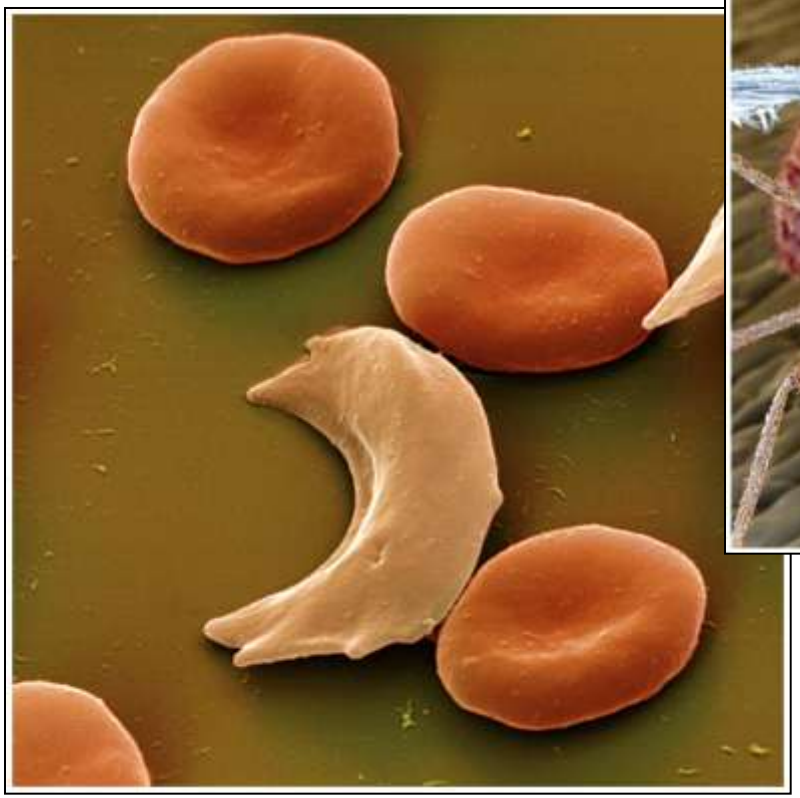
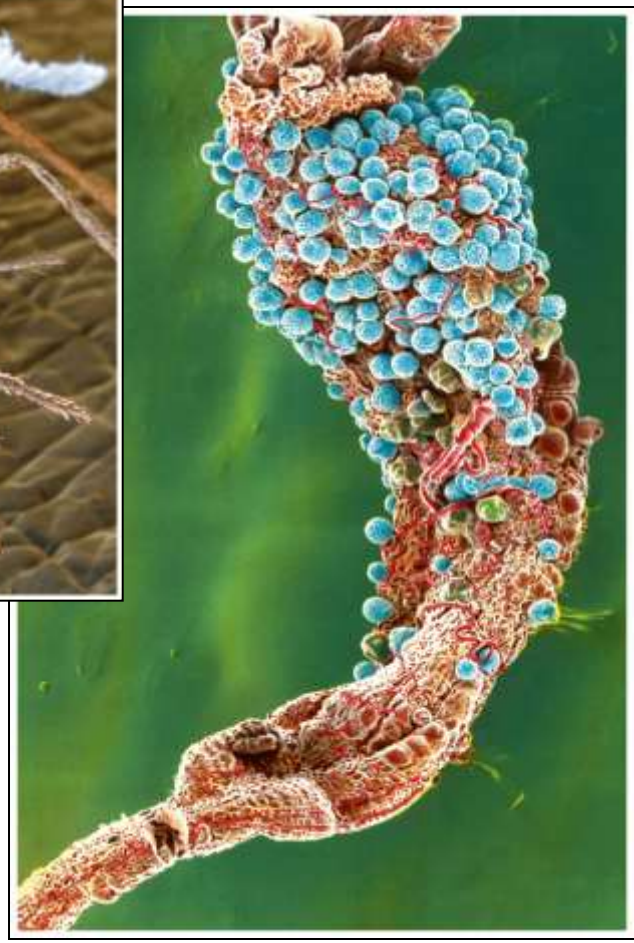
Chapter 4

Genes and Their Evolution:

Population Genetics



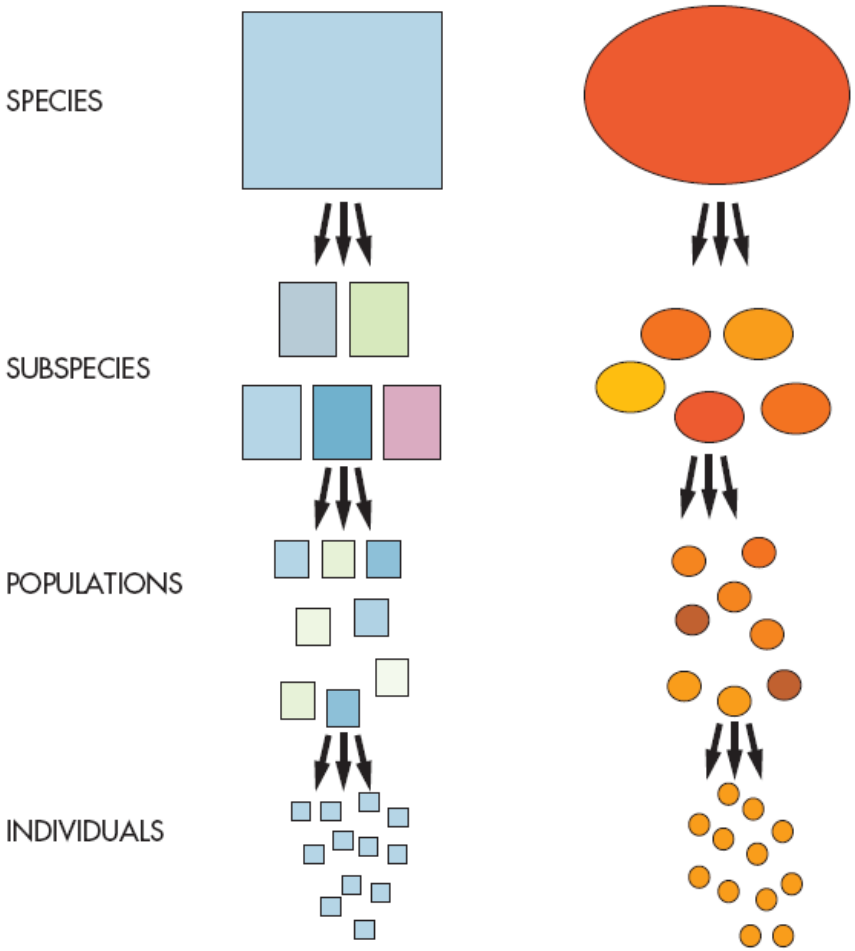


Demes, Reproductive Isolation, and species

What is a population?

