- Don’t forget Lecture quiz
- First midterm in 1 week (look for email announcements)

Evolution (recap)

- Descent with modification; genetic (allele frequency) change in *populations* of organisms over *generations*.
- Natural selection was the mechanism emphasized by Darwin and Wallace
- However, several other forces of evolution can cause changes in populations of living things

Forces of **Evolution**? (evolutionary agents)

- Forces of Evolutionary Change in a population include:

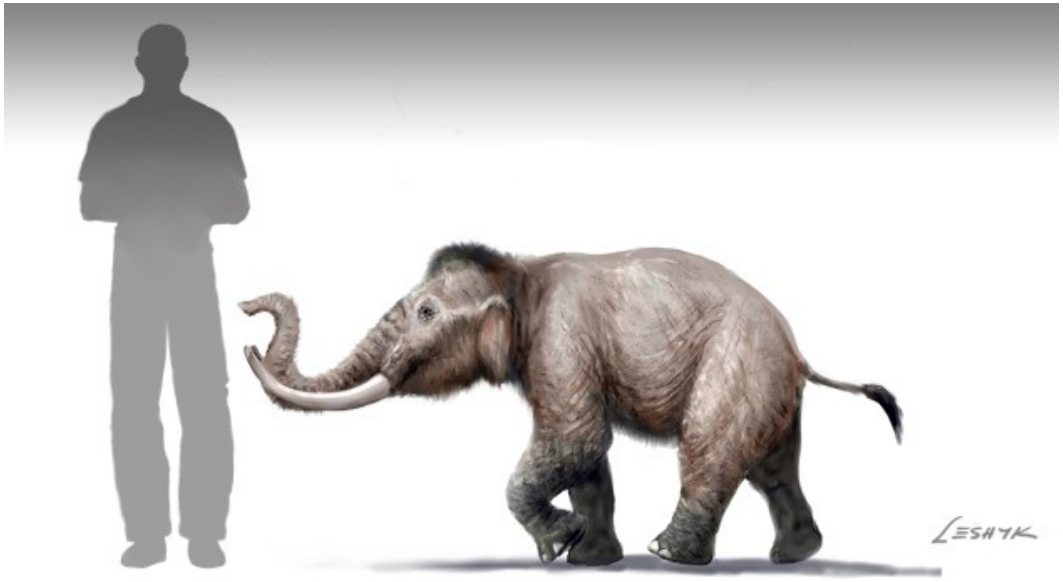
-Natural Selection

-Sexual Selection (often considered a kind of nat. selec.)

