Explain: Biodiversity & Evolution
SPRING SEMESTER 2024

INSTRUCTOR:

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Vocabulary / Key Terms/ Concepts	Biodiversity & Evolution Notes
• *Adaptation* • *Anatomical Homology* • *Biogeography*	**Student Expectations:** • ***Identify*** *evidence of common ancestry from the fossil record, biogeography, and homologies (anatomical, molecular, developmental).* • ***Describe*** *different rates of evolutionary change, such as gradualism, abrupt appearance, and stasis.* • ***Explain*** *how natural selection affects populations rather than individuals.* • ***List*** *the key elements of natural selection: inherited variation, overproduction of offspring, competition for resources, and differential reproductive success.* • ***Recognize*** *how natural selection can lead to the formation of new species (speciation).* • ***Define*** *evolutionary mechanisms beyond natural selection, including genetic drift, gene flow,*

- *Bottleneck Effect*
- *Competition for Resources*
- *Differential Reproductive Success*
- *Directional Selection*
- *Disruptive Selection*
- *Environmental Conditions*
- *Evolution*

mutation, and genetic recombination.

- ***Summarize*** *the process of evolution, including factors like population growth potential, genetic variation, competition, and survival of the fittest.*
- ***Identify*** *the impacts of changing environmental conditions on species, such as increases in population, speciation, and extinction.*

I. Charles Darwin and the Origin of Species

A. Who Was Charles Darwin?

- A _____ and _____ who developed the theory of evolution by natural selection.
- Published *"On the _____* ***of Species***" in 1859, explaining how species change over time.

B. The Journey on the HMS Beagle

- Darwin traveled around the world from 1831–1836 on the _____ _____ .
- Visited places like the _____ Islands, South America, and Australia.
- Observed and collected plants, animals, and fossils.

- *Fossil Record*
- *Gene Flow*
- *Genetic Drift*
- *Genetic Recombination*
- *Gradualism*
- *Inherited Variation*
- *Mutation*
- *Natural Selection*

C. Key Discoveries

- _____ **:** Traits that help organisms survive in their environment.
  - _____ *on the Galápagos Islands: Beak shapes varied depending on the type of food available.*
  - _____ : *Shell shapes were different based on the island's environment.*
- _____ **Evidence:** Fossils of extinct animals resembled living species.

D. Early Theories

- **Common** _____ **:** All species share a _____ _____ .
- **Natural Selection:** Organisms with traits that help them **survive** _____ more, passing those _____ to their _____ .

II. Theories on the Origin of Life

A. _____ (Origins of Life)

- Life arose from non-living matter over 3.5 billion years ago.

- *Overproduction of Offspring*
- *Punctuated Equilibrium*
- *Speciation*
- *Stabilizing Selection*
- *Stasis*
- *Survival of the Fittest*

- Miller-Urey Experiment (1953): Simulated early Earth conditions and produced amino acids, key building blocks of life.

B. _____ Theory

- Explains how complex cells (_____) evolved from simple cells (_____).
- **Key Idea:** Larger cells engulfed smaller ones, which became _____ like _____ and _____ .
- **Evidence**:
  - Mitochondria and chloroplasts have their own _____ , similar to _____ .
  - They reproduce _____ within cells.

III. Evidence of Evolution

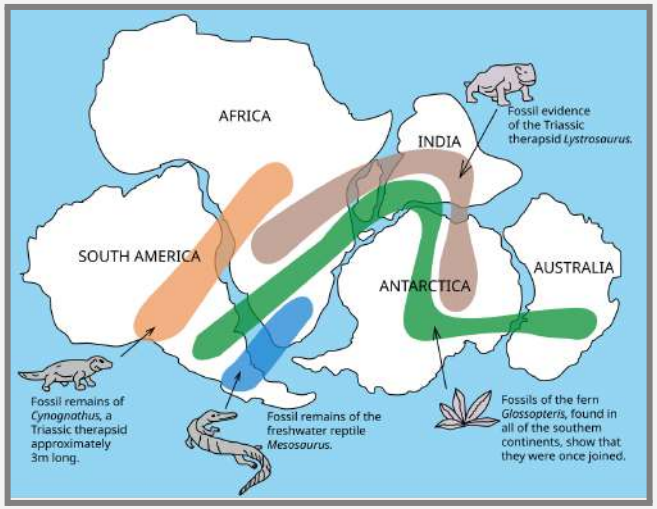
A. _____ Record

- **Fossils show how species have changed over time.**

- _____ in older rocks look very different from modern species.
- _____ **Fossils:** Show **links** between major _____ , like *Tiktaalik*, which connects fish and amphibians.
- **Law of** _____ : _____ fossils are _____ in the earth while _____ fossils appear near the _____