- Fluid concept
- Groups beneath species level?

- Deme (local breeding population)
- Subspecies, (Race)
- Gene pool



Demes, Reproductive Isolation, and species

- Reproductive isolation
  - Microevolution
  - Macroevolution

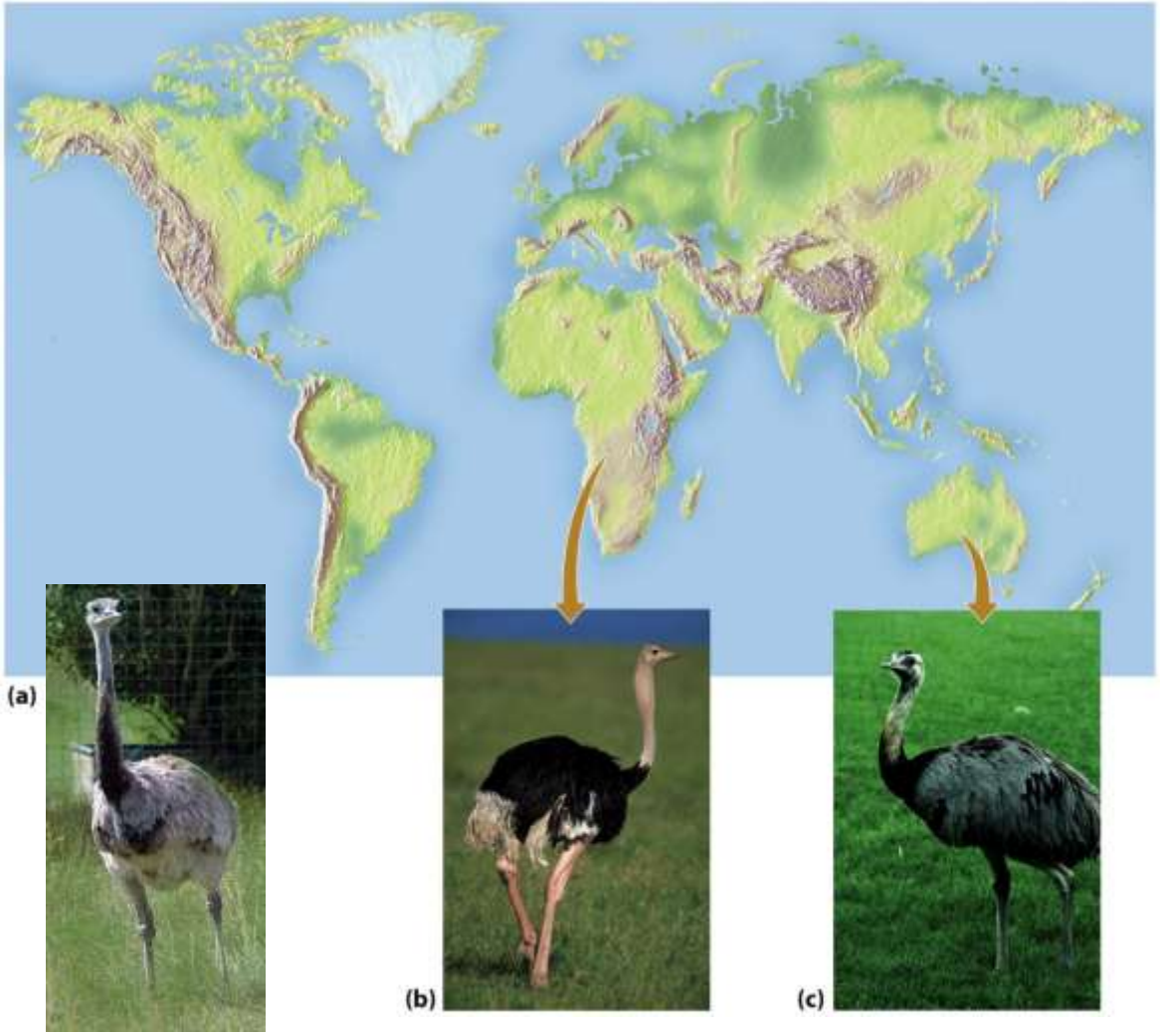
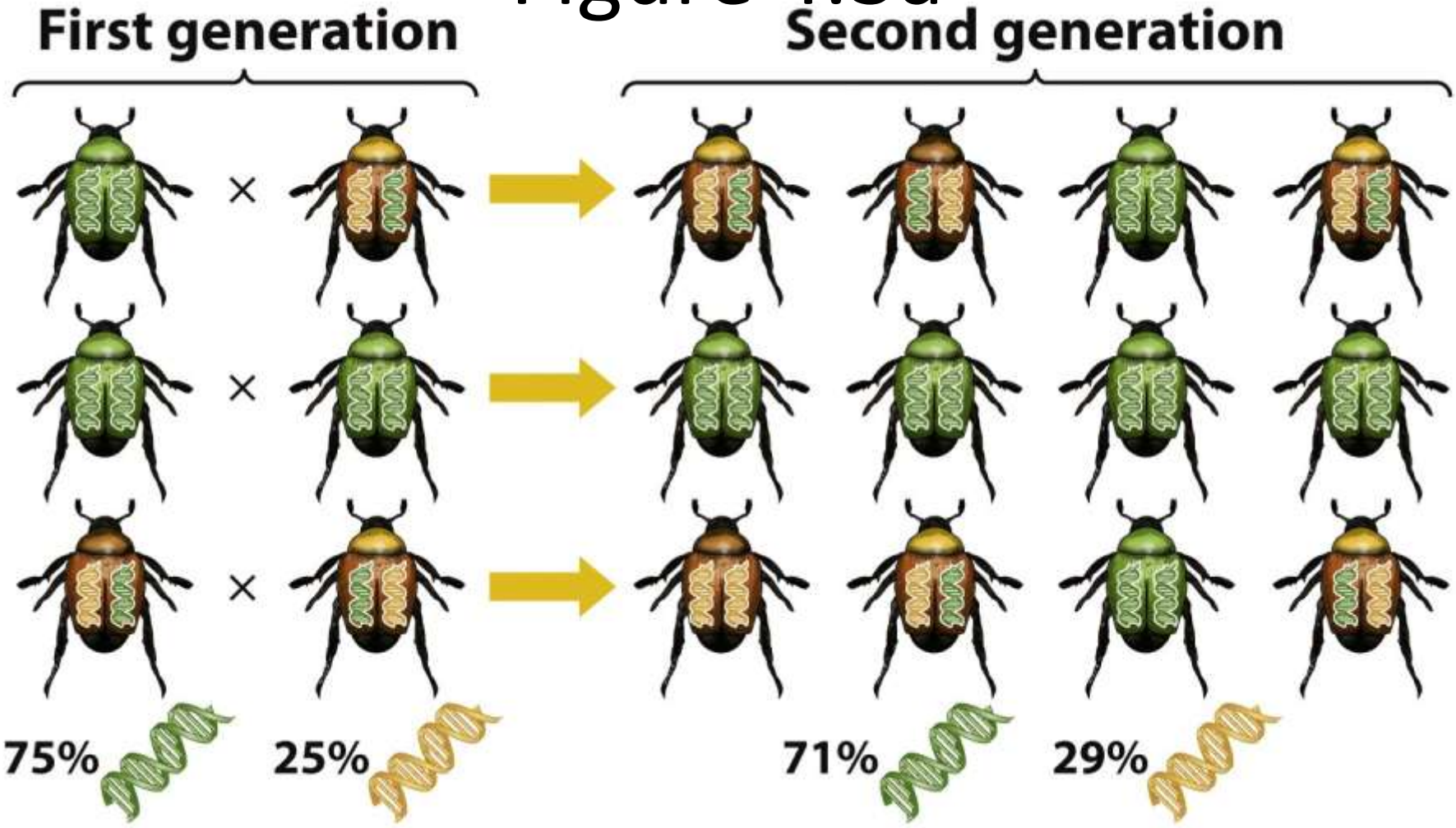