-Genetic Drift

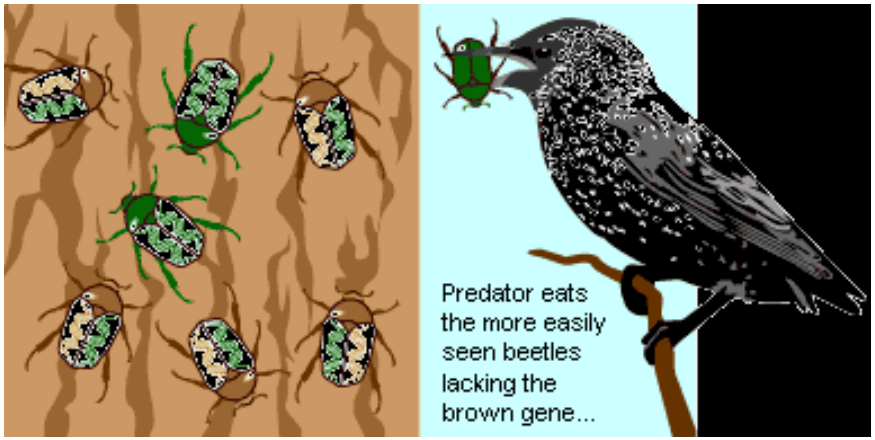
-Gene Flow

-Mutation



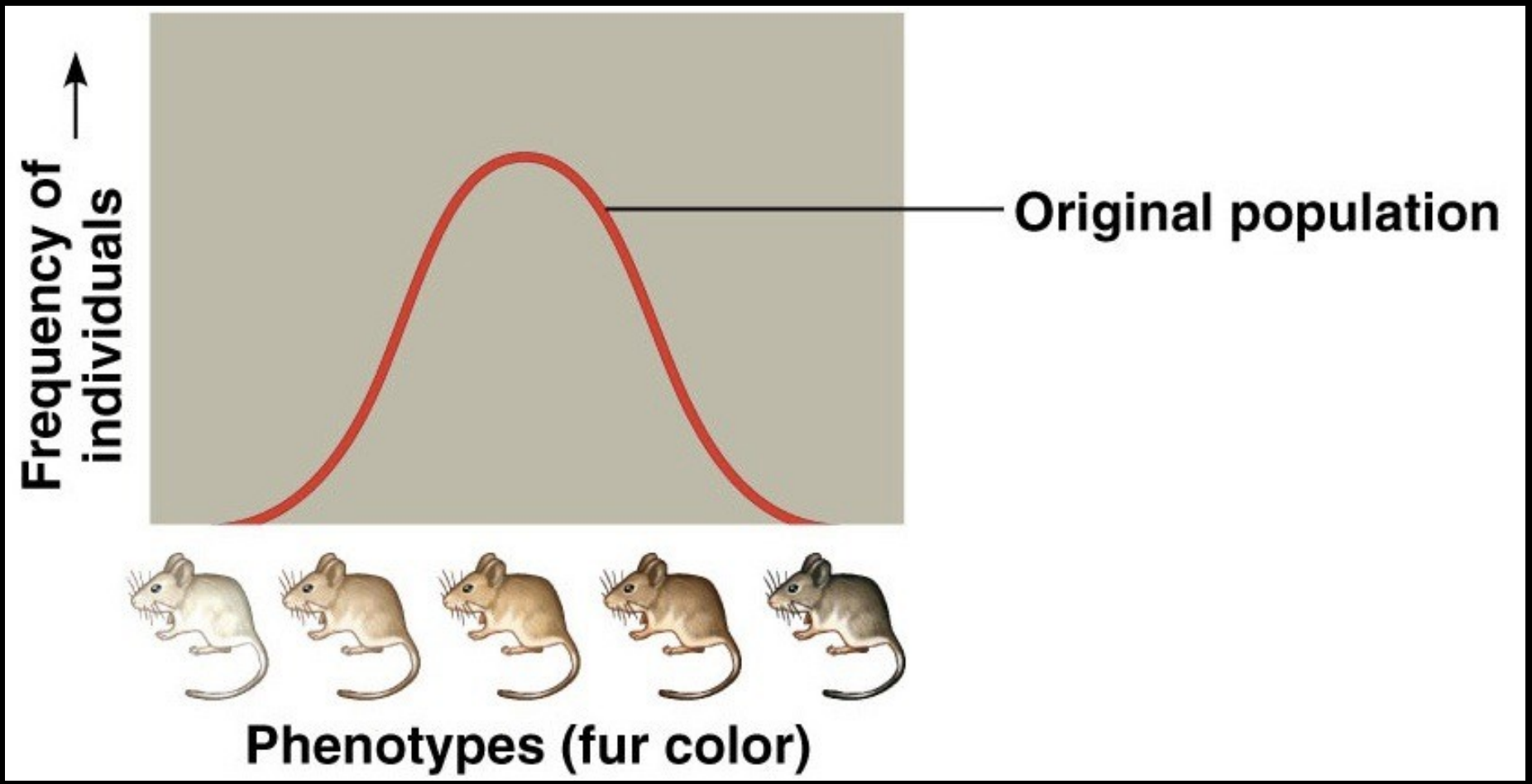
Fossil pygmy mammoths illustrate rapid evolution on islands

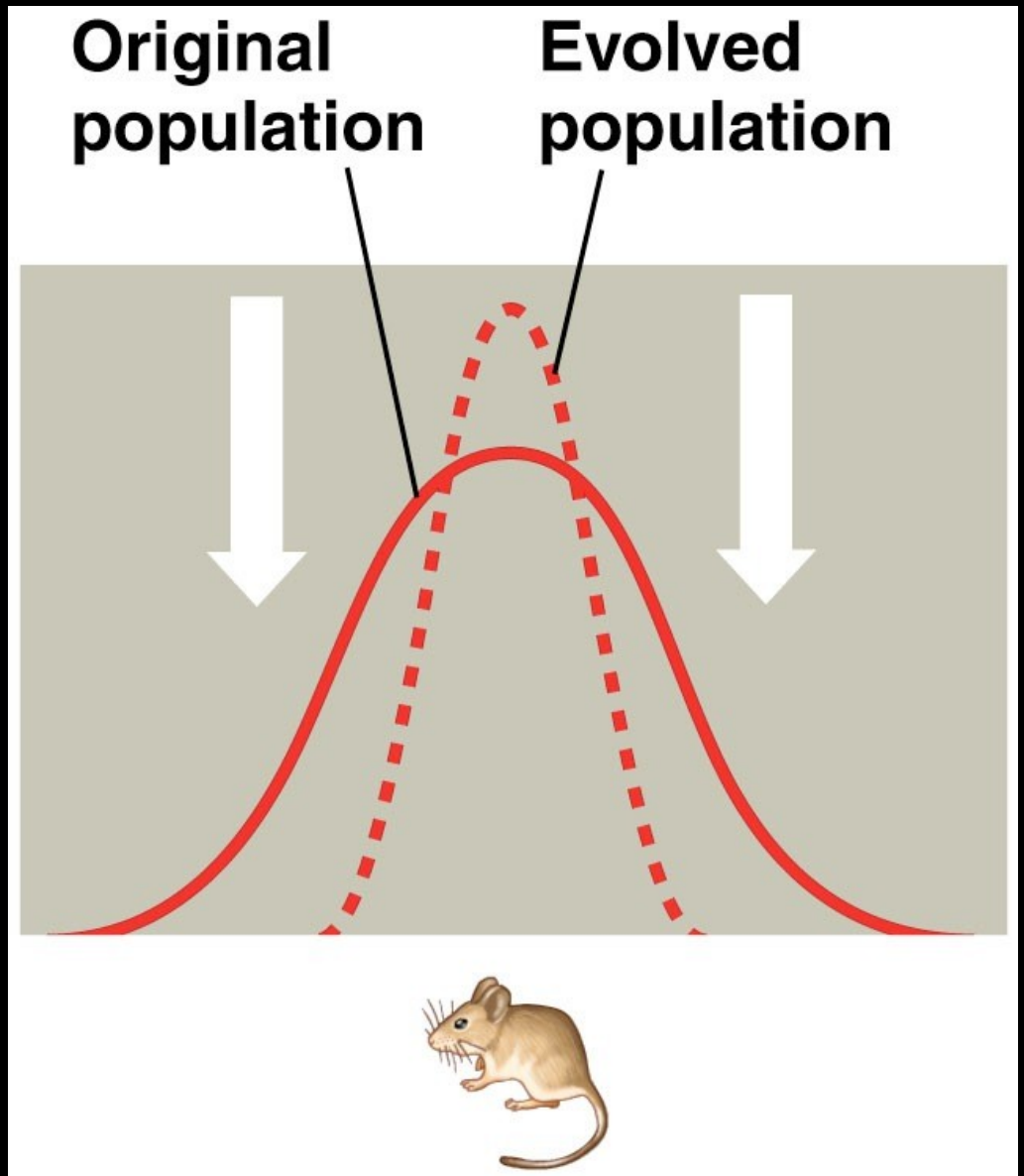
NATURAL SELECTION



Natural selection accumulates and maintains favorable genotypes (higher fitness) in a population- leading to adaptation