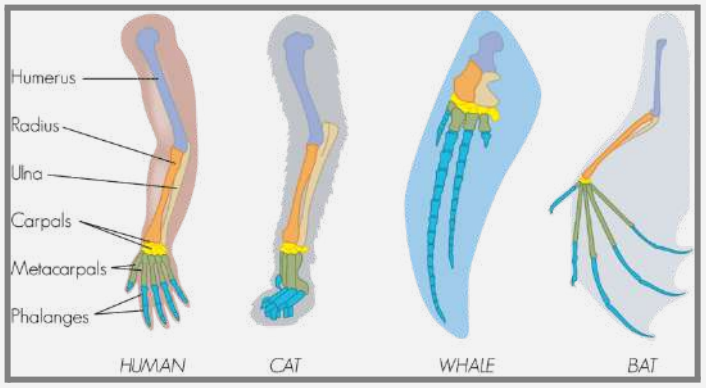
B. _____

- **Study of where species live and how they got there.**
  - **Example:** Marsupials like kangaroos in Australia suggest _____ **ancestry** due to geographic isolation.
  - **Endemic Species:** Found only in _____ places, like finches on the Galápagos.



C. _____

- **Traits shared by species because they came from a common ancestor.**
  1. _____ **Homologies: Similar structures**, like the bones in a whale's fin and a

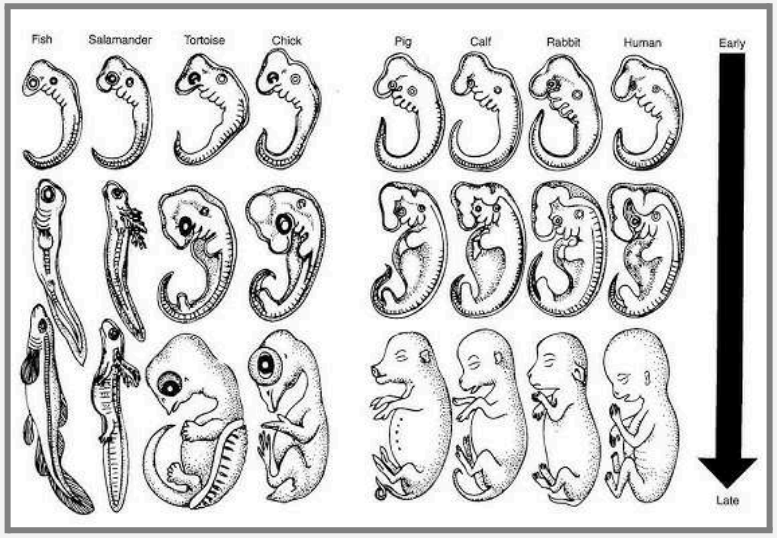


human hand.

Cytochrome *c* Evolution	
Organism	Number of amino acid differences from humans
Chimpanzee	0
Rhesus monkey	1
Rabbit	9
Cow	10
Pigeon	12
Bullfrog	20
Fruit fly	24
Wheat germ	37
Yeast	42

2. _____ **Homologies: Similar DNA** or **proteins** (e.g., fewer differences in cytochrome c in closely related species).

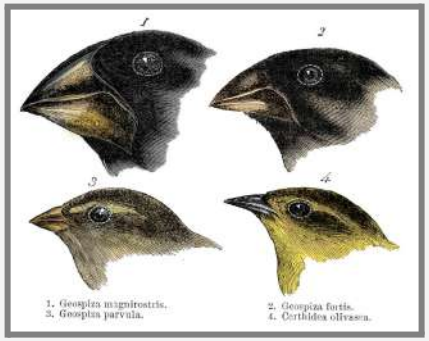
3. _____ **Homologies: Embryos** of different animals (e.g., humans and chickens) look **similar** during early stages.



