

1) Overview: The “Mystery of Mysteries”

- In the Galápagos Islands Darwin discovered plants and animals found nowhere else on Earth
- Flightless Cormorant (top) and the Blue-footed Booby (bottom)



2) Speciation

- **Speciation**, the origin of new species, is at the focal point of evolutionary theory
- Evolutionary theory must explain how new species originate and how populations evolve
- **Microevolution** consists of adaptations that evolve within a population, confined to one gene pool
- **Macroevolution** refers to evolutionary change above the species level

3) The biological species concept emphasizes reproductive isolation

- *Species* is a Latin word meaning “kind” or “appearance”
- Biologists compare morphology, physiology, biochemistry, and DNA sequences when grouping organisms

4) The Biological Species Concept

- The **biological species concept** states that a **species** is a group of populations whose members have the potential to interbreed in nature and produce viable, fertile offspring; they do not breed successfully with other populations
- Gene flow between populations holds the phenotype of a population together

5) The biological species concept is based on the potential to interbreed rather than on physical similarity

- The Eastern and the Western Meadowlark look alike but are distinct species because they do not interbreed
- *Homo sapiens*, on the other hand, may look decidedly different but are one single biological species because of the potential to interbreed



6) Reproductive Isolation

- **Reproductive isolation** is the existence of biological factors (barriers) that impede two species from producing viable, fertile hybrids
- Reproductive isolation can be classified by whether factors act before or after fertilization, that is, there can be prezygotic and postzygotic barriers

7) Details of prezygotic barriers:

- **Prezygotic barriers** block fertilization from occurring by:
 - Impeding different species from attempting to mate
 - Preventing the successful completion of mating
 - Hindering fertilization if mating is successful

8) Some specific prezygotic barriers:

- **Temporal isolation:**
Species that breed at different times of the day, different seasons, or different years cannot mix their gametes
- The Eastern Spotted Skunk (top) & the Western Spotted Skunk do not interbreed because the Eastern mates in late winter while the Western mates in late summer



9) More types of prezygotic barriers:

- **Habitat isolation:** Two species encounter each other rarely, or not at all, because they occupy different habitats, even though not isolated by physical barriers
- The garter snake on the left is primarily terrestrial while the one on the right is a water-dweller, so they do not interbreed



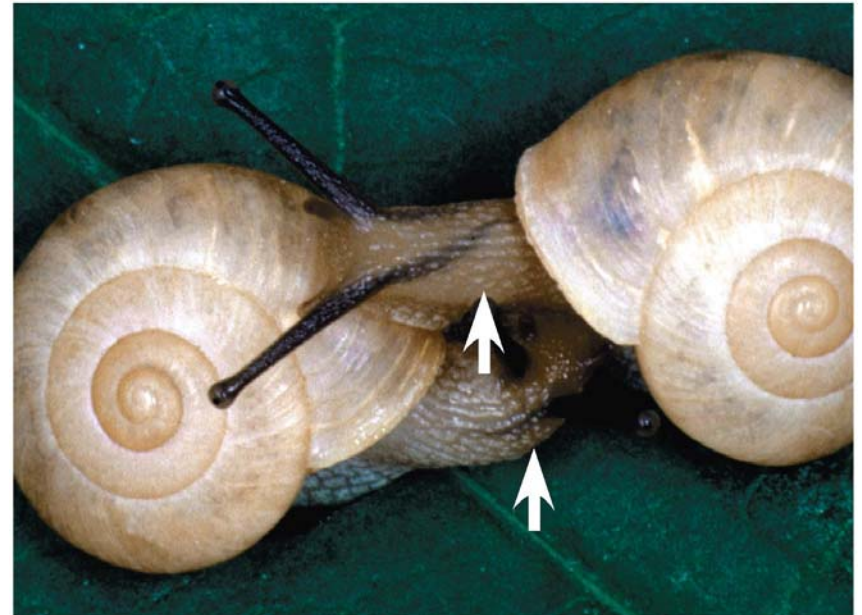
10) Prezygotic barriers—cont.