Modes of natural selection:
-Stabilizing selection
-Directional selection
-Disruptive selection


Frequency of individuals
Original population
Phenotypes (fur color)



(c) Stabilizing selection

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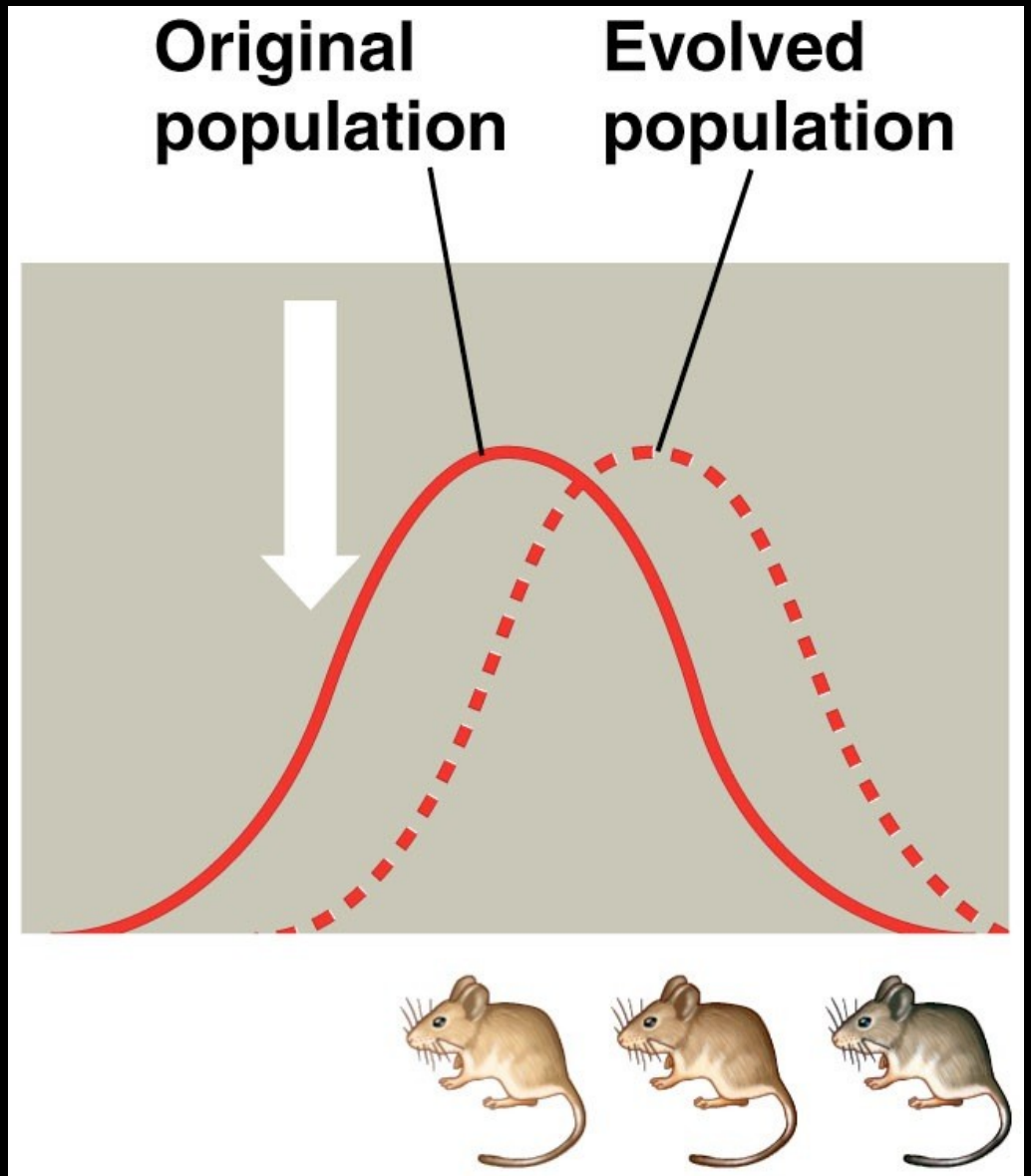