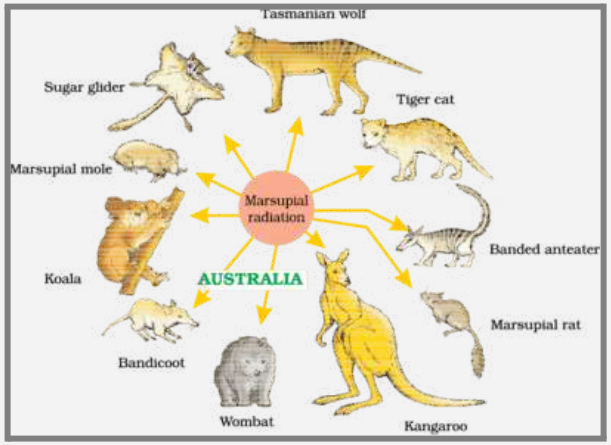
D. Patterns of _____

- _____ **Evolution:** Unrelated species develop similar traits because they live in similar environments.
    - **Example:** Wings of birds and bats.

- _____ **Evolution:** Related species evolve different traits due to different environments.
    - **Example:** Darwin's finches with varied beak shapes.



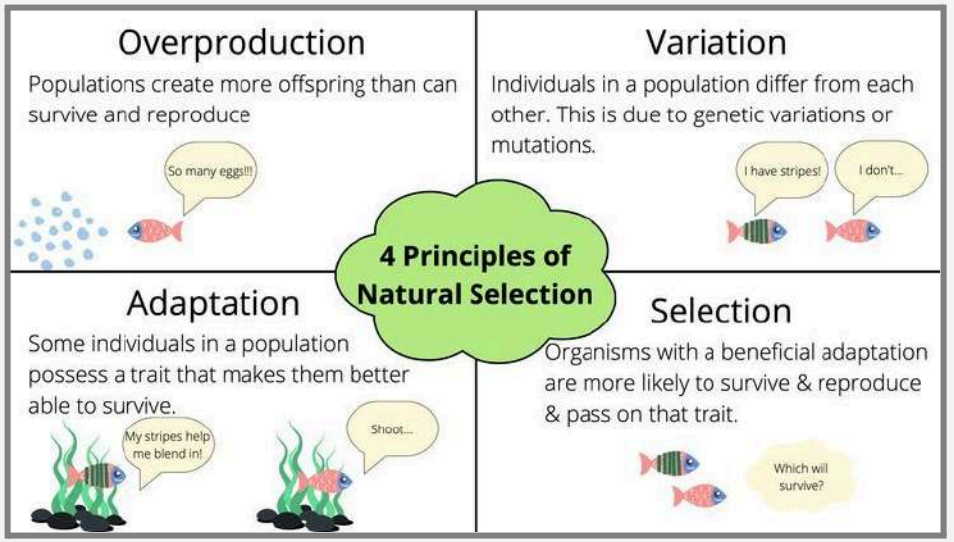
- _____ **Radiation:** One species evolves into many to fill different roles in an environment.
    - **Example: Australian Marsupials –** Different marsupial species evolved to fill ecological roles similar to placental mammals found elsewhere.



