Evolutionary processes to speciation

I. Microevolution: change in allele frequency over time

- **Gene pool** = all the alleles for all the loci
- **Genotype frequency** = proportion of a particular genotype in the population
  - \( f(Bb) = \frac{160}{500} = \)
- **Allele frequency** = proportion of a specific allele in a particular population
  - If there are 320 BB, 160 Bb, 20 bb individuals then there are 800 (B) alleles in the population
    - There are 200 (b) alleles
    - \( f(B) = \)
    - \( f(b) = \)

II. Hardy-Weinberg Principle

- Genetic equilibrium can be mathematically described – Hardy-Weinberg equation:
- For two alleles, \( p^2 + 2pq + q^2 = 1 \) where \( p \) and \( q \) are frequencies of the two alleles
  - For populations in equilibrium, \( p \) and \( q \) remain constant from one generation to the next

Several assumptions must be true for a population to remain in HW equilibrium

The Hardy-Weinberg principle only applies if evolutionary processes have not changed and mating has been random
The Hardy-Weinberg principle can serve as _______________________ (i.e., no evolution) in a natural population.

<table>
<thead>
<tr>
<th>Population and Location</th>
<th>Data Type</th>
<th>Genotype Frequencies</th>
<th>Allele Frequencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inuit (Greenland)</td>
<td>Observed</td>
<td>MM: 0.835, MN: 0.156, NN: 0.009</td>
<td>M: 0.913, N: 0.087</td>
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<tr>
<td></td>
<td>Expected</td>
<td>MM: 0.834, MN: 0.159, NN: 0.008</td>
<td></td>
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</tbody>
</table>

a. Measure frequencies of homozygotes (MM, NN) and heterozygotes (MN) = observed genotype frequencies.
b. Calculate allele frequencies (p, q).
   \( p = \) frequency of
   \( q = \) frequency of

c. Calculate expected genotype frequencies on the basis of the Hardy-Weinberg principle
   \( (p^2 + 2pq + q^2) \)

d. A difference between observed and expected

III. Evolutionary processes - agents that change allele frequencies

1. Mutation is ____________________________ of genetic variation that serves as raw material for ________________

2. Migration: Gene flow ... genetic exchange between populations.
   ________________ can be introduced into a population.
   ________________ genetic differences between populations

3. Genetic Drift – change in allele frequency due to ____________ alone.

   Effects of ____________ fluctuations enhanced by small population size
Random mating = each individual in the population mates without preference, any individual has an equal probability of being chosen as a mate.

**Non random mating** - changes in allele frequency due to selective mating...either individuals show a preference for their own phenotype or they avoid their own phenotype.

5. Natural selection: mechanism of evolution

- Selection acts on variants that exist in a population (**[ ]** is the selective pressure).

Evolution is not perfect!

- Organisms are locked into historical constraints
- Adaptations are often compromises
- Not __________________________
- Selection can only edit variations __________________________
Macroevolution: speciation

A. Biological Species Concept: When the two populations become different species, they have become different species.

• Barriers: isolation of gene pools

prezygotic barriers

Prevent mating between species or stop the fertilization of ova

a. habitat isolation – species live in different habitats
b. behavioral isolation – unique behavior prevent mating
c. temporal isolation –
d. mechanical isolation –
e. gametic isolation - sperm cannot survive, or fertilize egg

postzygotic barriers

Prevent the

a. reduced hybrid viability – embryo does not develop normally
b. reduced hybrid fertility –
c. hybrid breakdown – 1st generation ok, but next is sterile

Other ways to define species:

• Morphospecies Concept = different species
• Phylogenetic Species Concept = Monophyletic group defines the species; species are named on the basis of statistically significant differences in the traits used to estimate the phylogeny

B. Modes of speciation

1) allopatric
   • geological processes can fragment a population into
   • dispersal can result in isolation
   • isolated gene pools accumulate genetic differences via microevolution

2) sympatric
   • divergence of gene pools occurs within the ________________________ range
   • Polyploidy is the most common means
Chromosome mutations can result in polyploid individuals with extra copies of each chromosome... these individuals can self fertilize and become reproductively isolated.