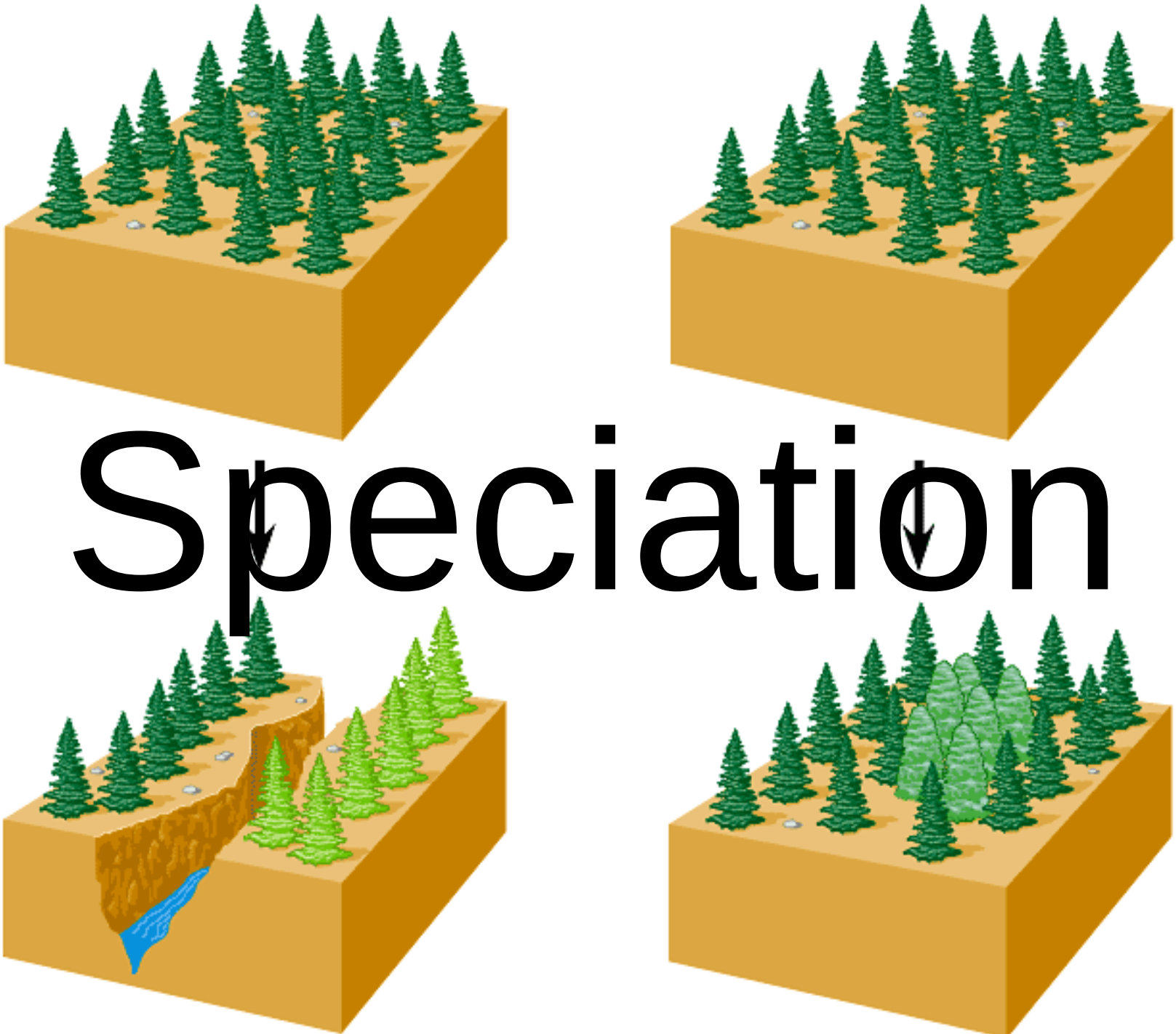

Speciation

Diagram 4

Adaptation