(a) Directional selection

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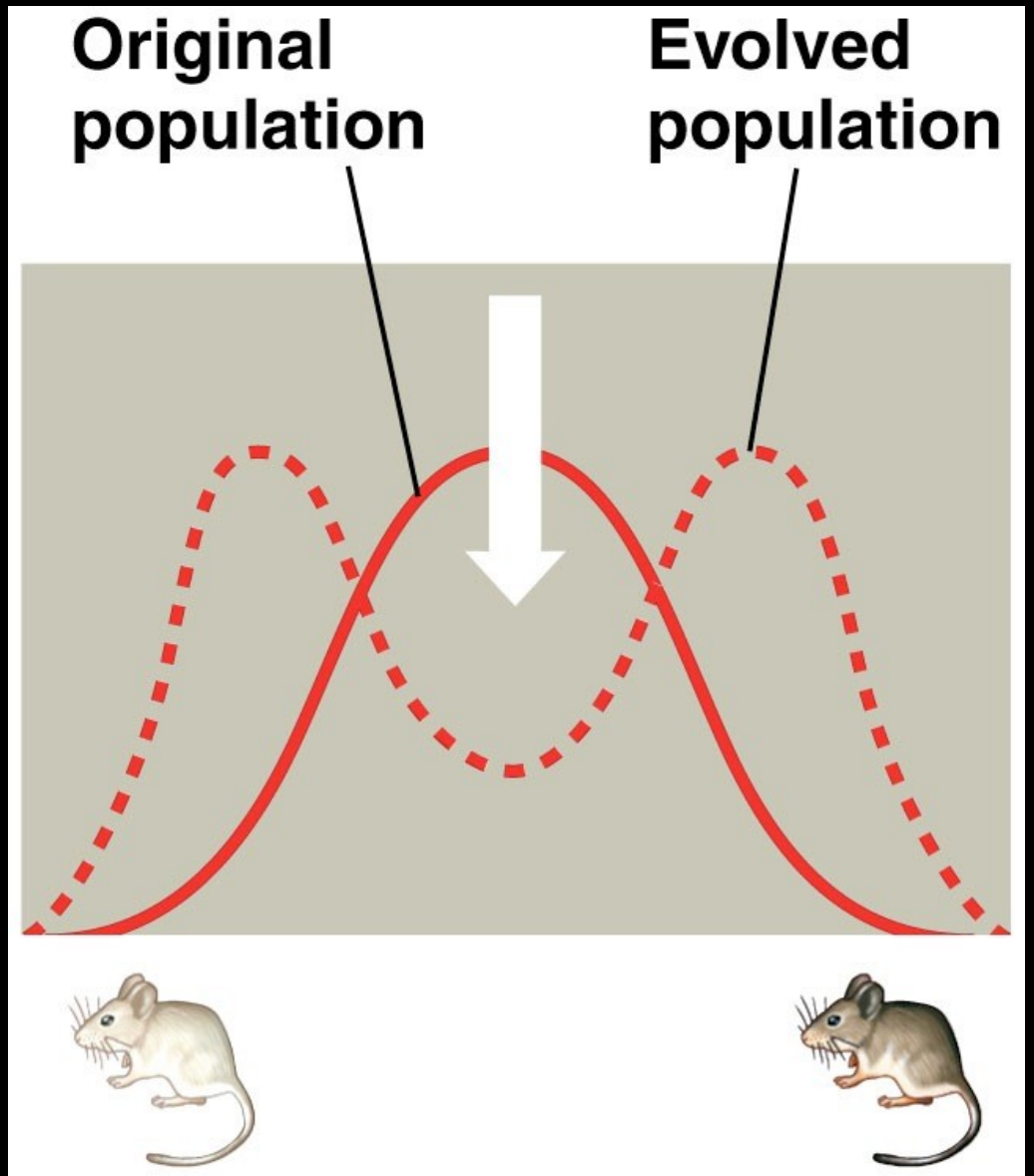

(b) Disruptive selection

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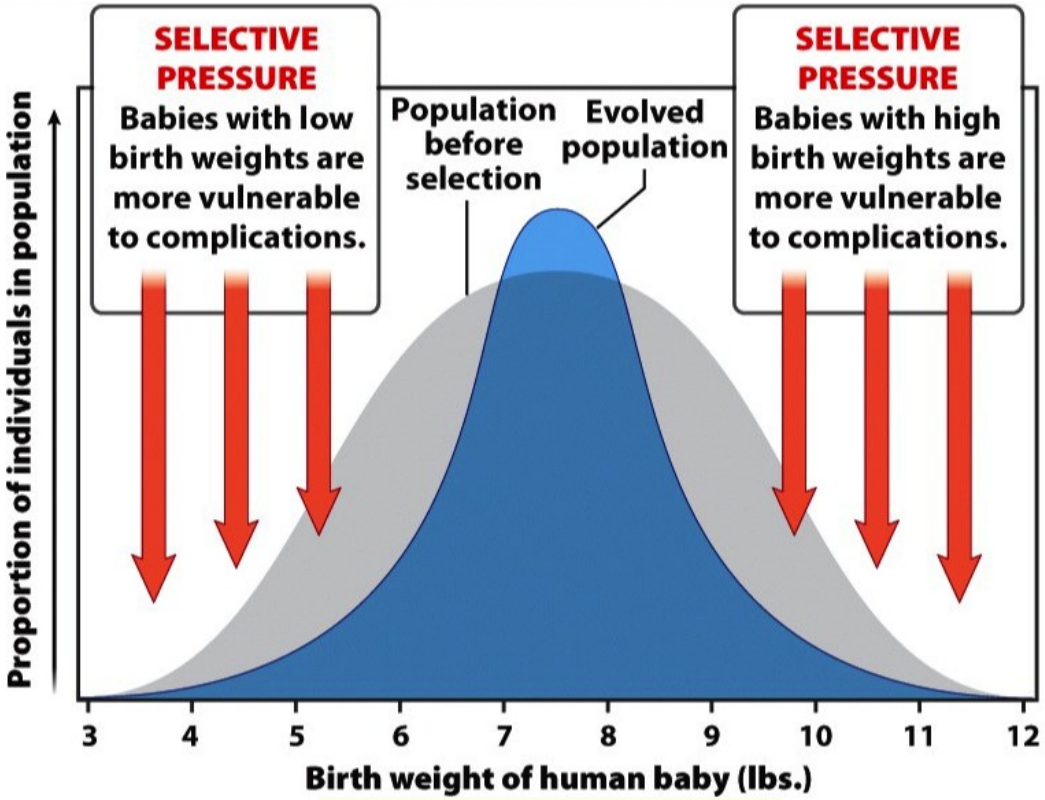
Example: Stabilizing Selection

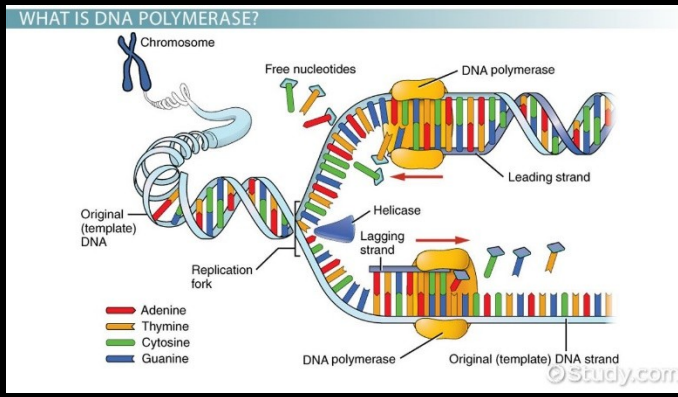


Mutation

- Mutations produce new variation
- Often caused by DNA polymerase* errors in DNA synthesis (or DNA repair)