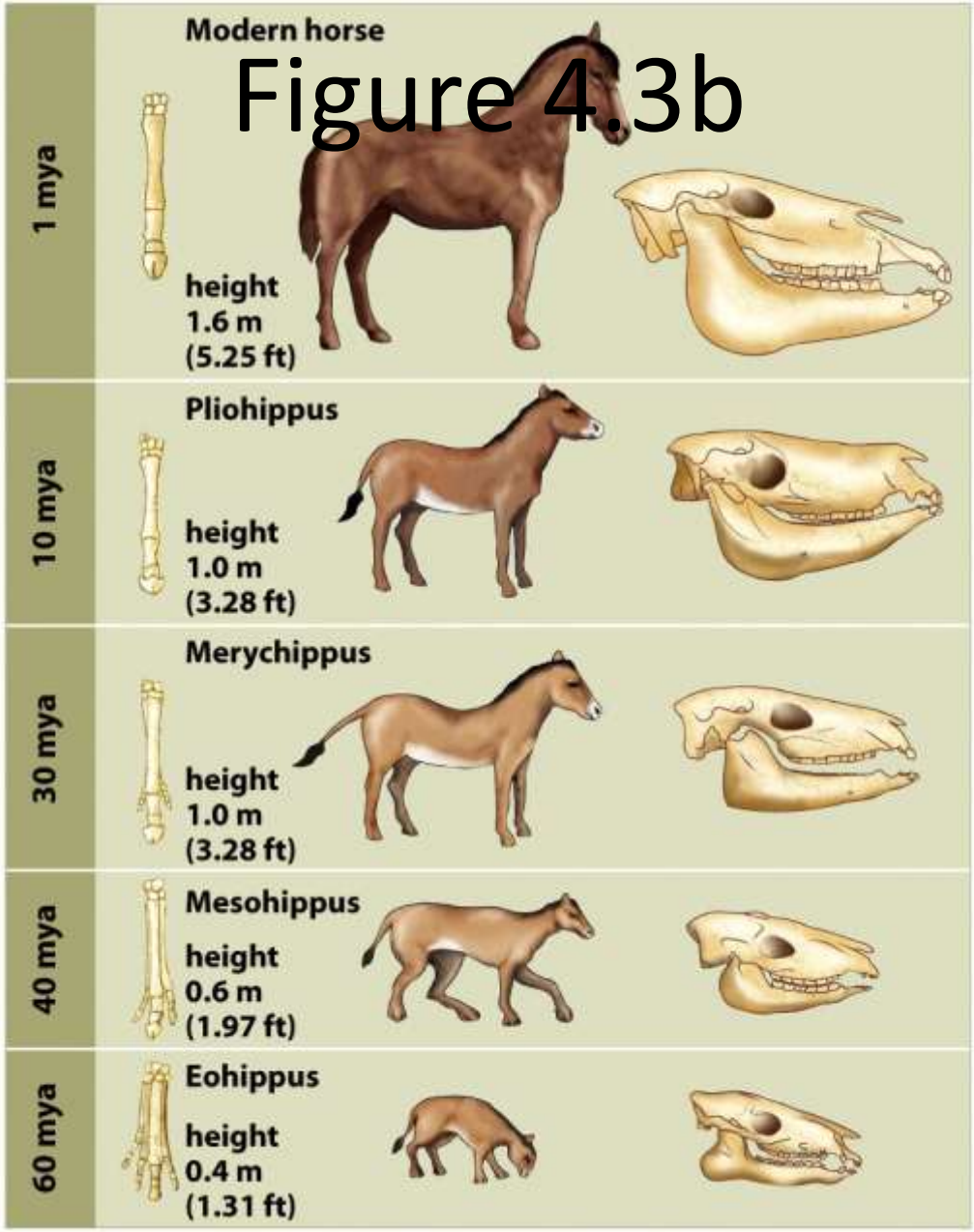
Figure 4.3a



Microevolution

Macroevolution

Figure 4.3b


1 mya
Modern horse
height
1.6 m
(5.25 ft)
10 mya
Pliohippus
height
1.0 m
(3.28 ft)
30 mya
Merychippus
height
1.0 m
(3.28 ft)
40 mya
Mesohippus
height
0.6 m
(1.97 ft)
60 mya
Eohippus
height
0.4 m
(1.31 ft)

