

**Lecture 14**

See web site; Article 12  
Reading from Futuyma, part of chap.  
9, 'Evolution' (Sinauer)

---

---

---

---

---

---

---

**Genetic terms to know**

- General terms:
  - Chromosome
  - Diploid
  - Gene
  - Locus
  - Transcription
  - Translation
  - Codon/anti-codon
  - Allele
  - Dominance

---

---

---

---

---

---

---

**More terms**

- About the individual
  - Genotype
    - Heterozygous
    - Homozygous
  - Phenotype
    - Discrete traits
    - Continuous traits

---

---

---

---

---

---

---

**More terms**

- Population level
  - Polymorphic (monomorphic)
  - Frequency
    - Allele frequency (p, q)
    - Genotype frequency ( $F_{11}$ ,  $F_{12}$ ,  $F_{22}$ )
    - Phenotype frequency (Freq(Landseer), Freq(typical))

---

---

---

---

---

---

---

---

**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?)

---

---

---

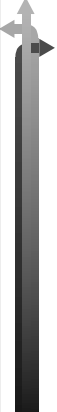
---

---

---

---

---



### Simplifying assumptions

- ⇒ 1
- ⇒ 2
- ⇒ 3
- ⇒ 4
- ⇒ 5
- ⇒ 6

---

---

---

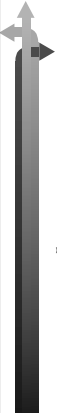
---

---

---

---

---



### Hardy-Weinberg Law

⇒ Matching socks in a drawer...

---

---

---

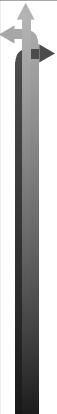
---

---

---

---

---



### 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.

The diagram shows the relationship between allele and genotype frequencies at two time points, Time t and Time t+1. At Time t, the Allele Frequency is p and q, and the Genotype Frequency is  $F_{11}$ ,  $F_{12}$ , and  $F_{22}$ . At Time t+1, the Allele Frequency is p and q, and the Genotype Frequency is  $F_{11}$ ,  $F_{12}$ , and  $F_{22}$ . The Hardy-Weinberg Law is shown as a diagonal arrow connecting the two time points, with the equations  $F_{11} = p^2$ ,  $F_{12} = 2pq$ , and  $F_{22} = q^2$  written along it. Equations (1) and (2) are also shown, relating allele frequencies to genotype frequencies at each time point.

---

---

---

---

---

---

---

---

## Sample Problem

- 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 - I'm leaving this on here in case you want to work them in advance!

→ 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?

---

---

---

---

---

---

---

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?

---

---

---

---

---

---

---

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? (Assume H-W)

---

---

---

---

---

---

---

**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

---

---

---

---

---

---

---