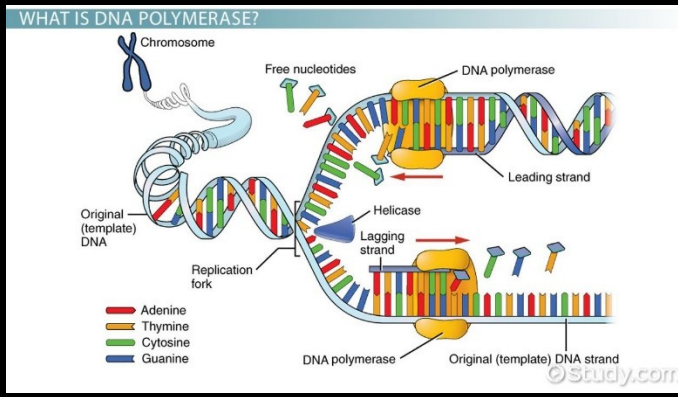
(*the enzyme that helps duplicate DNA)

- Mutations can be spontaneous errors or caused by mutagens



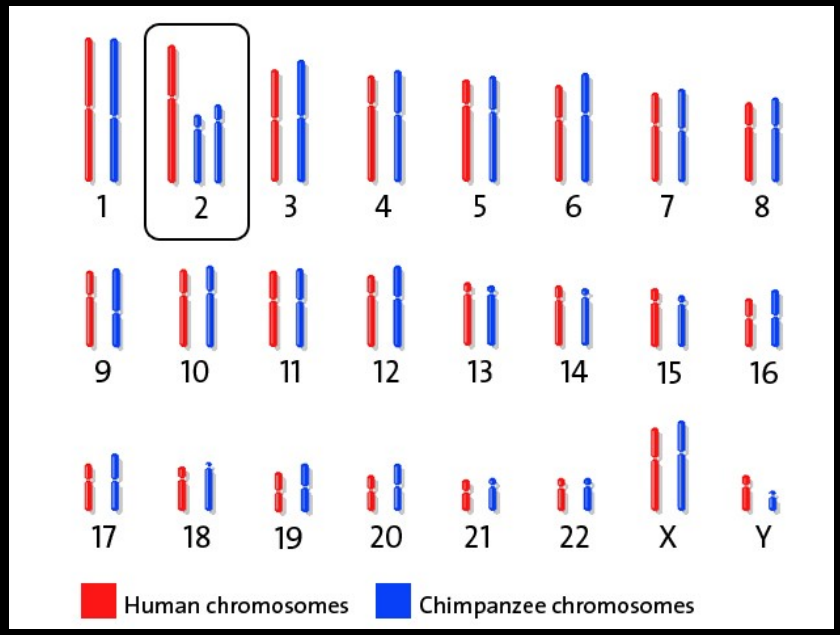
Kinds of mutations (a partial list)

- **Large scale**: large changes the number of chromosomes changes (e.g. chromosomes fused or cut in two)
- **Small scale**:, e.g. substitutions or insertions or deletions of single nucleotide pair (point mutations); or of more than one nucleotide pair