Hardy-Weinberg Law: Testing the Conditions of Genetic Equilibrium

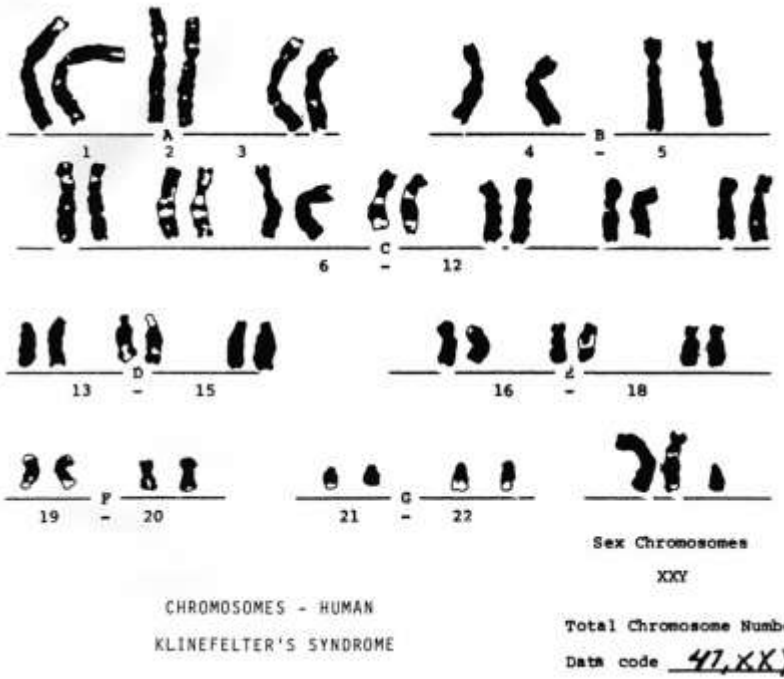
$$p^2 + 2pq + q^2 = 1$$

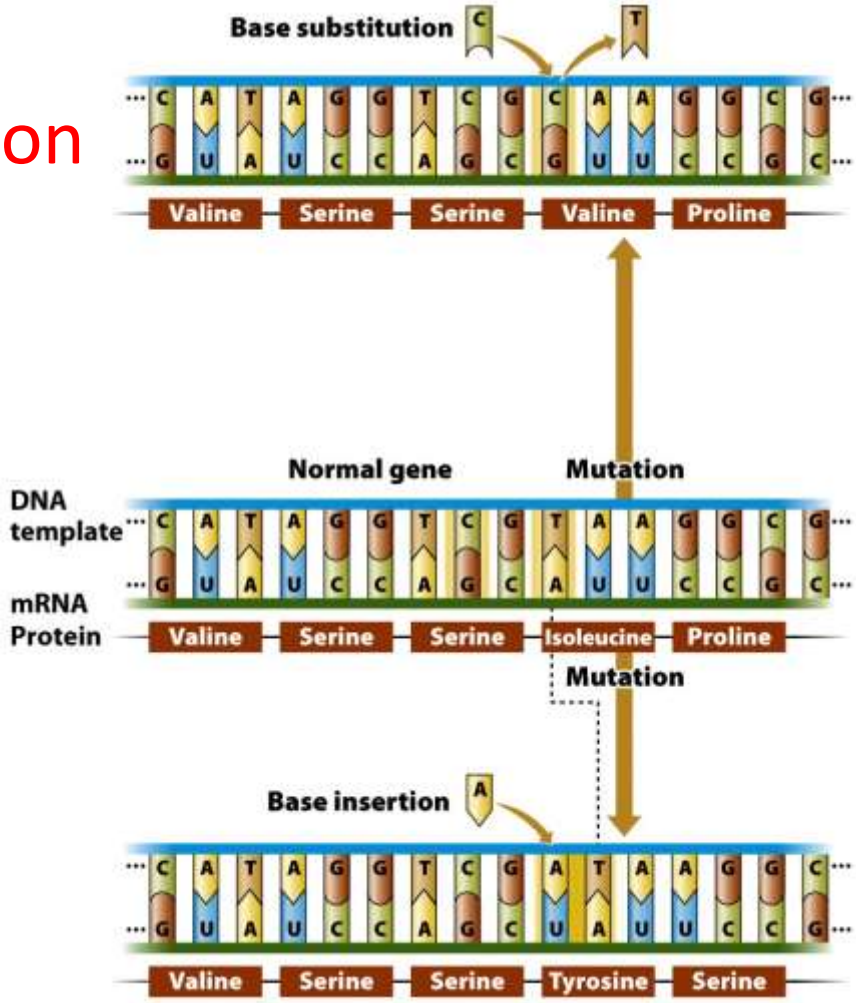
$p = A$

$q = a$

Mutation: The only source of New Alleles

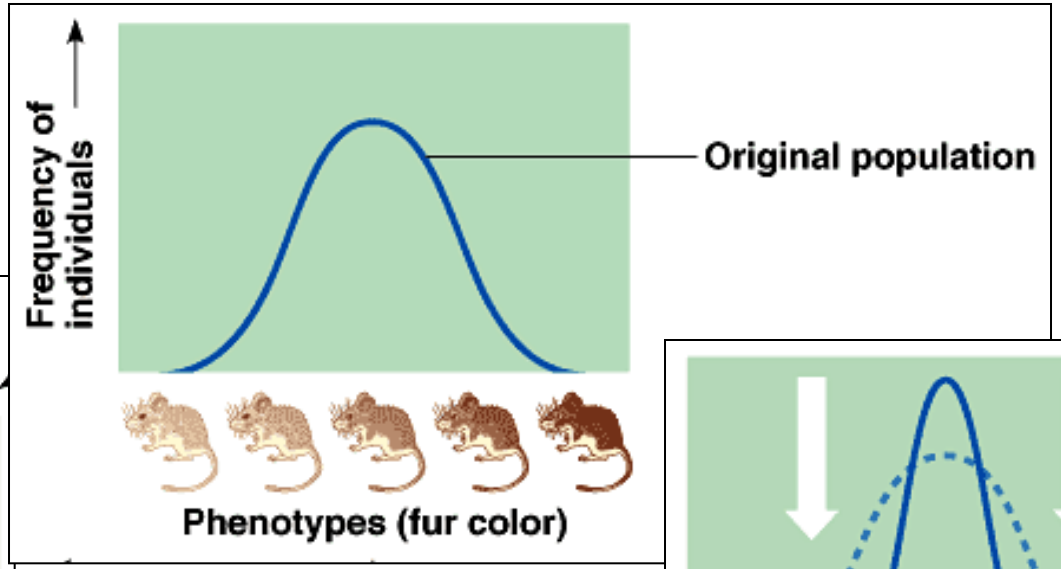
- Point mutations
- Transposable elements
- Klinefelter's syndrome
- Nonsynonymous point mutation
- Induced mutations
- mutagens

