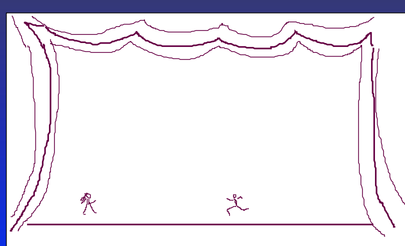
Lecture 12

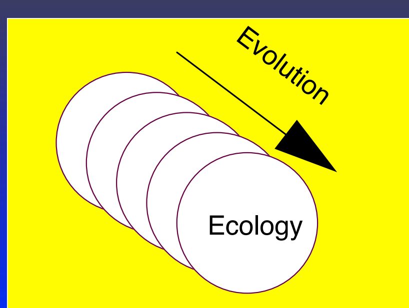
See web site; Article 12

Reading from Futuyma, part of chap. 9, ‘Evolution’ (Sinauer)

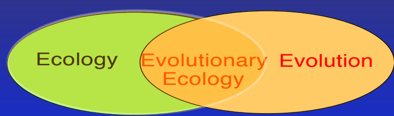
Ecological Theater and Evolutionary Play



Ecology Now, Evolution Over Time



Related Fields, Shared Questions



Evolution (population genetic sense)

Genetic change.

Measured as change in allele frequency over time.

Purpose of Hardy-Weinberg Law

- To answer the following question: In a population with known **allele frequencies** at time t, what will the **genotype frequencies** be at generation t+1?
- We will extend this to answer the evolutionary question: Given allele frequencies p and q at time t, what are the allele frequencies at time t+1? (Has there been evolution?)

Already Learned This in Bio. 115/117?

- A population contains 2 alleles, B_1 and B_2, for a flower color gene in mountain laurel. The B_1 allele is dominant over the B_2 allele, and B_1 codes for a pigment producing a dark pink flower (B_2B_2 is light pink). The genotype frequencies are F_{11}=.2, F_{12}=.4 and F_{22}=.4 at the present time. *Assume the Hardy-Weinberg Law holds*.
- 1. What is the allele frequency, p, in the current generation? (A) 0.2, (B) 0.3, (C) 0.4, (D) 0.5, (E) 0.6

Hmmm…

- A population contains 2 alleles, B_1 and B_2, for a flower color gene in mountain laurel. The B_1 allele is dominant over the B_2 allele, and codes for a pigment producing a dark pink flower (B_2B_2 is light pink). The genotype frequencies are F_{11}=.2, F_{12}=.4 and F_{22}=.4 at the present time. *Assume the Hardy-Weinberg Law holds*.
- 2. What will the frequency of heterozygotes be in the next generation? (A) 0.04, (B) 0.24, (C) 0.36, (D) 0.48, (E) 0.64

Are You 100% Confident? (you can leave now…)

- A population contains 2 alleles, B_1 and B_2, for a flower color gene in mountain laurel. The B_1 allele is dominant over the B_2 allele, and codes for a pigment producing a dark pink flower (B_2B_2 is light pink). The genotype frequencies are F_{11}=.2, F_{12}=.4 and F_{22}=.4 at the present time. *Assume the Hardy-Weinberg Law holds*.
- 3. What percent of the population will be dark pink in the next generation? (A) 0.24, (B) .48, (C) .64, (D) 0.86, (E) I don't know how to calculate this…

Simplifying assumptions

- 1
- 2
- 3
- 4
- 5
- 6

Hardy-Weinberg Law

- Matching socks in a drawer rule...

The Hardy-Weinberg Law

Evolution

- Evolution=________________________________
  ____
- What does the Hardy-Weinberg Law predict about allele frequency change?

Finding Allele Freq. Change

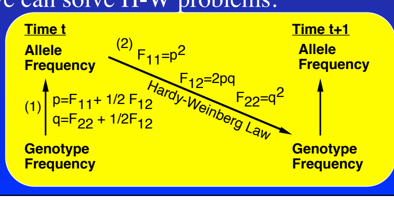
H-W and Evolution

- At any one point in time:

Allele frequency change

Hardy Weinberg Review

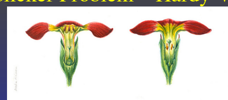
- The H-W Law predicts genotype frequencies (t+1) from allele frequencies (t)
- Combined with the relationship between allele and genotype frequencies within generations, we can solve H-W problems.



