Hardy-Weinberg Equilibrium
22 January 2003

I. H-W Assumptions
  - Large populations
  - Panmictic populations (randomly mating)
  - All alleles contribute equally to next generation (no selection)
  - No migration or mutation
  - Diploid sexual organisms

II. Translating Mendelian terminology into H-W
1 locus/2 allele system:
<table>
<thead>
<tr>
<th>Genotype</th>
<th>AA</th>
<th>Aa</th>
<th>aa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>P</td>
<td>Q</td>
<td>R</td>
</tr>
</tbody>
</table>

Allele freq of A = p =
Allele freq of a = q =

III. H-W Derivation: 1 locus w/2 alleles example

IV. H-W Derivation: 1 locus w/2 alleles example

  - Frequency of AA
    - P =
    - =
    - =
    - =

  - Frequency of Aa
    - Q =
    - =
    - =
    - =

  - Frequency of aa
    - R = \( \frac{1}{4}Q^2 + \frac{1}{2}QR + \frac{1}{2}RQ + R^2 \)
    = \( R^2 + RQ + \frac{1}{4}Q^2 \)
    = \((R + \frac{1}{2}Q)^2\)
    = q^2
V. Summary after one generation
- AA Aa aa
- \( p^2 \) 2PQ \( q^2 \)

VI. Cricket Frog Example
- Incomplete dominance:
  - BB = black =
  - Bb = brown =
  - Bb = yellow =
- Freq of B\(_1\) = \( p_1 = \)
- Freq of b\(_1\) = \( q_1 = \)
  - \( F_1 = p^2 + 2pq + q^2 = \)
- Freq of B\(_2\) = \( p_2 = \)
- Freq of b\(_2\) = \( q_2 = \)

VII. Predictions of H-W
- Gene frequencies
- For a population in equilibrium,
- It takes just one generation at equilibrium for genotype frequencies to
- If p is high, q will be
- Heterozygotes will be at their highest frequencies when

VIII. Uses of H-W

IX. Are snow geese in equilibrium?

X. Extensions of H-W
XI. Sex-linked Traits

XII. When not in equilibrium, evolution occurs!
- Natural selection
- Genetic drift
- Mutation
- Migration

...all cause evolution to occur in non-equilibrium populations