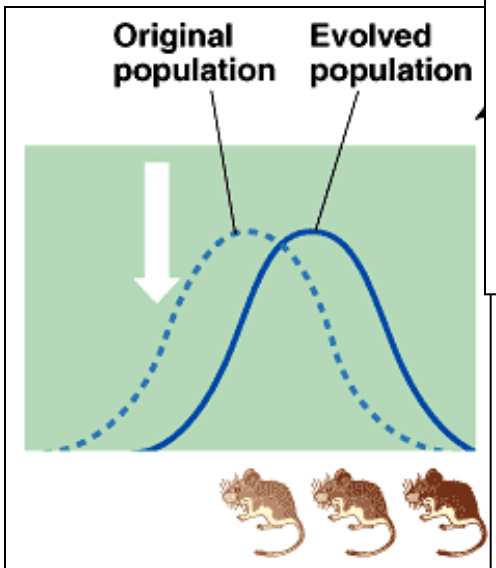


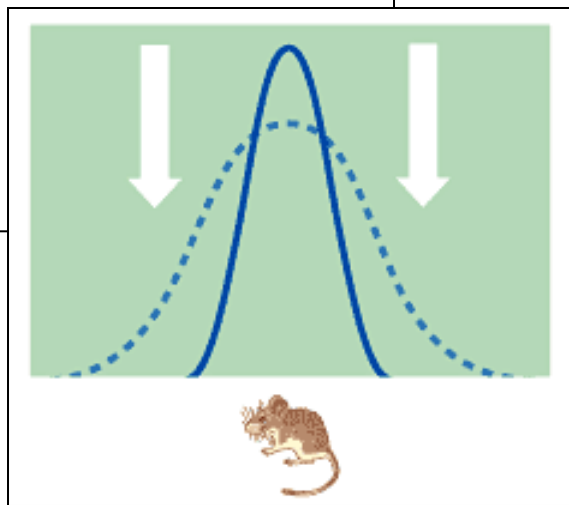


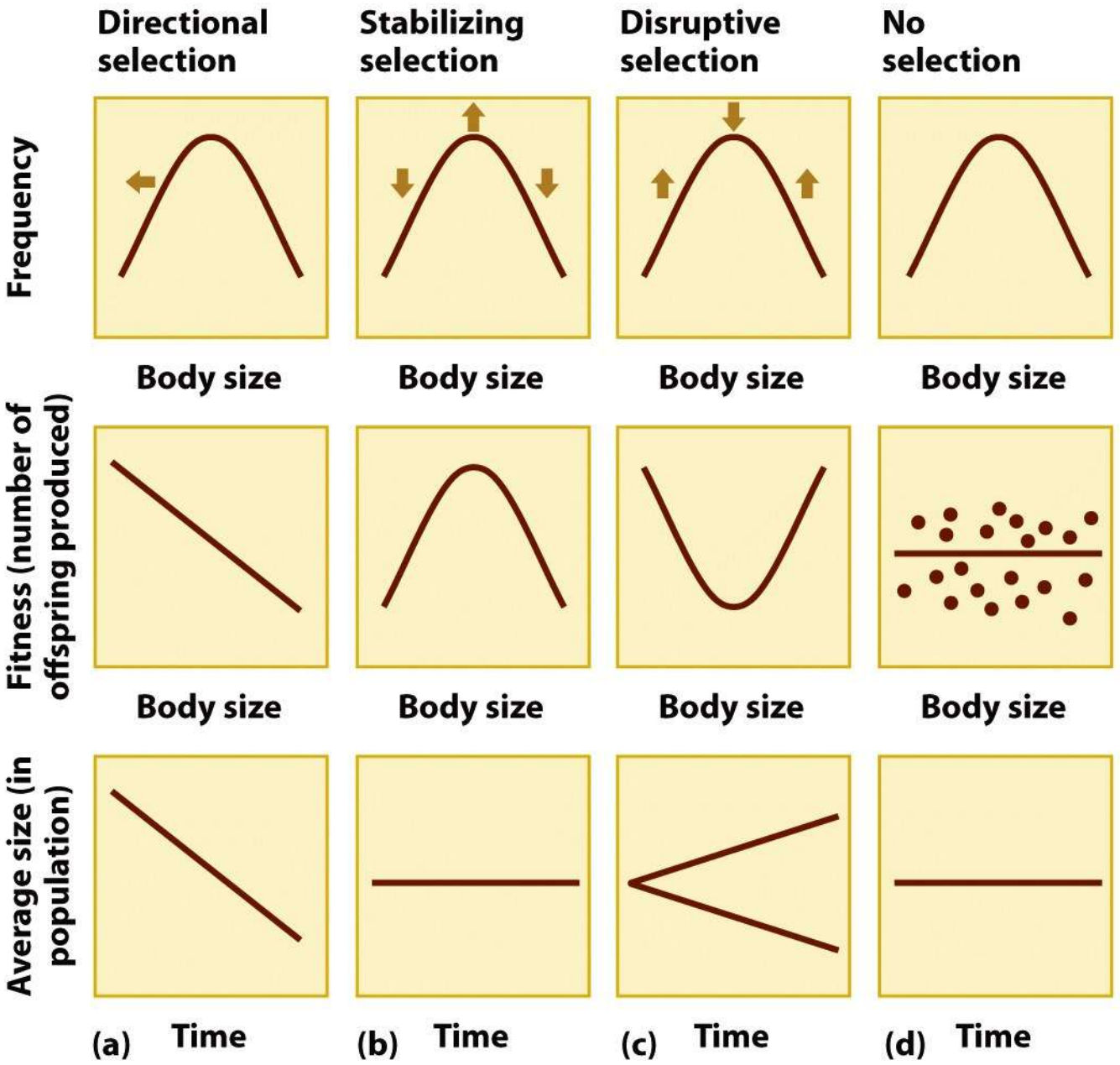
Natural Selection: Advantageous characteristics, survival and reproduction

