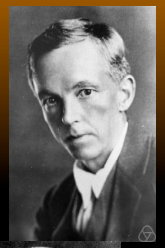
Chapter 11 The Evolution of Populations

11.4 Hardy-Weinberg Equilibrium

I. Hardy-Weinberg Equilibrium describes populations that are not evolving-

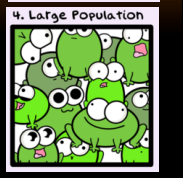
A. Godfrey Hardy and Wilhelm Weinberg created a mathematical model that describes the conditions under which populations would not evolve.



B. A population that is not evolving and is at Hardy-Weinberg equilibrium will have:

1. all individuals with equal reproductive success
2. mutations that do not alter the gene pool
3. no gene flow
4. a very large population
5. random mating

These conditions are hard to meet, thus most populations are evolving, although some are changing very slowly.



II. The Hardy-Weinberg equation is used to predict genotype frequencies in a population-

$$p^2 + 2pq + q^2 = 1$$

$$p + q = 1$$

p = frequency of dominant allele

q = frequency of recessive allele

p^2 = frequency of homozygous dominant individuals

2pq = frequency of heterozygous dominant individuals

q^2 = frequency of homozygous recessive individuals

1 = 100% of the population

A. The population is NOT evolving if the calculated frequency matches the actual measured frequency.

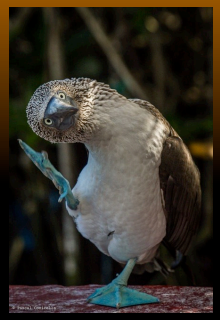
B. The population IS evolving if the calculated frequency differs from the actual measured frequency.

Example:

In a population of 500 blue-footed boobies, researchers expect to find 98% of the population with webbed feet (WW, Ww), the dominant trait and only 2% with non webbed feet (ww). Grad students collect the data in the population of boobies and find:

Webbed – 480

Non webbed – 20



1. Find the frequency of the q^2 (ww):
   q^2 = 20 non webbed / 500 ind in pop

2. Find q:
   $q = \sqrt{q^2} = \sqrt{0.04}$

3. Use p +q = 1 to find p:
   p + q = 1
   p = 1 – q

4. Calculate the actual genotype frequencies
   WW (webbed) = p^2 =
   Ww (webbed) 2pq =
   ww (non webbed) q^2 =

4. Calculate the predicted genotype frequencies from what researchers hypothesized:

   98% of the population with webbed feet (WW, Ww)

   2% with non webbed feet (ww)

   Find q:
   $q = \sqrt{q^2} = \sqrt{0.02}$
   =

   Use p +q = 1 to find p:
   p + q = 1 therefore p = 1 – q
   =

Find the predicted phenotypes.	Do they match?
WW (webbed) = p^2 =	0.64
Ww (webbed) 2pq =	0.32
ww (non webbed) q^2 = 0.02	0.04

NIET!

III. There are five factors that can lead to evolution-

A. Genetic drift – allele frequencies change in a population due to random chance

B. Gene flow – alleles move in and out of a population when individuals migrate and reproduce with other populations

C. Mutation – new alleles can be formed through mutation to DNA sequences leading to proteins with new functions

D. Sexual selection – certain traits may improve mating success

E. Natural selection – certain traits may be an advantage for survival