IV. _____ Selection

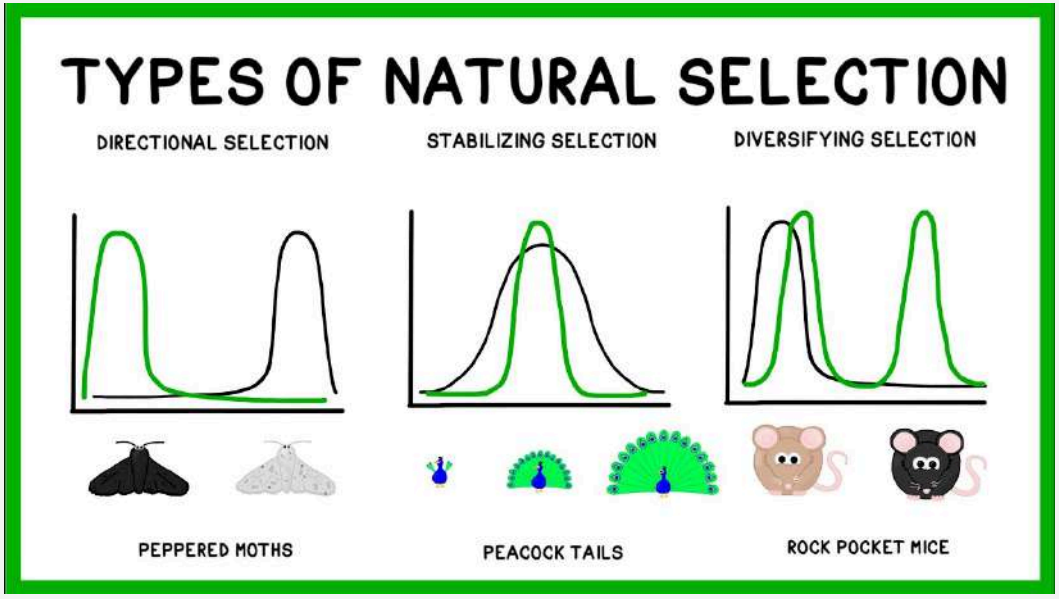
A. Key Concepts

- **Definition: The process where organisms with helpful traits _____ and _____ .**
- **Key Elements:**
    1. **_____ Variation:** Traits are passed from parents to offspring.
    2. **_____ of Offspring:** More offspring are born than can survive.
    3. **Competition for _____ :** Organisms struggle for food, water, and space.
    4. **Differential _____ Success:** Organisms with the best traits have more babies.



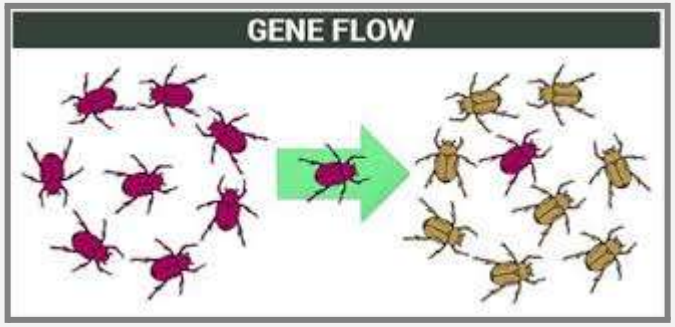
B. Types of Selection

- _____ **Selection:** Favors _____ **extreme** trait.
    - **Example:** Giraffes with longer necks.
- _____ **Selection:** Favors _____ **extreme** traits but not the average.
    - **Example:** Birds with very small or very large beaks.
- _____ **Selection:** Favors _____ traits and removes extremes.
    - **Example:** Human baby birth weights.