- Fitness
- Directional Selection
- Stabilizing selection
- Disruptive selection



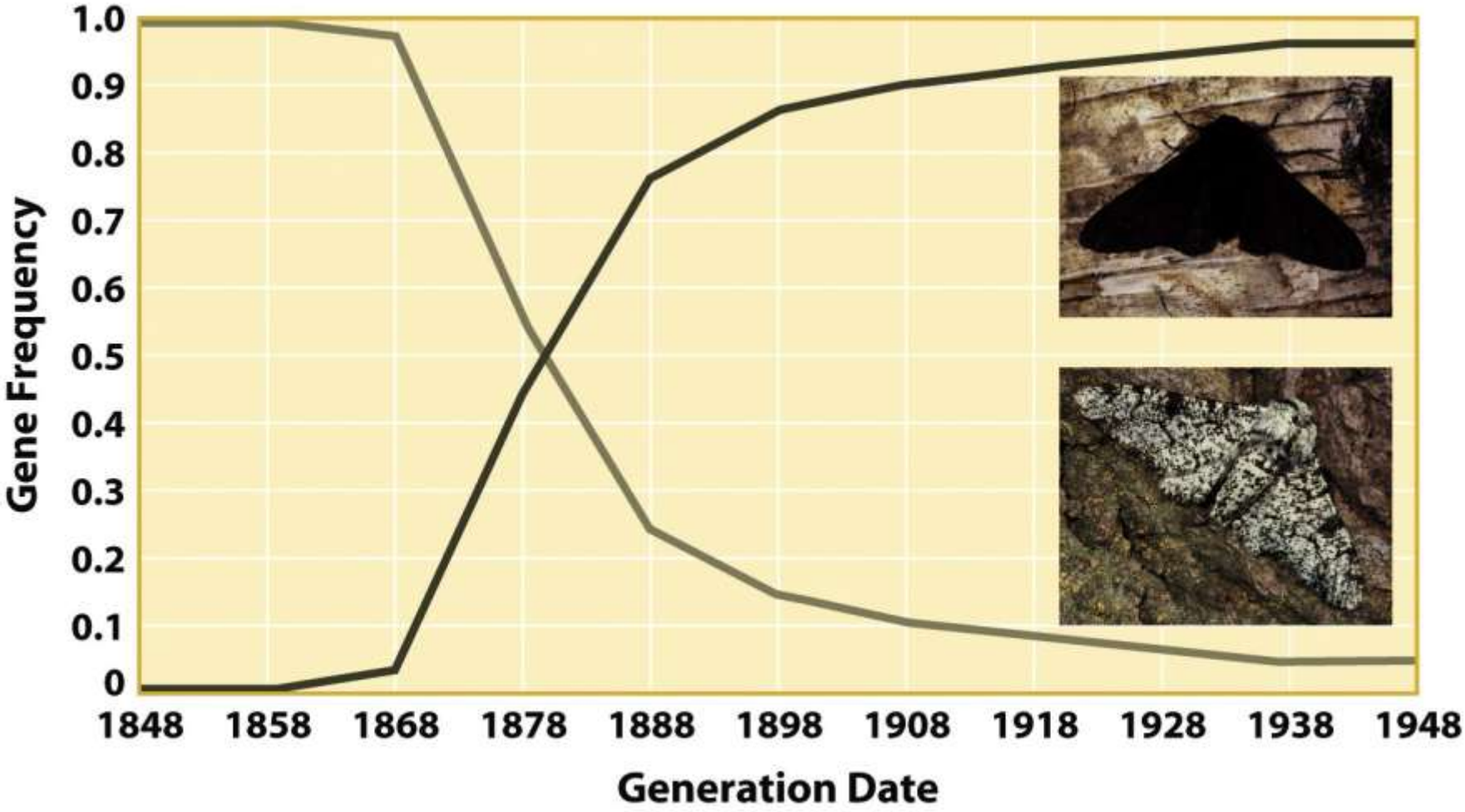


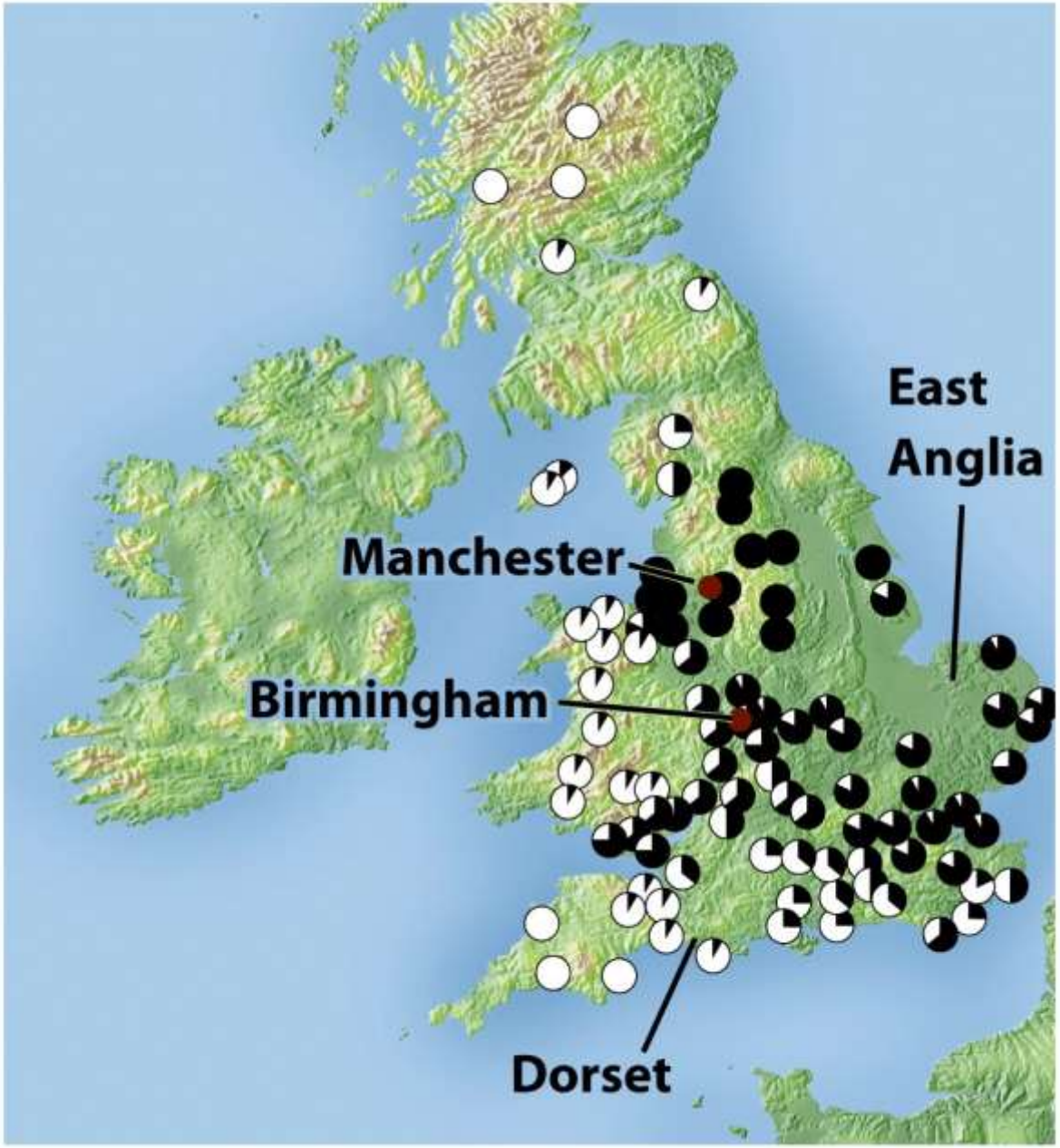



Directional selection
Stabilizing selection
Disruptive selection
No selection
Frequency
Body size
Body size
Body size
Body size
Fitness (number of offspring produced)
Body size
Body size
Body size
Body size
Average size (in population)
(a) Time
(b) Time
(c) Time
(d) Time