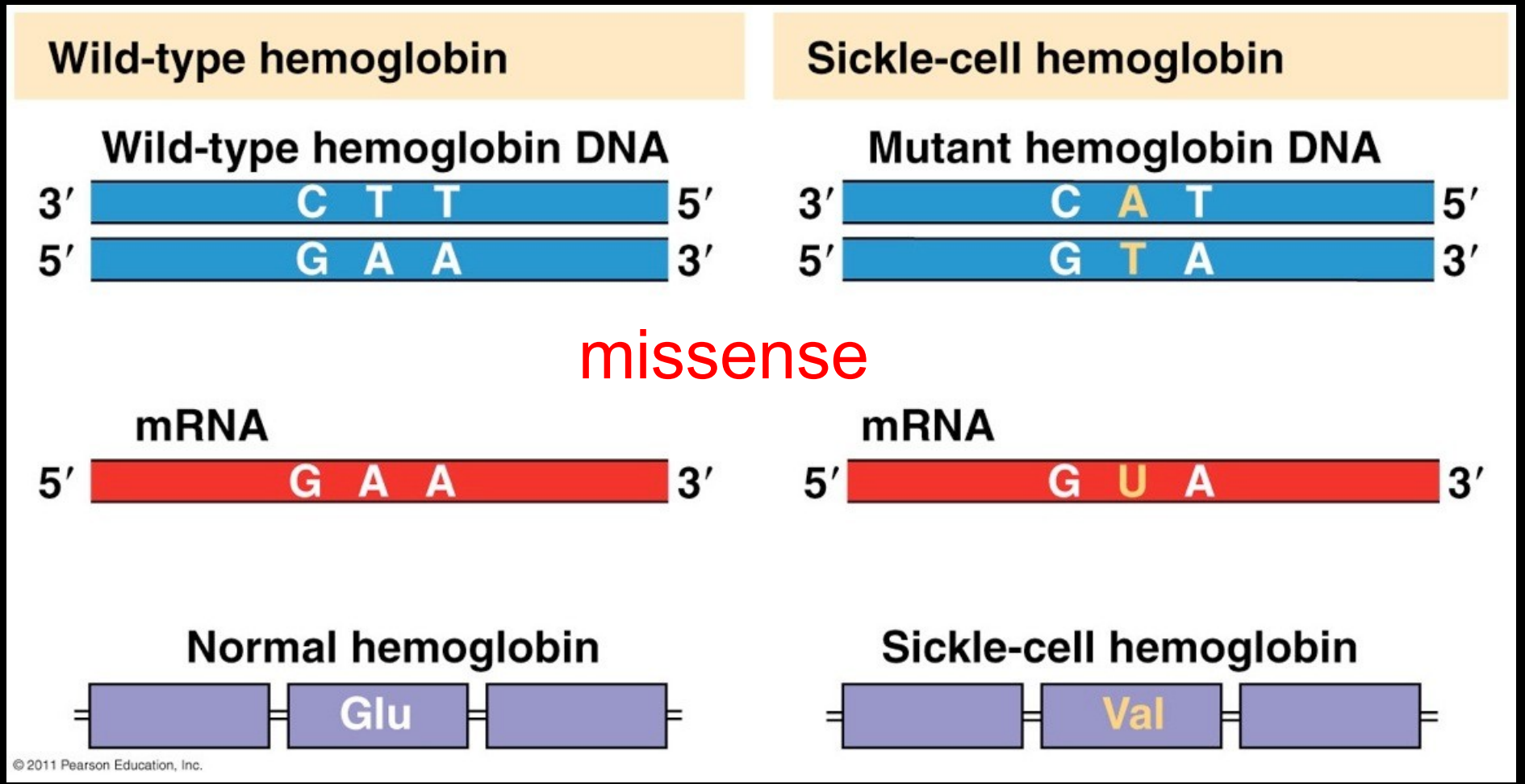


Large scale mutation

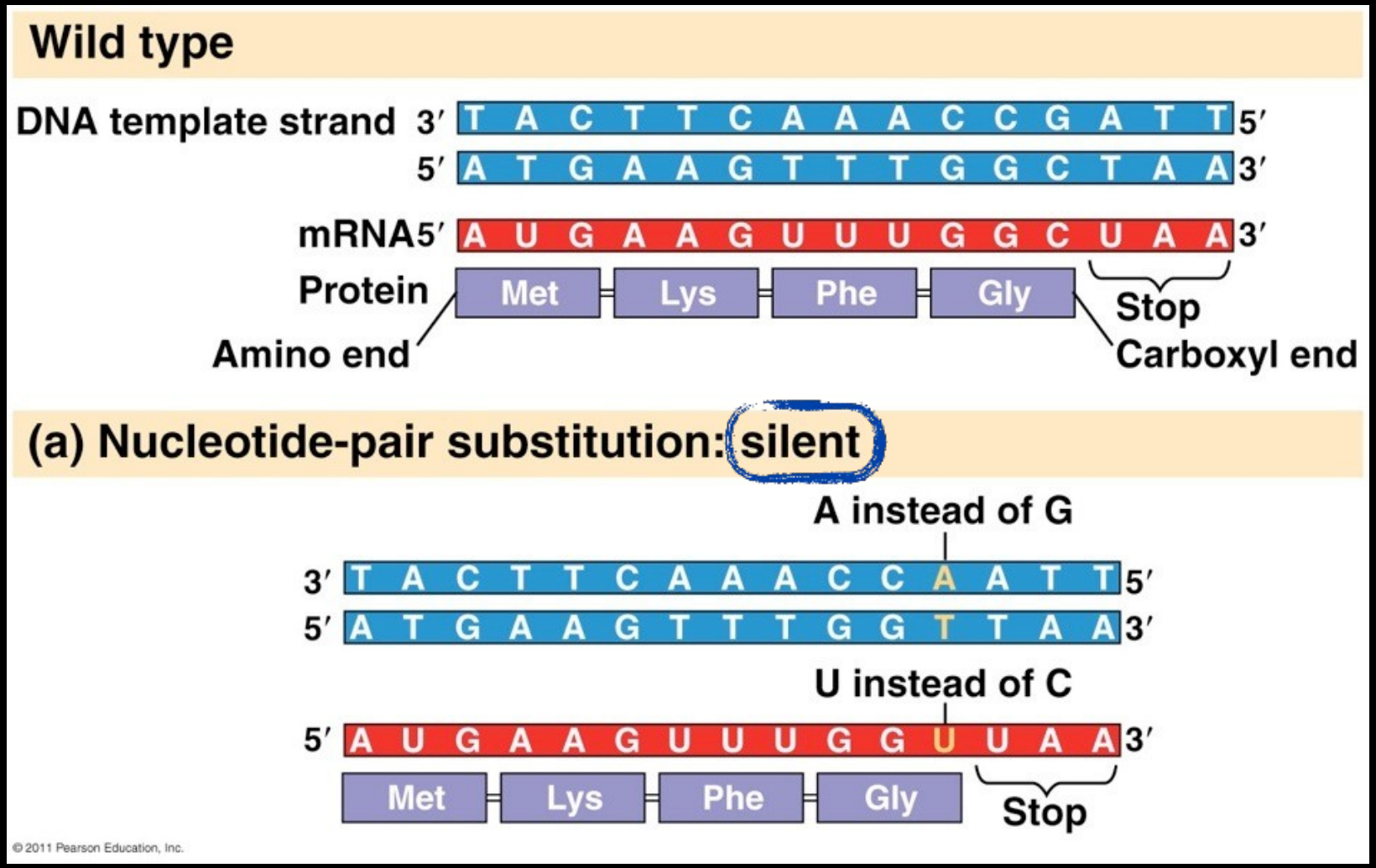
- **Large scale example: many apes (incl. chimpanzees) have 24 pairs of chromosomes, while humans have 23 pairs**
- **Genetic studies show that two chromosomes fused during the evolution of the genus *Homo* to form our Chromosome 2**