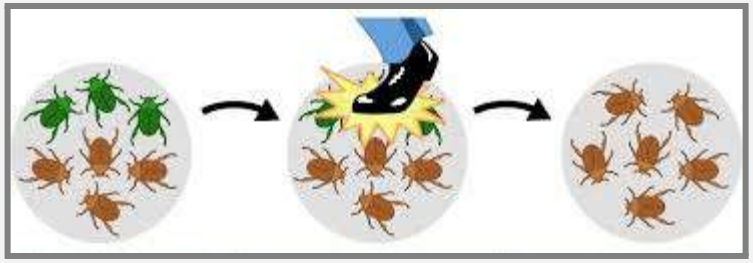
V. Mechanisms That Drive Evolution

A. _____ Flow

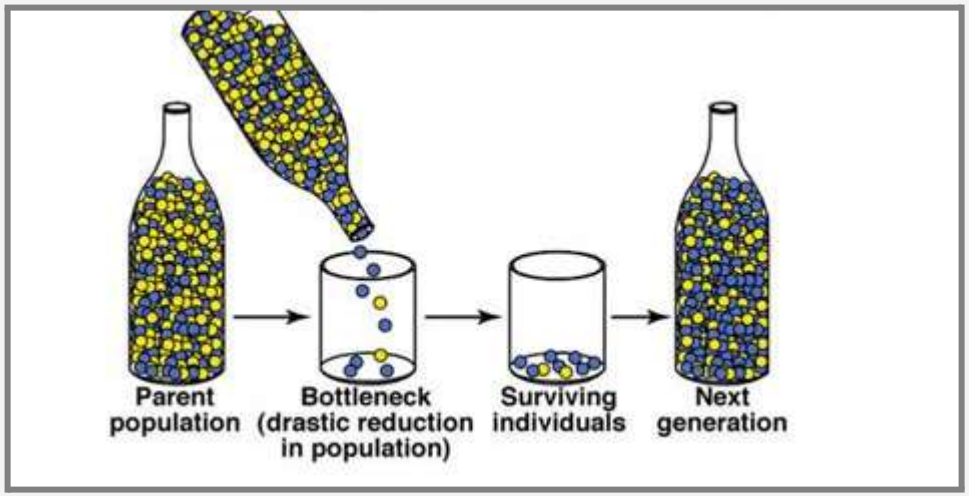


- **Movement** of _____ between populations (e.g., animals migrating and breeding in new areas).

B. _____ Drift



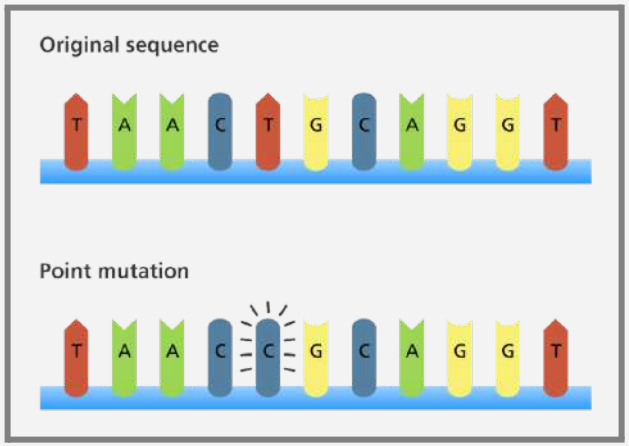
- **Random changes** in traits, especially in small populations. The _____ of _____ from a population
  - _____
    Effect: Population **shrinks**, **losing** genetic _____ (e.g., cheetahs).



- _____ **Effect:** A small group starts a **new** population with **limited** traits.

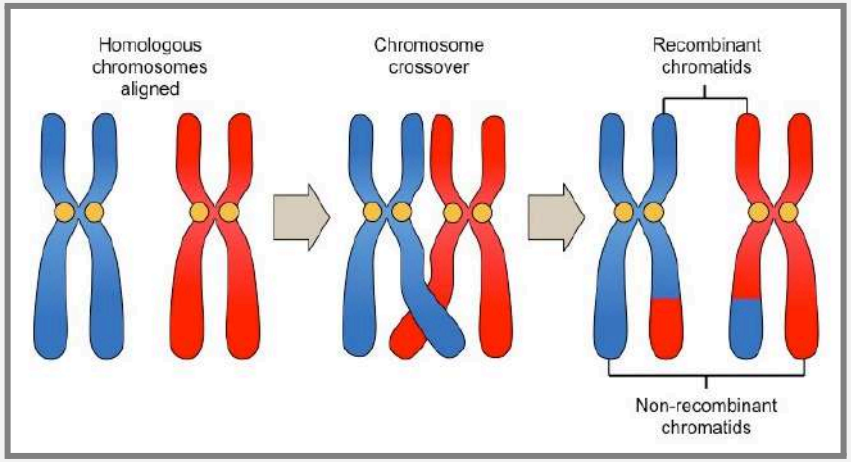
C. _____

- Changes in DNA introduce new traits.
  - **Example:** A _____ in fur color can help animals blend into their environment.

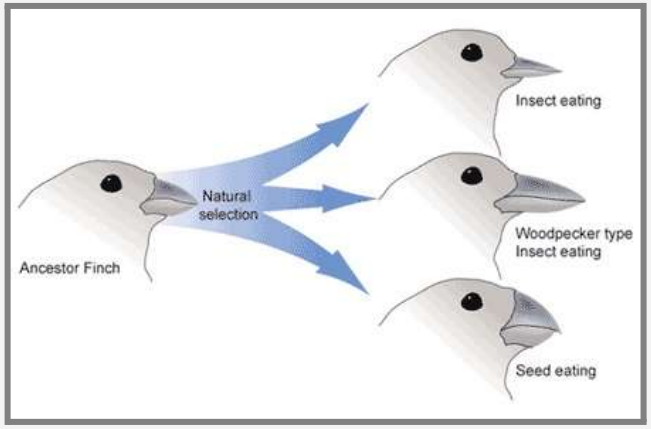


D. _____ **Recombination**

- **Mixing** of _____ during reproduction creates new trait combinations.
  - **Example**: Crossing Over during prophase I in Meiosis



