**General Biology I (101-NYA)**

**Evidence of Evolution & natural Selection Concepts & Learning Outcomes**

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| Topic | Concept | Learning Outcomes |
| Evidence of evolution | 1. The theory of evolution by natural selection is supported by 2 major lines of evidence:    1. Evidence for change through time    2. Evidence that species are related 2. What is the evidence that species are not static, but change through time?    1. Fossil record: most species have gone extinct.    2. Extinct, fossilized species frequently resemble living species found in the same area.    3. Transitional forms document change in traits through time.    4. Earth is ancient (based on the fossil record and other evidence).    5. Vestigial traits are common in species (eg, human tail bone, aka coccyx, and goose bumps).    6. Populations can be observed changing today (eg, emergence of bacterial resistance to antibiotics).      1. What is the evidence that species are related, not independent?    1. Closely related species often live in the same geographic area.    2. Homologous traits (similarity in traits due to descendance from a common ancestry) are common and exist at 3 levels: morphological (structural homology of limb bones of vertebrates); developmental (embryonic structures and processes); genetic (gene structure and genetic code) | 1. Outline the evidence of evolution and provide examples of evidence for change through time and evidence supporting the relatedness of species 2. Define homology and describe and provide examples of structural, developmental, and genetic homologies |
| Principle of natural selection | 1. Darwin was influenced by Thomas Malthus theory, which states that populations grow exponentially while food availability grows arithmetically. This results in tendency of populations to produce more offspring than the environment can support. Struggle for survival is a direct consequence of overproduction of offspring. 2. Natural selection as proposed by Charles Darwin and Alfred Wallace: species are not independent and do change over time (*descent with modification*); in other words, change over time produced modern species from ancestral species. 3. A population experiences natural selection whenever the following 4 conditions apply:    1. Individuals vary in their traits.    2. Some of these variations are heritable.    3. Some individuals survive and reproduce better than other individuals.    4. Differential survival and reproduction (Darwinian fitness) is influenced by the heritable traits of individuals. | 1. Explain Thomas Malthus theory and explain how Charles Darwin used this theory to explain the theory of evolution by natural selection 2. Define natural selection and explain the link between heritable traits, evolutionary fitness, and natural selection 3. List the 4 conditions needed for natural selection to apply 4. Analyze and interpret data on reproductive success and survivorship in order to classify individuals based in differing degrees of evolutionary fitness |
| Adaptation | 1. Organisms evolve by adapting to their environment through natural selection. 2. An adaptation is caused by a heritable trait that increases an individual's fitness in a particular environment relative to individuals lacking that trait. | 1. Describe the meaning of adaptation within an evolutionary context |
| Population genetics & evolution | 1. Population genetics is the study of genetic variation within and among species in order to understand the processes that result in evolutionary changes in species through time. 2. In population genetics Mendel's laws are applied to entire populations. | 1. Define population genetics |
| Genetic variation within populations | 1. Gene pool is the sum of all the alleles in a population and contains the variation (different alleles) that produces the differing phenotypes on which agents of evolution act. 2. Genetic variation provides the raw material on which agents of evolution (such as natural selection) act within a population. 3. Genetic variation is measured by examining allele frequencies in a population. Allele frequencies vary between 0 and 1, and the sum of all allele frequencies at a locus is 1. 4. The frequencies of different alleles at each locus and the frequencies of different genotypes in a population describe its genetic structure of a population. 5. Natural selection acts on individuals, but evolutionary change occurs in populations. 6. The basis of evolution is change in allele frequency over time. | 1. Define the terms gene pool and allele frequency 2. Explain how natural selection causes a change in allele frequency in a population 3. Explain why individuals do not change when natural selection occurs |