Species Concepts	Definition	Pros	Cons
Biological Species Concept	Organisms are members of the same species if they are capable of interbreeding to provide viable, fertile offspring; Species are reproductively isolated	• Able to distinguish morphologically similar species • Stresses idea of gene flow • Allows study of reasons for reproductive isolation (behavioural, ecological, morphological, etc.)	• Applicable to extant(exist) populations only • No temporal dimension • Not useful for species that do not reproduce sexually • Gene flow is possible between distinct taxa • Not applicable to hybrid species
Morphological Species Concept	All individuals of one species share measureable traits that distinguish them from individuals of another species; Species distinguished based on phenotypic traits	• Practical and easily understood • Helpful when mating habits are unknown • Focuses on distinct traits • Useful for fossil records	• Not useful for species exhibiting substantial phenotypic polymorphism (diverse traits within specie • Not useful for ring species • Situations where multiple species appear morphologically identical • Some species are morphologically similar due to convergent evolution
Ecological Species Concept	A species is a group of organisms that share a distinct ecological situation	• Limits defined by species ecological usage • Differences in species often related to differences in ecological resources • Emphasis on selection as main force prevents intermediate forms	• Similar species may exploit the same resources • Niche may be difficult to define (subjective @times) • Many species are flexible regarding niche • Only applicable to extant populations • Convergent evolution
Phylogenetic Species Concept	Species is a group of organisms bound by a unique ancestry All members of a species resemble each other genetically	• Considers temporal factors • Based on genetics(evolution) • Similar forms of interbreed, subspecies distinction is significant (wolf vs. dog) • Monophyletic origins (group of species with genes indicating common ancestry	• Possibly too easy to distinguish species; more rare species identified • Minor genetic differences, not representative of special events • "uni-parental" species – clones without mutations = new species? • Gene flow → another species & reproduce = changing species under this • Not applicable to polyploidy (chromosome #) • Can happen repeatedly • These species dont have monophyletic origins
Practical Species Concept	Based on the judgement of the systematist	• Based on careful consideration of all available data • Flexible criteria	• Everyone has their own set of rule (everyone different) • What happens when systematists disagree?

Differential Fitness Species Concept	Species are groups of individuals reciprocally characterized by features that would have negative effects in other groups and cannot be exchanged between groups upon contact - "Opposite Fitness Effect" of alternative alleles - One group's trait is not effective in another environment?	• Allows gene-flow (as long as it is not deleterious) • Species-specific features arise via isolation and differential selection • Reproductive isolation unnecessary • Applicable to "uniparental" and "biparental" species	• Only applicable to extant populations • Hard to now fitness effects of trait variation • How do we deal with individuals in the same environment carrying different selectively neutral alleles that are incompatible when combined in offspring?

Important Terms	**Definitions**
Reproductive Isolation	Organisms from different populations cannot produce viable, fertile offspring
Clade	An organism and all of its descendants (lineage)
Polyploidy	An organism has extra sets of chromosomes
Convergent Evolution	Species independently evolve similar traits due to environmental pressures + selective forces, not because of common ancestry
Reinforcement	Selective pressure increase reproductive isolation; factors contributing to isolation i.e. hybrid species have lower fitness
Fusion	Fused into one species (from two species that could reproduce together); weakens reproductive barriers; natural or artificial occurrence
Subspecies	Different populations (wolf vs. dog); geographically separated populations of a species exhibit dramatic phenotypic variation
Ring species	A species with geographic distribution that forms a ring around an inhabitable terrain; changed so much over time - 1 cannot mate with 6. But 2-3, 3-4 .. ok
Cline	Species distributed over large, environmentally diverse area. Smooth variation along geographic gradient; similar to ring species but straight line
Hybrid	Viable offspring of two different species, often infertile (mule, liger)
Androdioecious	Species consisting of hermaphroditic and male individuals
Gynogenetic	Female organisms capable of reproducing without male sperm
Prezygotic	Prevents organisms from reproducing, prior to zygotic formation - Physically different so it cannot mate; different location; different mating call
Postzygotic	Gametes form a viable zygote, but some point between cell division and second generation failure occurs (not fertile or generation failure Mules dying at young age

Speciation	Definition
Allopatric speciation (different country)	*geographical barrier* separation(no gene flow); **most common mechanism**; gene frequencies diverge + no interbreed @ contact
Parapatric speciation (adjacent country)	Common ancestor different environment within the same area
Sympatric speciation (same country)	Common ancestor without the presence of a geographic barrier (very rare**)
Genetic Drift	One or more forms significantly reduced in frequency due to a random event – i.e. natural disaster
Sexual Selection	Assortative mating: individuals prefer to mate with similar members of same species Disassortative mating: individuals prefer to mate with individuals with different phenotypes or genotypes
Euploid	Proper # of chromosomes
Aneuploid	Irregular # of chromosomes
Polyploidy	Offspring has differing amount of genetic information (may be morphologically different than parents) Can be reproductively isolated due to different # chromosomes in gametes
Autopolyploidy (self)	Errors in cell division during mitosis or meiosis; lead to gametes with extra DNA
Allopolyploidy (other)	An organism that has chromosomes from different species

Evolution	Definition
Evolution	Changes in the allele frequency in population over time
Descent with modification	Species change slowly over time as they adapt
Homology	Similarities organisms share due to common ancestry
Vistigial traits	Characteristics inherited from a common ancestor that no longer serve their function (appendix)
Biogeography	The study of geographical distribution of speies
Uniformitarianism	Process observable now, happened in the past
Stasis	A period of inactivity, little to no evolutionary change
Punctuated equilibrium	Periods of stasis "punctuated" by rapid burst of diversification (rare events impose a strong selective pressure) No change for a long time, out of nowhere sudden change
Phyletic Gradualism	Species evolve slowly, uniformly over long periods of time
Punctuated Gradualism	Speciation events are rapid, but change after initial divergence continues Species evolve slowly through time and are punctuated by random events
Adaptive Radiation	Rapid diversification with new lineage evolving different adaptations, typically due to environmental factors
Anagenesis	"same creation" Accumulation of mutations, but speciation not occuring
Cladogenesis	"different creation" Accumulation of changes in two or more descendent species; speciation occurs – splitting lineages
Snowball hypothesis	Genetic differences accumulate rapidly during reproductive isolation
Homeotic genes	Genes that control the transcription of developmental genes; Small changes to these genes can create drastic phenotypic changes

Reproductive Isolating Mechanisms		
Timing Relative to Fertilization	**Mechanism**	**Mode of Action**
Prezygotic ("premating") mechanisms	Ecological isolation	Species live in different habitats
	Temporal isolation	Species breed at different times
	Behavioural isolation	Species cannot communicate
	Mechanical isolation	Species cannot physically mate
	Gametic isolation	Species have nonmatching receptors on gametes
Postzygotic ("postmating") mechanisms	Hybrid inviability	Hybrid offspring do not complete development
	Hybrid sterility	Hybrid offspring cannot produce gametes
	Hybrid breakdown	Hybrid offspring have reduced survival or fertility