Industrial Melanism

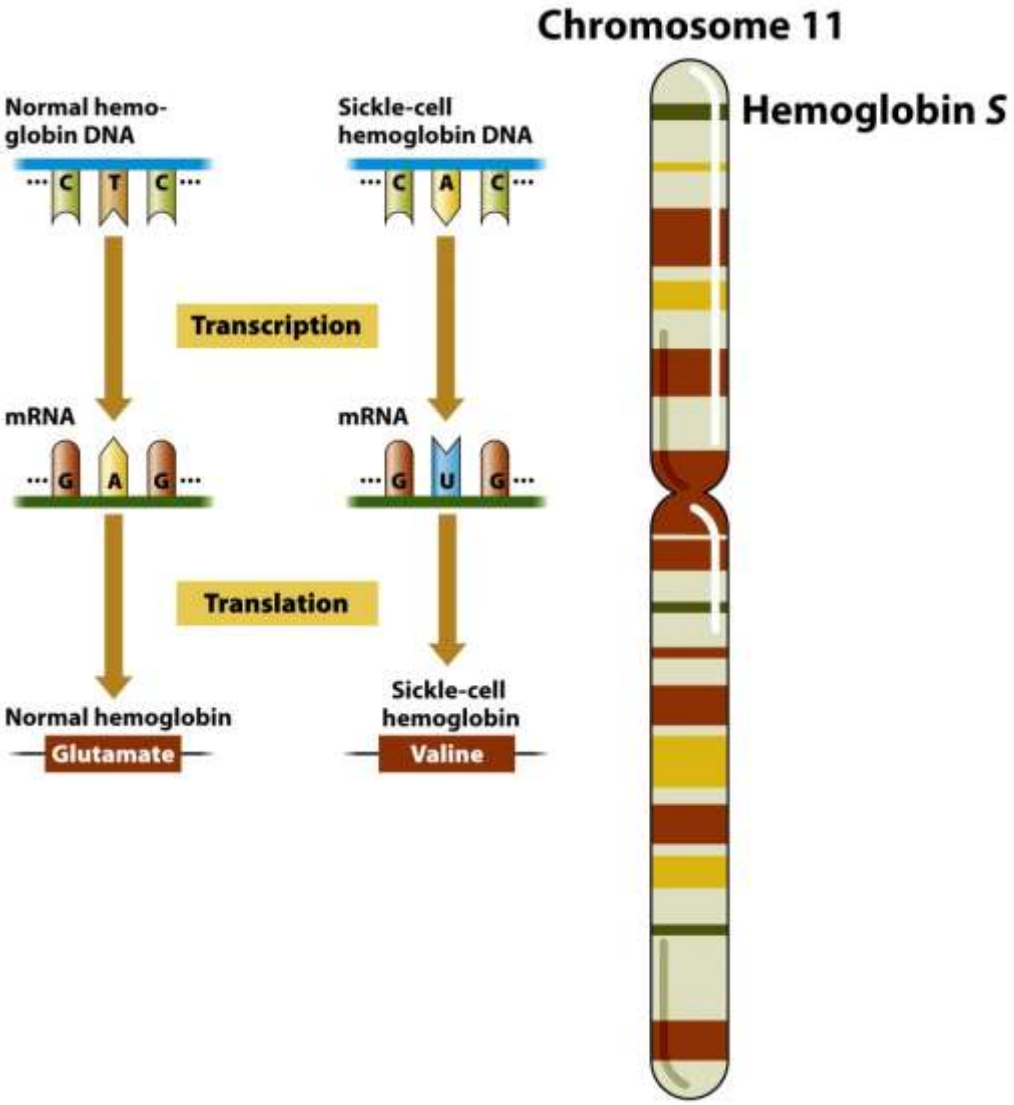
Melanic/Nonmelanic


1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Gene Frequency
1848
1858
1868
1878
1888
1898
1908
1918
1928
1938
1948
Generation Date


East
Anglia
Manchester
Birmingham
Dorset

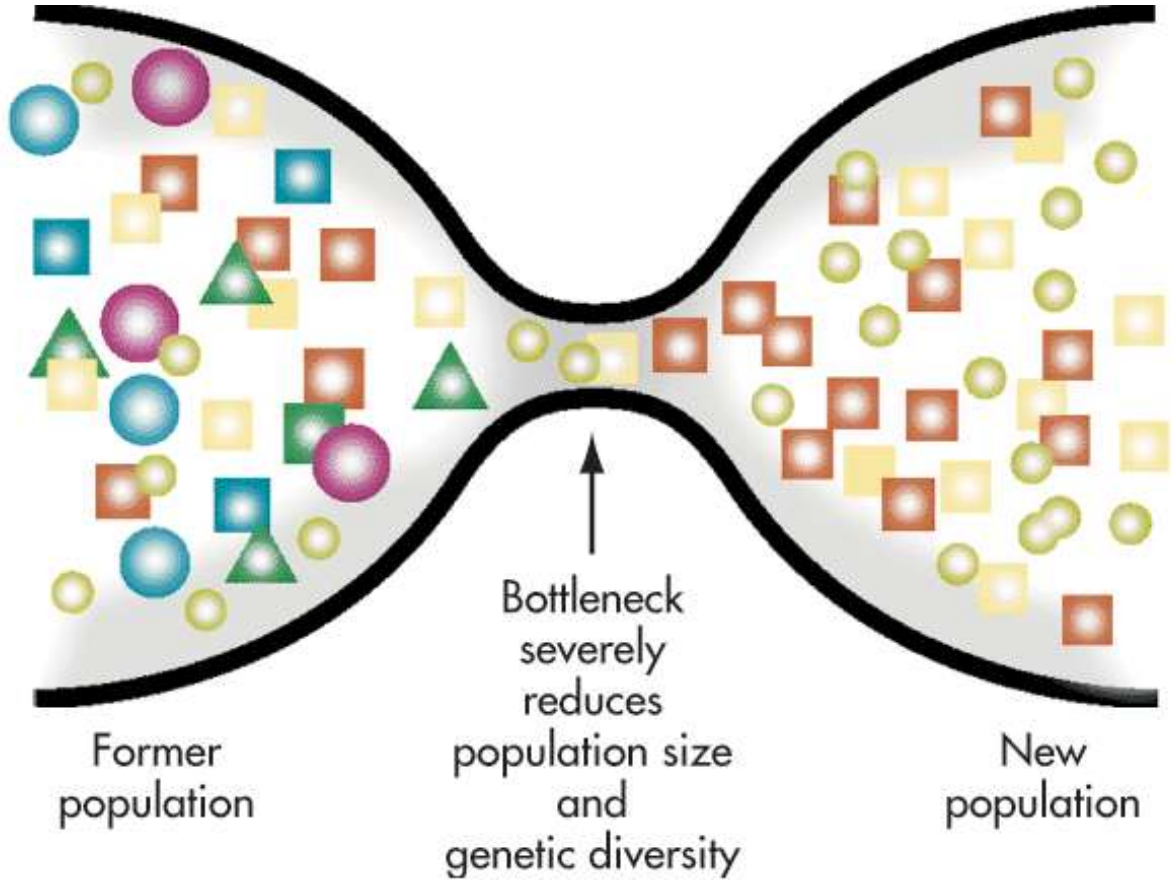
Natural Selection in Humans: Abnormal hemoglobins and resistance to malaria

- Positive selection
- Hemolytic anemias
- Hemoglobinopathies
- Ballanced polymorphism
- Capillaries



Genetic Drift: Genetic Change due to chance

- Founder effect and genetic bottleneck
- More important with small populations



- exogamous

Gene flow: Spread of genes across population Boundaries

- **Admixture** Tends to make populations genetically similar, offset problems of inbreeding