

**Lecture 14**

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

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**Genetic terms to know**

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

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**More terms**

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

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## 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))

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## Evolution (population genetic sense)

Genetic change.

Measured as change in allele frequency over time.

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## 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?)

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Simplifying assumptions

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

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Hardy-Weinberg Law

→ Matching socks in a drawer...

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The Hardy-Weinberg Law

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**Evolution**

→ Evolution= \_\_\_\_\_

→ What does the Hardy-Weinberg Law predict about allele frequency change?



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**Finding Allele Freq. Change**



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**H-W and Evolution**

→ At any one point in time:



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## Allele frequency change

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## 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.

Time t Time t+1

Allele Frequency		Allele Frequency
(1) ↑	↓ (2)	↑
Genotype Frequency	Hardy-Weinberg Law	Genotype Frequency

$F_{11} = p^2$      $F_{12} = 2pq$      $F_{22} = q^2$

$p = F_{11} + 1/2 F_{12}$      $q = F_{22} + 1/2 F_{12}$

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## 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?

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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?

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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?

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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)

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**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**

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**Hardy-Weinberg**

- \*Is the fundamental theorem of population genetics
- \*Relaxing Hardy-Weinberg assumptions one at a time allows us to develop evolutionary models

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