How does speciation progress?

-Pops of a single species become reproductively isolated from each other

-Over time, these isolated pops begin to genetically diverge

-Changes in gene pool within pops relative to allele freq. for diff traits

-One possibility: genetic divergence results in inability of one pop to breed with another → speciation has occurred

-OR… the genetic divergence is not enough to prevent interbreeding → successful offspring (viable)

-OR… successful breeding can occur, but not always → it is tough to tell if speciation

-Partial isolation → often leads to selection against mating

-Why? Reproduction is energetically expensive → mating with a member of other isolated pop → can lead to infertile offspring/no offspring → wasted effort/energy → dead end → particularly an issue if produce once a year or once in lifetime

-Partial isolation

-Most breeding events result in no offspring, a few do produce offspring

-In some cases, these offspring are fertile

-Breeding between individuals from the 2 pops → lost reproductive effort

-Often leads to new traits becoming important in mate selection

-Reinforcement

-After initial genetic divergence of pops, if they come back together – other isolating mechanisms begin to arise and prevent interbreeding

-Maintaining genetic diffs

-Ex: European flycatchers- some areas of 2 isolated pops overlap → can lead to some offspring produced

-Very low survival from egg to juvenile

-Female produce fewer viable eggs when they interbreed

-Reinforcement occurs in overlapping range thru changes in plumage (feather) color → significantly decreases interbreeding

Speciation can occur through genetic drift

-Separation of random groups of individuals into distinct/isolated pops

-Often thru founder effect

-Ex: Hawaiian fruit flies- each island has distinct species group, based on morphology, habitat, behavior

-Adaptive radiation

-rapid production of new species

-recently evolved from same common ancestor

-founder effect/natural selection

-Ex: few birds on an island = lots of food and no competition; come back years later to many birds and low food availability, high competition for preferred food. Some individuals shift to alternative food and never go back to old

-Ex: natural dams forming lakes in a river, have a single common ancestral species; competition for food leads to new pops, competition for breeding habitat leads to some shifted habitats

-adaptive radiation in Alpine buttercups – 14 species in New Zealand
-driven by periodic isolation and environmental change
-increased speciation rate and few competitors and diverse habitat range
-when glaciers recede, growth moves across mountain ranges again; when glaciers present, they prevent growth

Allopatric speciation: species separated geographically; ex- isolated island kingfishers vs mainland kingfishers
-much less common than sympatric? Than adaptive radiation?

Sympatric speciation: occurs without geographic separation

Imagine mutation occurs
-shell coiling changes direction
-leads to mechanical isolation

Sympatric speciation example:
-fruit flies went from doing behavioral dancing on Hawthorn trees to doing it on apple trees, which are similar (maybe by wind?) and never went back
Example 2:
-anoles → speciation can occur as a function of natural selection
-anoles living on tree trunk → competition for food/space → some anoles shift habitat to ground and don't switch back → this separation can lead to genetic divergence → can lead to speciation

-Speciation can occur rapidly or take a very long time (millions of years)
-RAPID EVOLUTION
-punctuated equilibrium
-short bursts of evolutionary change, resulting in speciation (often thru mutation)
-SLOW EVOLUTION
-gradualism: change occurs gradually over a long period of time – intermediate forms

Extinction
-Vastly more extinct species than currently existing species
-When it happens, new niches open up allowing for population separation and genetic divergence
-Can happen due to small changes in environment… anthropogenic alteration of habitats/drought or famine
-Can occur thru catastrophe

Chapter 23 – Systematics, Phylogenetics, etc.

Systematics: method of classifying, naming orgs within an evolutionary framework
Goals…

-inventory of all living things
-universal system of naming orgs. → taxonomy
-determining evolutionary relationships among orgs

Phylogenetics: technique/tool for reconstructing evolutionary relationships

-based on common ancestry

Carolus Linnaeus

-Systema Naturae (book) → binomial nomenclature
-suggested all names be in Latin (universal language)
-each org has 2 word name: genus, species. Ex: *Homo sapiens*
-Hierarchical nomenclature: kingdom, phylum, class, order, family, genus, species

Carl Woese

-prokaryotes vs eukaryotes
-pro lack membrane-bound nucleus, eu have one
-domain should precede kingdom
-3 domains: Bacteria, Archaea, Eukarya
-Archaea more similar to eukaryotes

Phylogenetic trees/cladograms: main trunk with branches coming off it

-organismal organization based on evolutionary relationships (common ancestor at the base)
-relative position of branches based on shared characteristics