Evolution 3

What is a species?
Human populations

• How different are humans from each other?
• What makes us different?
• Are all humans the same species?
What makes a species?

Diversifying selection

- One type of pollinator specializes in pale flowers = high fitness.
- Neither pollinator chooses intermediate color = low fitness.
- Another pollinator specializes in dark flowers = high fitness.
- Population diversifies into pale variety and dark variety.
What produces traits?

- **Genes**
  - Parts of a strand of DNA that are responsible for the production of some traits
  - Passed down from parent to offspring
    - Version of a gene that are passed down from one parent to offspring = **allele**
    - 2 alleles (one from each parent) for each gene
What produces traits?

• Individual with high fitness
  – Passes down more of its alleles than an individual with low fitness
  – Over time, those alleles become more common in a population
    • Evolution by natural selection

• Different species have different sets of traits as a result of different sets of alleles
  – How did they end up with different sets of alleles?
  – What makes species different from each other?
What is a species?

• Biological Species Concept
  – Species are groups of actually or potentially reproducing organisms that are reproductively isolated from other groups.
    • You’re the same species as another if you can mate and produce viable and fertile offspring
What does that mean?

- Same species IF they WOULD interbreed when you put them together.
  - Isolation isn’t enough to make them separate species

Plethodon jordani
**Plethodon jordani complex**

- Separated by valleys between mountains

*P. montanus*  
*P. cheoh*  
*P. shermani*  
*P. metcalfi*
Gene flow can prevent speciation

- Movements of individuals between populations can prevent divergence

- If there is no gene flow between populations, may get speciation
Speciation

Populations become isolated (no gene flow).

Evolutionary changes accumulate over time, and the populations diverge in their characteristics.
Speciation

• Isolation MAY result in speciation
  – The formation of one or more new species as a result of changes in allele frequencies or trait frequencies in populations

• How do we get isolation?
  – 2 ways
    • Pre-fertilization (Pre-zygotic)
    • Post-fertilization (Post-zygotic)
Speciation

- Pre-fertilization isolating mechanisms
  - 1. Behavioral
    - Mate choice

![Courting dance]
Speciation

- Pre-fertilization isolating mechanisms
  - 2. Spatial isolation
    - Salamanders on mountains
  - 3. Temporal isolation
    - Hawthorn and apple flies mate at different times of year
Speciation

• Pre-fertilization isolating mechanisms
  – 4. Gamete incompatibility
  – 5. Mechanical isolation

Speciation

• Post-fertilization isolating mechanisms
  – 1. Hybrid death
  – 2. Hybrid infertility
Speciation

• How can we determine if two organisms are the same species if they:
  – Are extinct?
  – Don’t have sexual reproduction?
Speciation

• Morphological species concept
  – Species are groups of organisms that have some sets of physical features that are different from those found in other groups
Speciation

• Genealogical species concept
  – The smallest group of reproductively compatible organisms that contains all the descendants of a single, common ancestor
## Speciation

<table>
<thead>
<tr>
<th>Species concept</th>
<th>Definition</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Biological</strong></td>
<td>Species consist of organisms that can interbreed and produce fertile offspring and are reproductively isolated from other species.</td>
<td>Useful in identifying boundaries between populations of similar organisms. Relatively easy to evaluate for sexually reproducing species.</td>
<td>Cannot be applied to organisms that reproduce asexually or to fossil organisms. May not be meaningful when two populations of the same species are separated by large geographical distances.</td>
</tr>
<tr>
<td><strong>Genealogical</strong></td>
<td>Species consist of organisms that can interbreed and are all descendants of a common ancestor and represent independent evolutionary lineages.</td>
<td>Most evolutionary meaningful because each species has its own unique evolutionary history. Can be used with asexually reproducing species.</td>
<td>Difficult to apply in practice. Requires detailed knowledge of gene pools of populations within a biological species. Cannot be applied to fossil organisms.</td>
</tr>
<tr>
<td><strong>Morphological</strong></td>
<td>Species consist of organisms that share a set of unique physical characteristics that is not found in other groups of organisms.</td>
<td>Easy to use in practice on both living and fossil organisms. Only a few key features are needed for identification.</td>
<td>Does not necessarily reflect evolutionary independence from other groups.</td>
</tr>
</tbody>
</table>

Table 11-1 Biology: Science for Life, 2/e © 2007 Pearson Prentice Hall, Inc.