- **Behavioral isolation:**
Courtship rituals and other behaviors unique to a species are effective barriers



11) Prezygotic barriers—cont.

- **Mechanical isolation:**
Morphological differences can prevent successful mating
- Here two species of snails have shells that spiral in different directions, so that the snails' genital openings (arrows) are not aligned, preventing mating



12) Prezygotic barriers—cont.

- **Gametic isolation:** Sperm of one species may not be able to fertilize eggs of another species
- The red and purple species of sea urchins shown here release their eggs and sperm into the water at the same time, but the gametes do not recognize each other



13) Postzygotic Barriers

- **Postzygotic barriers** prevent the hybrid zygote from developing into a viable, fertile adult via 3 mechanisms:
 - Reduced hybrid viability
 - Reduced hybrid fertility
 - Hybrid breakdown

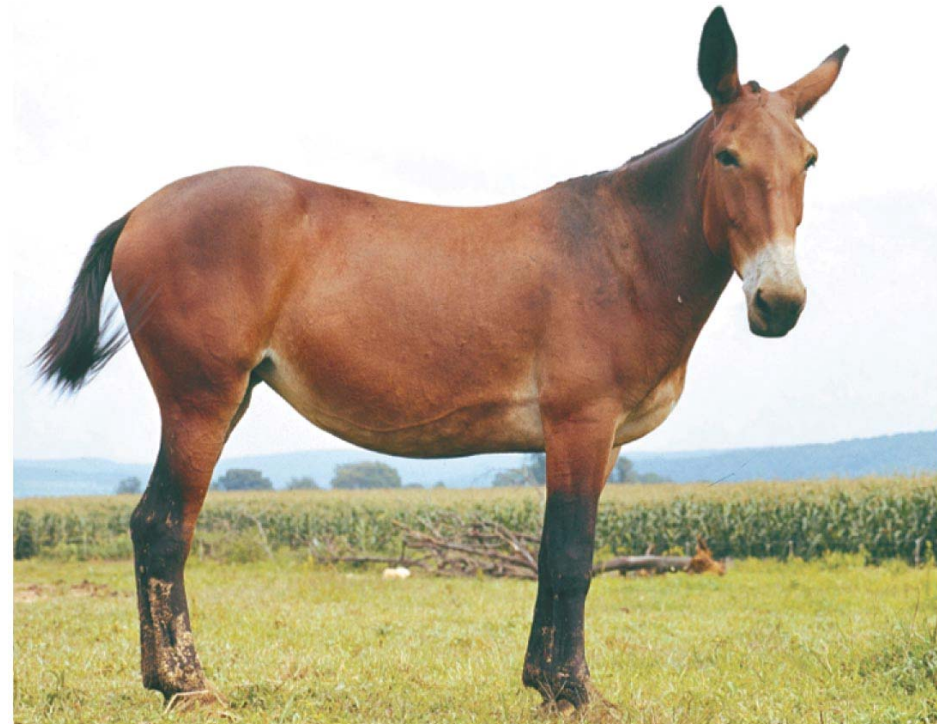
14) Postzygotic barriers—cont.

- **Reduced hybrid viability:** Genes of the different parent species may interact and impair the hybrid's development
- This is a hybrid of 2 salamander species, which is fairly common, but most never complete development and the few that do are frail



15) Postzygotic barriers—cont.

- **Reduced hybrid fertility:** Even if hybrids are vigorous, they may be sterile
- The sturdy mule is an example of a mating between a donkey & a horse



16) Postzygotic barriers—cont.

- **Hybrid breakdown:** Some first-generation hybrids are fertile, but when they mate with another species or with either parent species, offspring of the next generation are feeble or sterile
- These larger 2 rice plants are vigorous fertile hybrids, but the stunted (& sterile) one in the middle is the next generation

