General Biology I (101-NYA)
Speciation Concepts & Learning Outcomes

Topic	Concept	Learning Outcomes
Defining and identifying species	1. Species: distinct type of organism belonging to a population that is isolated from other species populations due to lack of gene flow. 2. A species can be identified as follows: biological species; morphological species; phylogenetic (lineage) species; ecological species. 3. Ernst Mayr (1940) definition of biological species: "Species are groups of actually or potentially interbreeding natural populations which are reproductively isolated from other such groups.“ In other words, species are evolutionarily independent populations because they are reproductively isolated (no gene flow) from each other. 4. Morphospecies concept: Evolutionary independence can also be estimated by looking at population morphology (appearance). Different appearances often evolve when populations experience different natural selection, mutations, and genetic drift. These different forms will persist only if gene flow is restricted. 5. Phylogenetic species concept: On phylogenetic trees, an ancestral population plus all its descendants is called a monophyletic group. A phylogenetic species is the smallest monophyletic group on a phylogenetic tree. 6. Ecological species concept: This is defined as a set of organisms that exploit same resources, have the same range of environmental tolerances, and are subjected to the same predatory and parasitic pressures. This concept is most applicable to asexual prokaryotes and eukaryotes.	1. Define species and differentiate between biological species, morphospecies, and phylogenetic species, and ecological species concepts
How species arise: interruption of gene flow	6. Genetic divergence (due to mutations, genetic drift, natural selection, etc.) in populations may lead to speciation (creation of new species). Speciation is facilitated by interruption of gene flow among populations. 7. The critical process in the formation of new species is the segregation of the gene pool of the ancestral species into two separate gene	5. Outline how species arise by reproductive isolation and explain the Dobzhansky-Muller genetic model of speciation

	pools. 8. Dobzhansky-Muller model of speciation that leads to the formation of 2 reproductively isolated species from a common ancestral population: 2 lineages of the ancestral species develop new alleles that become fixed at different gene loci. The new alleles are neither compatible with the ancestral alleles nor with one another.	
Allopatric speciation	9. Allopatric speciation results from physical separation of populations through: a. Dispersal (founder effect): a group colonizes a new habitat b. Vicariance: separation through a physical barrier	9. Define allopatric speciation and provide examples of how reproductive isolation is achieved in this type of speciation
Sympatric speciation	10. Sympatric speciation is the subdivision of a gene pool in the absence of geographical barriers. This happens through either habitat preference or polyploidy. 11. Habitat preference may result from disruptive selection. An example is food switching in insects. When some individuals in a population switch plant hosts, they experience different selection pressures and reduced gene flow with the original population. 12. Polyploidy (increase in the number of chromosome sets) may arise from chromosome duplication within a species (autopolyploidy) or from hybridization that results in combining chromosome sets of 2 species (allopolyploidy). Polyploidy is the most common cause of sympatric speciation, and is most common in plants	10. Define sympatric speciation and provide examples of how reproductive isolation is achieved in this type of speciation
Causes of gene flow interruption: barriers to gene flow	13. Barriers to gene flow in emerging species result from 2 types of reproductive isolation: a. Prezygotic isolation: individuals from different populations are unable to mate. b. Postzygotic isolation: individuals from different populations can breed, but the offspring produced have low fitness.	11. Differentiate between prezygotic and postzygotic reproductive isolation 12. List and give examples of the specific reproductive isolating mechanisms