III. Selection Assumption
A. All individuals survive at equal rates and contribute equally to the gene pool.
   1. Selection occurs when ________________
   2. Simple models assume genotype strictly determines phenotype
      a. This is generally not true
      b. Simple model provides insights into selection effects
      c. Thus, some genotypes contribute more alleles to future generations than others

   3. How does selection alter allele frequencies within a population
      a. Can Selection lead to fixation?
      b. What influences rates of fixation?
      c. How do we predict effect on allele frequencies in next generation?

B. Some Terms
   1. ________________
      a. Traits evolve that make organisms more suited to their immediate environment

   2. Adaptation arises mostly via ________________
      a. Differential reproduction of genotypes in response to the surrounding environment

   3. Measure Darwinian fitness
      a. __________________

4. Fitness Values
   a. Simplest form - ________________

      - 6 A1A1 breeding individuals - produce 60 offspring
        i. on average each A1A1 produced 10 offspring

      - 10 A1A2 breeding individuals - produce 50 offspring
        i. on average each A1A2 produced 5 offspring

      - 20 A2A2 breeding indiv. - produced 40 offspring
        i. on average each A2A2 produced 2 offspring

      - Relative fitness
        \[ W_{11} = \]
        \[ W_{12} = \]
        \[ W_{22} = \]

      - Fitness usually denoted by \( w_{11} \) or \( w_{12} \), etc.
        i. I will use caps for visualization

   b. Average Fitness \( \bar{W} \)  (hard for me to make bar over W so please include them when missing)
      - multiply the fitness of each genotype by frequency in the population
      - sum the proportionate fitnesses

      __________________
c. Simply measuring # of offspring not always the best measure of fitness
   - Sometimes greater numbers of offspring
     i. because each individual offspring is less fit

4. Selection Coefficient
   a. Measure of the __________________
      Selection Coefficient (s) = 

      If Relative fitness Then Selection Coefficient
      W11 = 10/10 = 1.0
      W12 = 5/10 = 0.5
      W22 = 2/10 = 0.2

C. Calculate Allelic Frequency Change due to natural selection
D. Classes of Natural Selection

1. 
   - all fitness values equal
   \[ W_{11}=W_{12}=W_{22} = 1.0 \]
   Assumption for HW EQ

2. 
   a. One homozygote has selective advantage
      - 
      i. Selective force directly responsible for rate of evolution
      - Operating against a 
      i. when recessive allele is 
      i. most recessive alleles in 
      - As frequency of recessive allele increases, 
      i. recessive alleles showing up in 
      ii. quick acceleration to 100% fixation
      - Adaptive landscape - 
      i. rate of increase in fitness begins slow and accelerates
      - Operating against a 

   - Initially frequencies change 
   - As recessive allele becomes rare, 
     i. When recessive allele rare, most recessive alleles hidden in 
     ii. Heterozygotes same as 
     - Adaptive Landscape
     i. Rate of increasing fitness of pop. Slows as approach fixation of Dominant allele.

3. 
   a. Heterozygote has advantage - 

   - Sickle Cell Anemia
     i. 3 hemoglobin genotypes
        Hb-A/Hb-A, normal red blood cells-
        Hb-S/Hb-S, sickle cell anemia -
        Hb-A/Hb-S, mild sickle cell anemia,
        - unfavorable environment for Malarial parasite

4. Disruptive Selection/Diversifying Selection/Underdominance
   Both the homozygotes have 
   - initial allele frequencies matter
     i. 

5. ___________________
  a. previous examples considered constant selective force
     - leads to fixation of allele (directional, underdominance)
     - or leads to stable equilibrium (Heterosis)
  
  b. Frequency dependent selection
     * ___________________

  c. ___________________ frequency dependent Selection
     - ___________________
     i. whichever allele becomes more frequent will become fixed
     - Example from ___________________
       two version of coloration
       transferred both forms to four sites
       in sites where form A in great abundance - selection against form B = ____
       in sites where form A not as abundant - selection against form B = ____
       Selection determined by bird beak marks on recaptured moths
     ___________________

  d. ___________________ Frequency-dependent Selection
     - ___________________
     - allele frequencies ___________________
     - direction of selection fluctuates depending on allele frequencies
     - Example of ___________________ (Hori, 1993)
     i. Fish in Lake Tanganyika, eats scales off of other fish
     ii. Mouth is either twisted ___________________
         - right handed fish attack right flank
         - left handed fish attack left flank
     iii. Prey species are vigilant for attackers
     iv. Hypothesis
         - If more right handed scale-eating fish
           i. most prey fish would be vigilant on ___________________
           ii. fitness of ___________________
         - If more left handed scale eating fish
           i. most prey fish would be vigilant of ___________________
           ii. Fitness of ___________________
     v. the data
         - sampled fish for 11 years
         - saw fluctuation of phenotype around 0.5
         - measured breeder phenotypes on several years
         * found most abundant handedness among breeders,
IV. Testing for Hardy-Weinberg Equilibrium
A. Null Hypothesis
1. Population is in Hardy-Weinberg EQ ___________________
   a. ___________________

B. Example from Box 5.5 in text
Data from Matthijs et al., 1998
Examination of R141H allele and Other allele
These are the genotype numbers observed

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Observed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other/Other</td>
<td>11</td>
</tr>
<tr>
<td>Other/R141H</td>
<td>43</td>
</tr>
<tr>
<td>R141H/R141H</td>
<td>0</td>
</tr>
</tbody>
</table>

1. Calculate Observed allele frequencies from genotype numbers

\[ p = \quad q = \]

2. Calculate expected genotype frequencies under HW EQ

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Observed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other/Other</td>
<td>11</td>
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<td>Other/R141H</td>
<td>43</td>
</tr>
<tr>
<td>R141H/R141H</td>
<td>0</td>
</tr>
</tbody>
</table>

3. Calculate expected number of individuals

54 total individuals in population

4. Chi Squared Test

\[ \chi^2 = \]

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Observed</th>
<th>Expected</th>
<th>d</th>
<th>d^2</th>
<th>d^2/e</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oth/Oth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oth/R1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R1/R1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

where \( d^2 = \)
\[ e = \]

5. Determine the degrees of freedom (df)

\[ df = k-l-m \]
\[ k=\]
\[ m=\]

can only independently calculate one, second frequency dependent on first

\[ df = \]

null hypothesis =