VI. _____



A. Definition

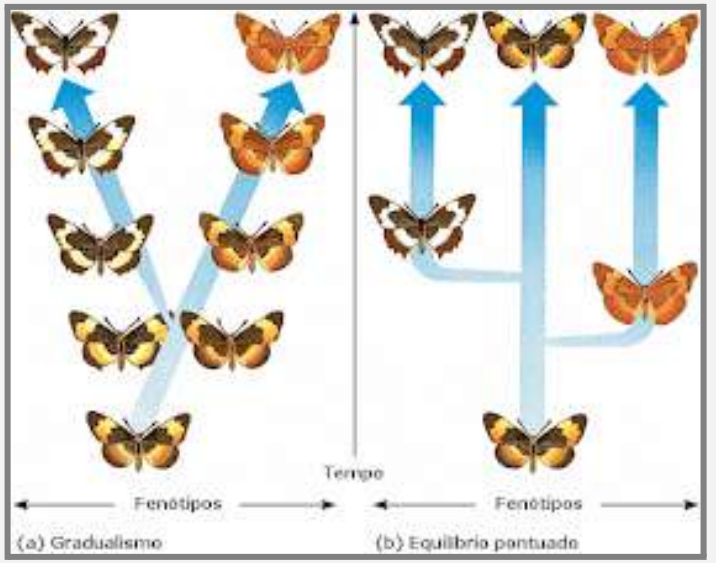
- The _____ of new _____ when _____ become _____ and stop interbreeding.

B. Causes

- _____ **Isolation: Physical** barriers, like mountains or rivers.
- _____ **Isolation:** Differences in **mating** behaviors.

- _____ **Isolation:** Reproducing at different **times**.

VII. Rates of _____



A. _____

- Evolution happens _____ over a long time.
    - Fossil evidence shows continuous, small changes.

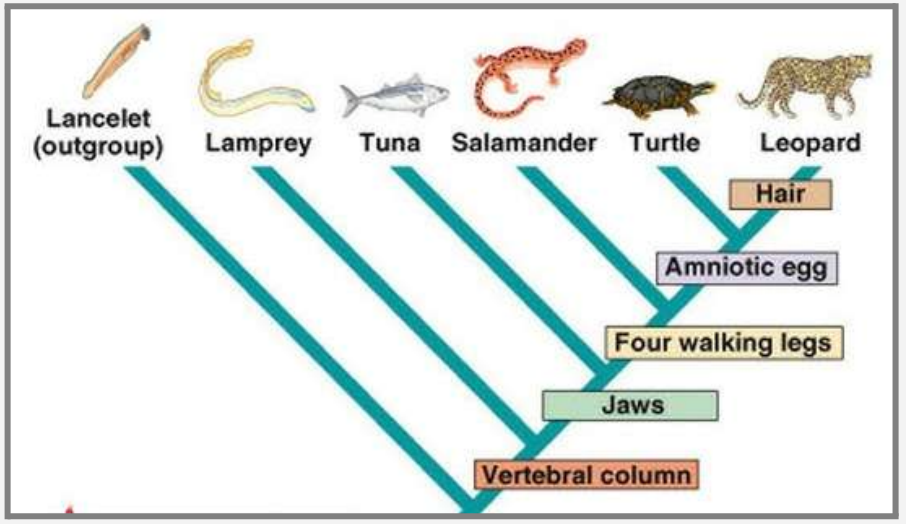
B. _____

- Evolution happens in _____ with **long** _____ of no _____ (stasis).
    - Triggered by sudden environmental changes or mutations.