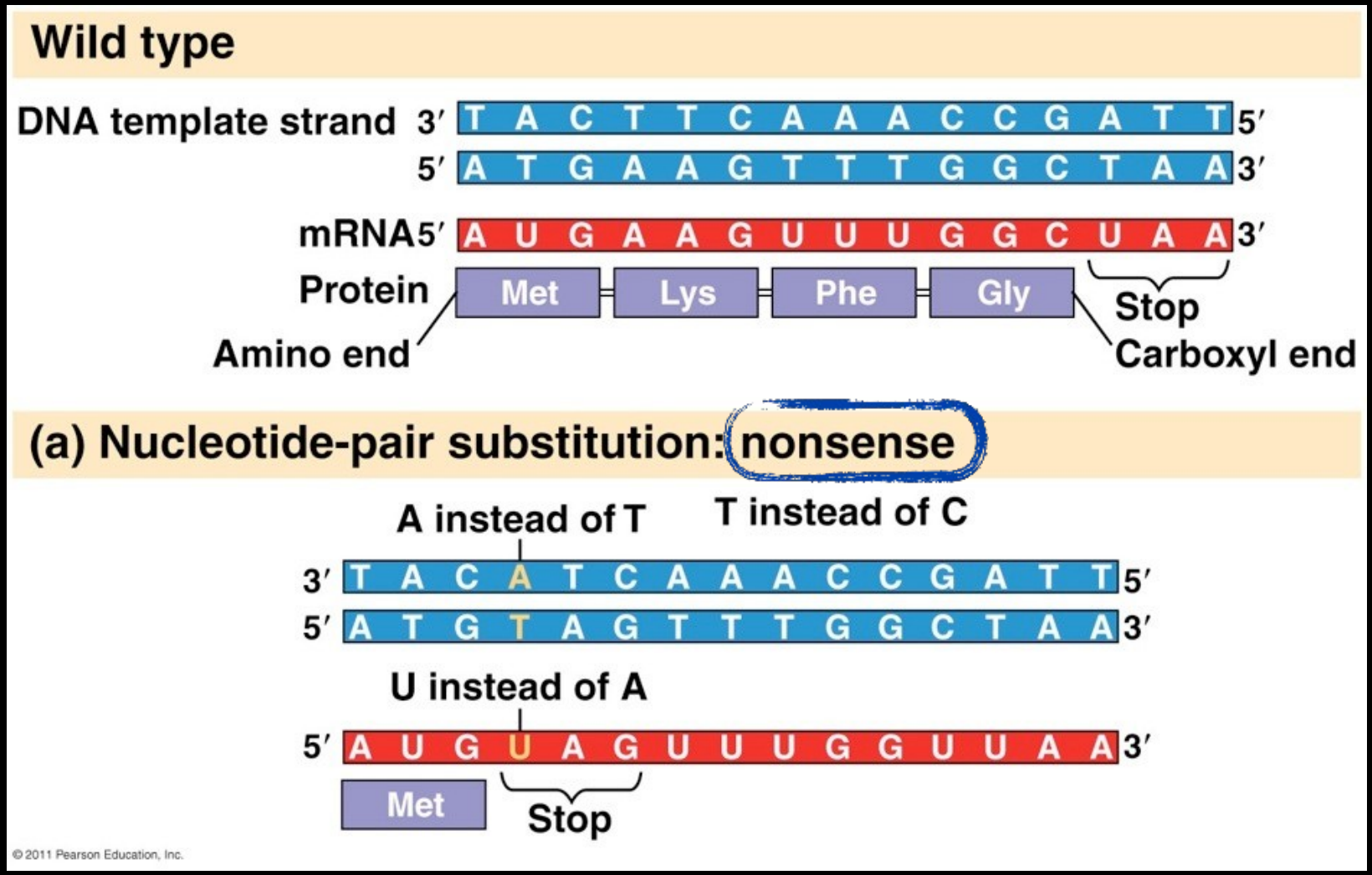
Small scale: Point mutations



Point mutations



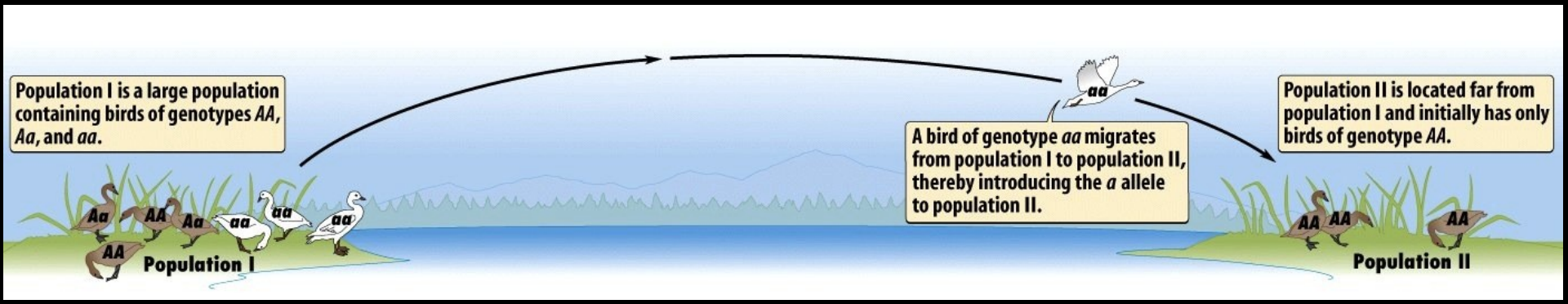
Point mutations



Point mutations (deletion, insertion) can also lead to frameshift (subsequent codon triplets shifted and all wrong)

Gene flow

- Consists of “flow” of alleles between populations due to movement of fertile individuals (or gametes, e.g. in pollen)
- Causes populations to have more similar gene pools (can benefit pop. , but also sometimes be maladaptive)



