

EVOLUTION

- WHAT is it? Evolution is a process by which organisms have developed and diversified from earlier forms during the history of the earth
- it is a theory: a well-tested explanation that unifies a broad range of observations and hypotheses, and enables scientists to make accurate predictions about new situations
- Occurs at the population level, not organismal level
- operates on the phenotypic level and indirectly on the genotype
- evolution in genetic terms, refers to the change in relative frequency of alleles in a population

- Sources of variation: mutations and crossing-over in meiosis serves to increase genetic variation that is used as a basis for adaptations

- Types of adaptations: ① behavioral - ex. migration, parenting practices

② physiological - ex. relate to chemical processes, ex. guard cells

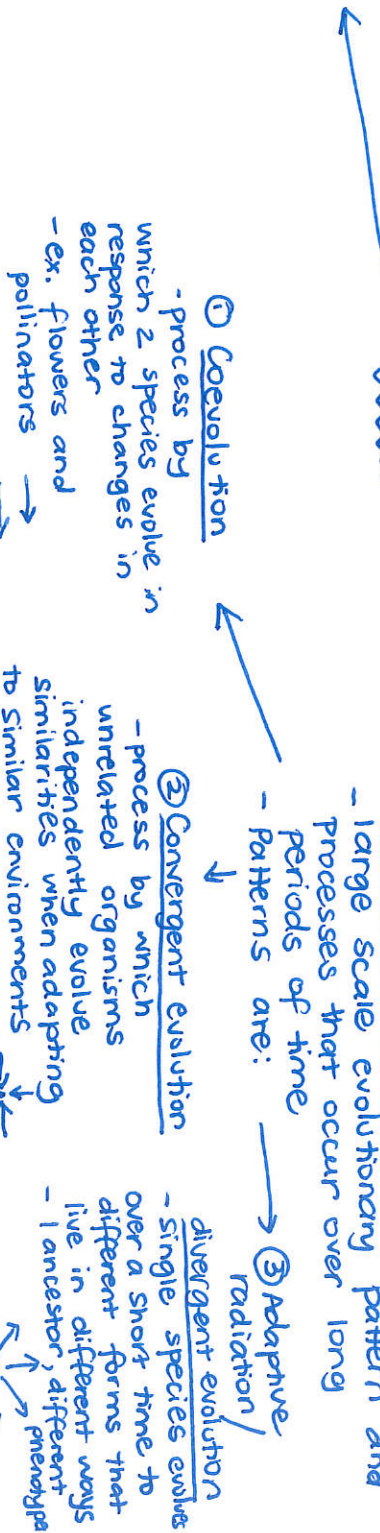
③ structural - ex. penguins - webbed feet, waterproof feathers

- WHY? Populations evolve because the environment changes and some organisms have adaptations that increase their ability to survive and reproduce

- If populations do NOT evolve, they are/remain at genetic equilibrium. Hardy Weinberg equilibrium states that populations will remain at genetic equilibrium when all 5 conditions are met. They are ① no mutations, ② no natural selection, ③ random mating, ④ no immigration or emigration, and ⑤ must have a large population. The formula is $p^2 + 2pq + q^2 = 1$ or $p + q = 1$

Types

MACROEVOLUTION



MICROEVOLUTION

- small genetic changes of a population
- can occur in a short amount of time
- may lead to macroevolution

EVOLUTION

HOW does it occur?
(The process)

① Natural Selection - process by which organisms

with variations most suited to their local environment survive and leave more offspring

- variation produced from genes serves as the basis of determining which organism has a higher fitness.

The organism with a higher fitness will survive long enough to reproduce and pass on the gene (that increases fitness) to successive generations

- in single gene traits, the allele that confers a higher fitness will increase in the population over time

- in polygenic traits, natural selection affects phenotypes in 3 ways:

① Directional - results in an increase in the # of individuals with the trait at one end of the curve



② Stabilizing - individuals in the center are more fit



③ Disruptive - individuals at the end of a curve are more fit



- can result in speciation in which organisms become reproductively isolated so species are no longer capable of interbreeding and producing fertile offspring

- The types of isolation are:

- ① Behavioral isolation - ex. courtship rituals
- ② Geographic isolation - ex. geographic barriers
- ③ Temporal isolation - time, ex. seasons

→ EVIDENCE

① DNA

- same structure (nucleotides to components)
- DNA → proteins
- analyze similarity of genes

② Fossil record

- physical record that shows gradual change with lineages, splitting of lineages, and extinctions

③ Embryology

- same developmental sequence for complex multicellular organisms
- possible because organisms share similar genes & gene expression at certain points of development

④ Anatomical structures

- a. Vestigial structures - structures no longer perform the function for which it evolved, ex. hind legs of a whale, wings of an ostrich, human appendix, coccyx (tail bone)

- b. Homologous structures - structures that are the same but have a different function. ex. bones in human arm, bird wing, dog bones
- shows evidence of recent common ancestor and divergent evolution

- c. Analogous structure - structures that are different but have a similar function
- shows evidence of a distant ancestor and convergent evolution
- occurs because organisms occupy a similar niche or function, ex. bird wing and insect wing or dolphin fins and the fins of a fish

How does it occur?

[The Process]

② Sexual selection - process by which mates will select a mate based on preference. As a result, the individual who has a favorable trait is more likely to reproduce
-ex. plumage on male peacocks

③ Artificial selection - process by which humans select favorable traits. Individuals with the favorable trait are more likely to reproduce
-ex. dog breeds, selective breeding

④ Genetic drift - change in allele frequencies due to chance
-it is random who survives
- Examples:

a) Bottleneck effect: change in allele frequency following a dramatic reduction in the size of the population due to chance, especially a disaster
-ex. beluga whales, leopard seals

b) Founder effect: change in allele frequency due to change as the founding individuals may carry alleles that differ in relative frequencies from those of the main population
-ex. the spanish colonization of the Americas

⑤ Gene Flow - the migration or the movement of genes from one population to another
-ex. pollen blown from one flower in a different location to another