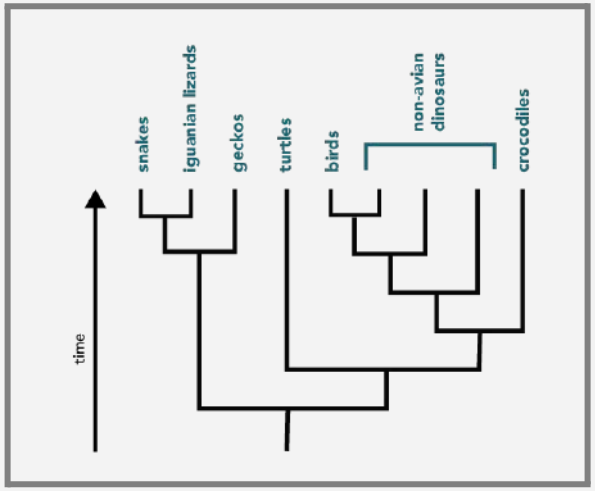
VIII. _____ and _____ Trees

A. Definitions

- _____ : Shows _____ based on _____ traits.



- _____ **Tree:** Shows **evolutionary** _____ , often with **time** included.

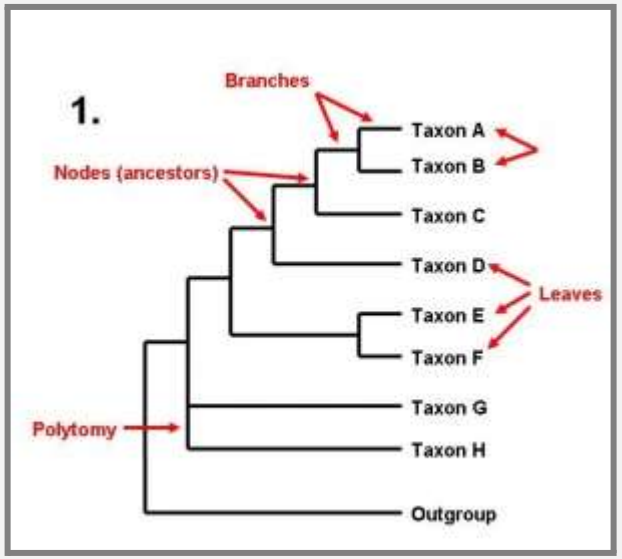


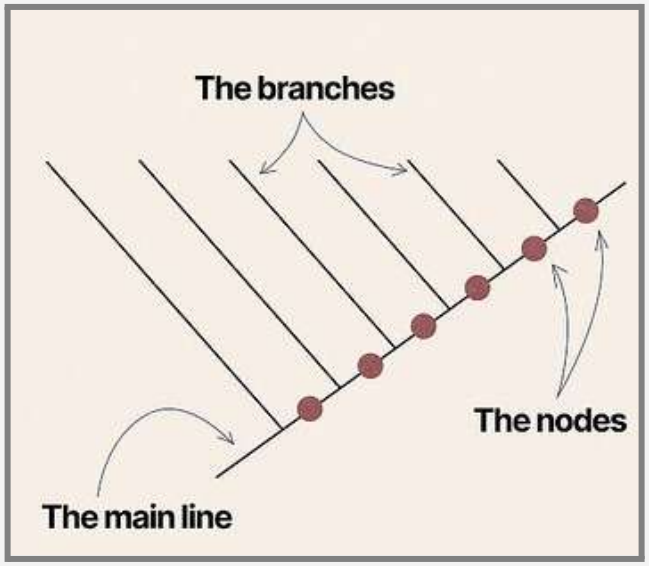
B. How to Read

- _____ : Represent **common ancestors**.
- _____ : Show **evolutionary paths**.
- **Example:**

- Species closer on the tree share a more _____ ancestor.
- Longer branches indicate more _____ change or time.

C. Example Diagram





IX. Environmental Changes and Evolution

A. Population Changes

- Favorable conditions lead to population growth.
- Unfavorable conditions can lead to extinction.

B. Speciation

	• New species form when environments change and populations adapt. **C. Extinction** • Rapid changes, like habitat destruction, can eliminate species unable to adapt.
Notes Summary	Life on Earth is constantly changing through processes that shape species over time. Evolution explains how living organisms are connected through common ancestry, with evidence found in fossils, geographical distribution, and similarities in structures, DNA, and development. Traits that help organisms survive and reproduce, called adaptations, play a key role in natural selection, where favorable traits become more common in populations. Changes can happen gradually or in sudden bursts, leading to the formation of new species. Life's origins are linked to early chemical processes and the development of complex cells through cooperation between simpler ones. Understanding evolutionary relationships helps explain how species are connected and adapt to changing environments.