Genetic Drift

- Random changes in allele frequencies within populations which result from **chance** variation in individual survival and reproduction
- Most important in small populations
- Changes can be neutral, maladaptive, or adaptive

Examples:
-Bottleneck effect
-Founder effect

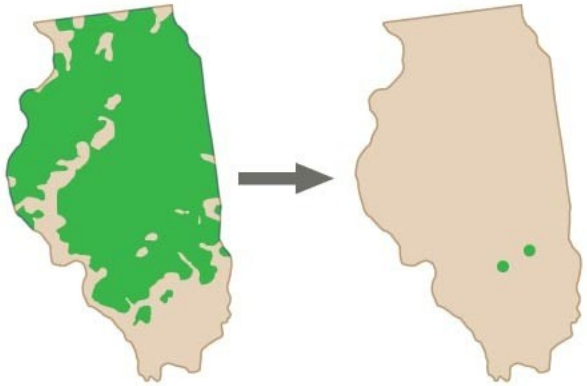
Genetic drift:
Bottleneck effect (happens at near-extinction events)

- Dramatic decrease of population size leaves only part of the genetic variation
- Example: Northern elephant seals

Greater prairie chicken

Pre-bottleneck (Illinois, 1820)

Post-bottleneck (Illinois, 1993)



Range of greater prairie chicken

(a)

Location	Population size	Number of alleles per locus	Percentage of eggs hatched
Illinois 1930–1960s 1993	 1,000–25,000 <50	 5.2 3.7	 93 <50
Kansas, 1998 (no bottleneck)	750,000	5.8	99
Nebraska, 1998 (no bottleneck)	75,000–200,000	5.8	96

(b)

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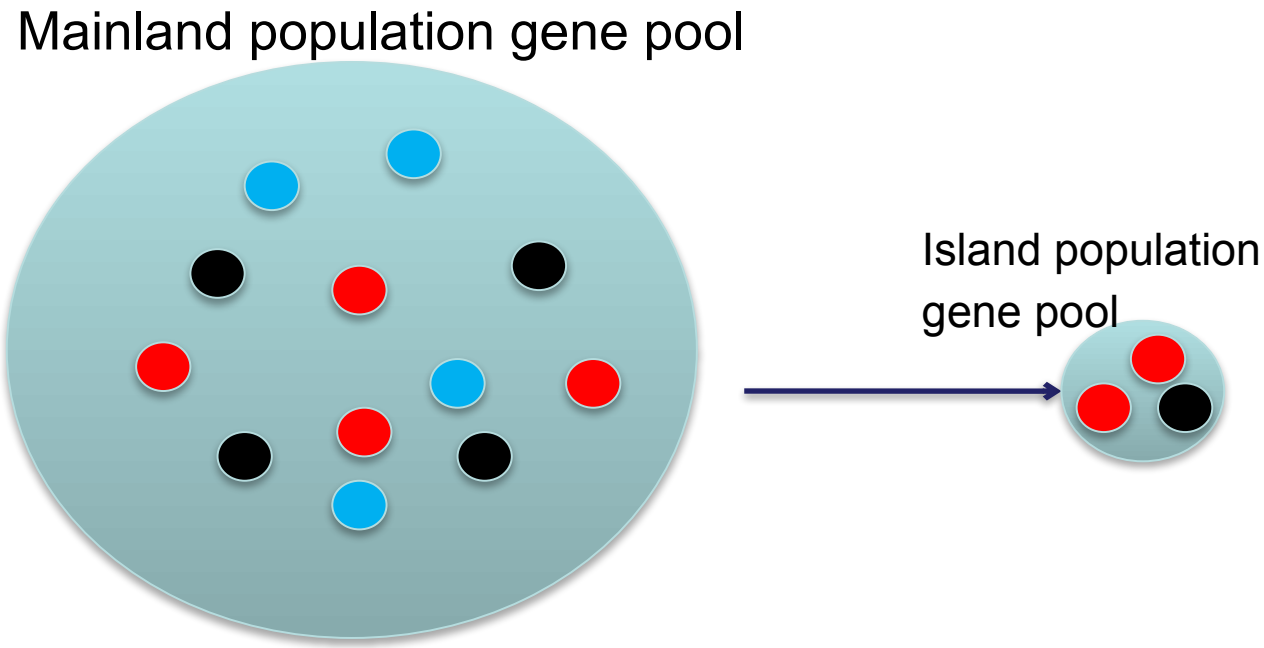
Genetic drift :
Founder effect (happens at dispersion events)

- Dispersion to small founder population can lead to random differences in allele frequencies



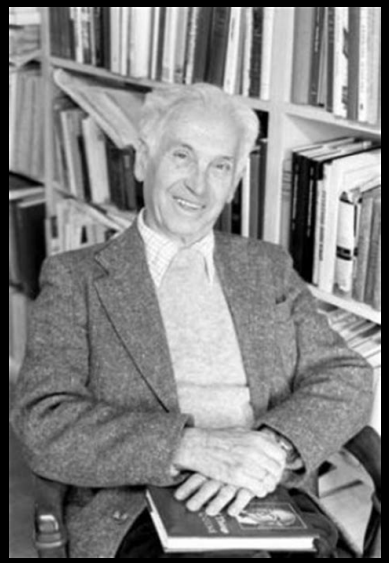
Genetic drift: Founder effect examples

- Amish – small founder population – EVC syndrome (Ellis Van Creveld); polydactyl, short-limb dwarfism
- Descendants of British colonizers of Tristan da Cunha – retinitis pigmentosa; blindness

The Modern Synthesis

- First half of the 20th century e.g. Ernst Mayr and Theodosius Dobzhansky
- Natural selection combined with genetics, particularly Mendel's inheritance laws (also DNA transcription, plus paleontology , speciation, and phylogenetics)

Dobzhansky 1900-1975



Mayr 1904-2005