Sample Problem - revisited

- A population contains 2 alleles, B_1 and B_2, for a flower color gene in mountain laurel. The B_1 allele is dominant over the B_2 allele, and codes for a pigment producing a dark pink flower (B_2B_2 is light pink). The genotype frequencies are F_{11}=.2, F_{12}=.4 and F_{22}=.4 at the present time. Assume Hardy-Weinberg assumptions are met.
- 1. What is the allele frequency, p, in the current generation?
- 2. What will the frequency of heterozygotes be in the next generation?
- 3. What percent of the population will be dark pink in the next generation?

Clicker Problem – Hardy-Weinberg



- The height of anthers in *Primula vulgaris* is controlled by gene A. Genotype AA or Aa produces a tall anther, while aa produces a short anther. A population **is presently in** Hardy-Weinberg equilibrium and the frequency of plants with short anthers is 36%.
- 1. What is the frequency (p) of the A allele in the population? (A) 0.36 (B) 0.40 (C) 0.60, (D) 0.64, (E) 1

Clicker Problem 2

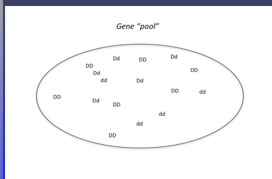
- The height of anthers in *Primula vulgaris* is controlled by gene A. Genotype AA or Aa produces a tall anther, while aa produces a short anther. A population **is presently in** Hardy-Weinberg equilibrium and the frequency of plants with short anthers is 36%.

2. What will the frequency of genotype Aa be in the next generation? (A) 0.16, (B) 0.24, (C) 0.36, (D) 0.48, (E) 0.72

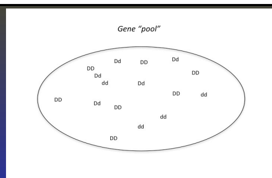
Clicker Problem 3

- The height of anthers in *Primula vulgaris* is controlled by gene A. Genotype AA or Aa produces a tall anther, while aa produces a short anther. A population **is presently in** Hardy-Weinberg equilibrium and the frequency of plants with short anthers is 36%.
- 3. What will the frequency of tall anthers be in the next generation? (A) 0.16, (B) 0.48, (C) 0.64, (D) 0.72 (E) 1

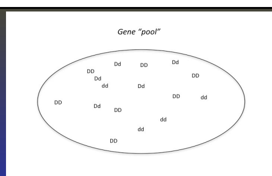
Rcent Final Exam Question



- What is the frequency (p) of allele D in the population in the gene pool above?
- (A) .6125 (B) .59375 (C) .52145 (D) .48625 (E) .40625



- What is F_{12}?
- (A) .4375
- (B) .25
- (C) .3125
- (D) .40625
- (E) cannot be calculated with the information given



- 7. Is this population already in Hardy-Weinberg equilibrium?
-
- (A) Yes.
- (B) No. At present there are too many heterozygotes and not enough homozygotes
- (C) No. At present there are too few heterozygotes and too many homozygotes
- (D) No. At present there are too many DD, but not enough Dd and dd
- (E) No. At present there are to few DD, Dd, and dd

Yet another

- If the Hardy-Weinberg assumptions are met for one generation, what *change* in allele frequency p would be expected between t and t+1?
-
- (A) 0
- (B) -.1260
- (C) -.2225
- (D) +.04665
- (E) +.0625

Reiteration of Hardy-Weinberg conclusions

- In large populations of a species with a simple life history, and no differential fitness of individuals carrying different genes:
- **genotype frequencies will be p^2,2pq,q^2**
- **these genotype frequencies will be reached after 1 generation of random mating**
- **populations will not evolve in terms of allele frequency**

Hardy-Weinberg

*Is the fundamental theorem of population genetics

*Relaxing Hardy-Weinberg assumptions one at a time allows us to develop evolutionary models