

1 **Speciation**

Mark Mayo
Cypress College

2 **Species**

- Species defined
 - morphological species
 - a kind of animal
 - older meaning
 - form only was used to group organisms in the past
 - new biological definition from Mayr – groups of interbreeding natural populations that are reproductively isolated
 - Best definition: organisms that can mate and produce fertile offspring

3 **Reproductive Isolation**

- Definition of reproductive isolation: methods by which interspecific mating is prevented

4 **Reproductive Isolation**

- Pre-zygotic isolation – occur before fertilization; prevents waste of gametes
 - temporal isolation – reproduction occurs at different times
 - (aka – seasonal isolation)

5 **Reproductive Isolation**

Pre-zygotic isolation

- behavioral isolation
 - courtship rituals differ from one species to another
 - if you don't sing correctly, have cool feathers or dance like they like
 - you are not mating!
 - (aka - ethological isolation)

6 **Reproductive Isolation**

- Pre-zygotic isolation
 - mechanical isolation – physically different and pollination or copulation is not possible

7 **Reproductive Isolation**

- Pre-zygotic isolation
 - ecological isolation – microenvironment requirements differ so they cannot live near enough to interbreed
 - (aka – habitat segregation)

8 **Reproductive Isolation**

- Pre-zygotic isolation
 - gametic mortality – the gametes cannot survive to cause zygote formation
 - the gametes are not attractive to one another, they might be destroyed or die before fertilization
 - Sperm may not be able to penetrate egg

9 **Reproductive Isolation**

- Post-zygotic isolation
 - after fertilization occurs there is a problem that prevents successful production of offspring
 - the zygote may not be accepted by the female's body (assuming internal fertilization)
 - there may be physical size differences (dinosaur baby in modern day lizard)

10 **Types of Speciation**

- Speciation is the formation of a new species from an existing species
- Darwin, and modern Darwinists, conceived of gradual change as taking millions and millions of years to bring about evolution of one species into another.
- Phyletic gradualism brings about a very slow, steady branching and slow divergence of two populations, as modification of one or both branches results in two new species.

11 **Types of Speciation**

- Phyletic gradualism

12 **Types of Speciation**

- A new model, proposed by Niles Eldridge and Stephen Jay Gould in 1972, envisions sudden sharp branches in the evolutionary tree followed by long periods of stasis and no change.
- They termed this model punctuated equilibrium.

13 **Types of Speciation**

- Both phyletic gradualism and punctuated equilibrium are in effect on earth

14 **Types of Speciation**

15 **Types of Speciation**

- allopatric speciation – geographic isolation caused by physical barriers – oceans, mountain ranges, river, oceans etc.

16 **Types of Speciation**

- Parapatric speciation – no barrier exists, but buffer zone of hybrids exists between two species
 - there is still contact along a common border
 - there are hybrid organisms in the buffer zone between the species

17 **Types of Speciation**

- sympatric speciation – both species reside within the same geographic region
 - may be a result of factors like feeding preference or other differences

18 **Types of Speciation**

- polyploidy – multiples of the chromosome number result in new plant species
 - almost always happens exclusively in plants
 - over 50% or all plants are polyploid
 - gametes are usually haploid ($2N/2 = N$) $N+N = 2N$ zygote
 - usually lethal in humans (even one extra chromosome is serious hazard)

19 **Special Patterns of Speciation**

- Cladogenesis – branching pattern where speciation occurs.
- the branching of the phylogenetic tree is due to speciation

20  **Special Patterns of Speciation**

- Cladogenesis vs. anagenesis
 - anagenesis – non-branching pattern where the same species has changes in allele frequencies. Directional change within a single lineage
 - cladogenesis – a branching diagram depicting speciation

21  **Special Patterns of Speciation**

- Evolutionary trees
 - trunk = original species, each branch is a new species off of the original species
 - gradual – slightly divergent at first and then over time it becomes more pronounced
 - punctuated – distinct changes with pronounced differences immediately

22  **Special Patterns of Speciation**

- Adaptive radiation – burst of species from a single lineage (genetic divergence)

23  **Special Patterns of Speciation**

- all mammals are related to a primitive precursor and present-day mammals are the ultimate result of adaptive radiation

24  **Special Patterns of Speciation**

- Adaptive radiation of Darwin's Finches

25  **Special Patterns of Speciation**

- each member of the lineage may radiate to unfilled zones and this is governed by three main forces:
 - physical access – must be able to reach the new environment to allow speciation to occur
 - evolutionary access – must evolve a new body part of adaptation to allow the lineage to flourish in the new environment
 - (land to water or water to land)
 - toes to wings
 - legs to flippers
 - air hole (blow hole) on dorsal surface vs. anterior
 - ecological access – enter an unoccupied zone or displace another population