

Topic 09 Evolution



I. Populations

A. Evolution is change over time

(change in the frequency of heritable phenotypes & the alleles that govern them)

I. Populations

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B. Populations are the units of evolution

I. Populations

A. Evolution is change over time

B. Populations are the units of evolution

Microevolution detected here

Allelic and phenotypic freq. change in pops.

Contrast with macroevolution

1. Speciation
2. Extinction
3. Transitions from water to land, etc.

II. Evolution

A. Forces of evolution

II. Evolution

A. Forces of evolution

1. Mutation

a. When & How:

- 1) Mitotic or meiotic DNA Replication errors*
- 2) Recombination errors (meiosis)*
- 3) Natural accidents or induction by mutagens*

II. Evolution

A. Forces of evolution

1. Mutation

a. When & How:

- 1) Mitotic or meiotic DNA Replication errors*
- 2) Recombination errors (meiosis)*
- 3) Natural accidents or induction by mutagens*

b. Types:

II. Evolution

A. Forces of evolution

1. Mutation

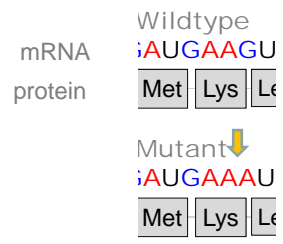
a. When & How:

- 1) Mitotic or meiotic DNA Replication errors*
- 2) Recombination errors (meiosis)*
- 3) Natural accidents or induction by mutagens*

b. Types:

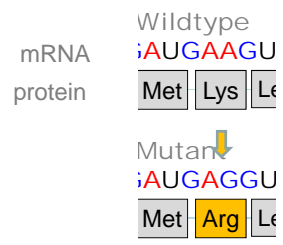
- 1) Based substitutions*
 - a.) Silent*
 - b.) Missense*
 - c.) Nonsense*

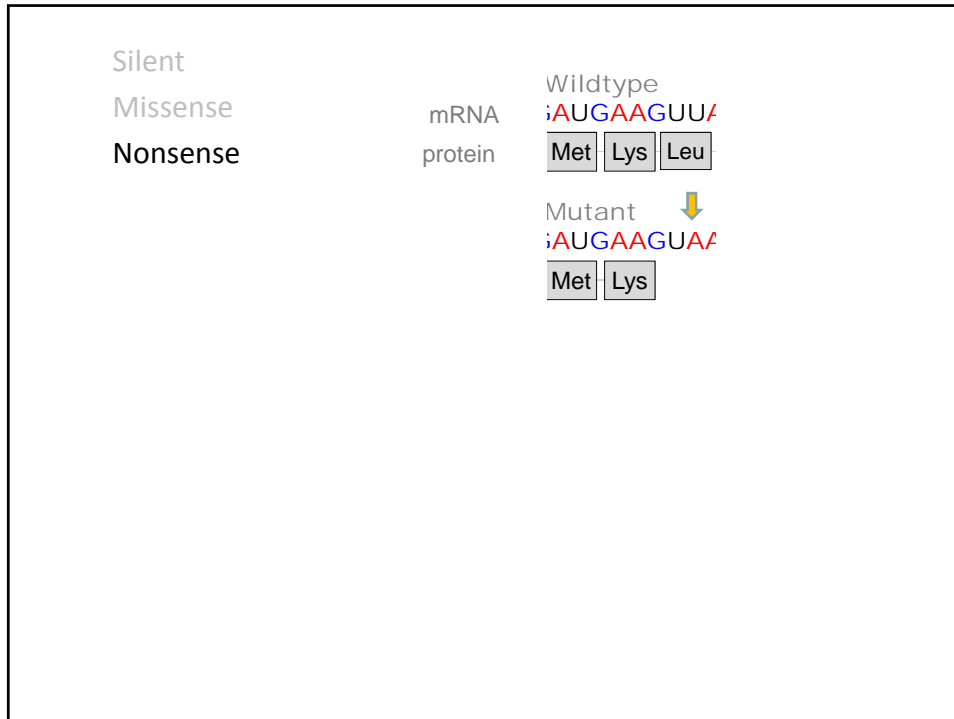
Silent



Silent

Missense





II. Evolution

A. Forces of evolution

1. Mutation

a. When & How:

- 1) Mitotic or meiotic DNA Replication errors
- 2) Recombination errors (meiosis)
- 3) Natural accidents or induction by mutagens

b. Types:

- 1) Based substitutions
 - a.) Silent
 - b.) Missense
 - c.) Nonsense
- 2) INDELS
 - a) Insertions
 - b) Deletions

Insertions

mRNA Wildtype
:AUGAAGUUA AUGGCAUGA

protein Met Lys Leu Met Ala

Mutant C inserted
:AUGAAGUUA ACUGGCAUG,

protein Met Lys Leu Thr Gly Met I

Deletions

mRNA Wildtype
:AUGAAGUUA AUGGCAUGA

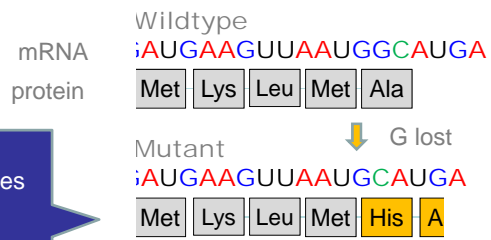
protein Met Lys Leu Met Ala

Mutant G lost
:AUGAAGUUA AUGCAUGA

protein Met Lys Leu Met His A

Deletions

-INDELS in protein coding genes shift the "reading frame"



II. Evolution

A. Forces of evolution

1. Mutation

a. When & How:

b. Types:

c. Effect:

Drosophila research:

70% deleterious

30% neutral or weakly advantageous

II. Evolution

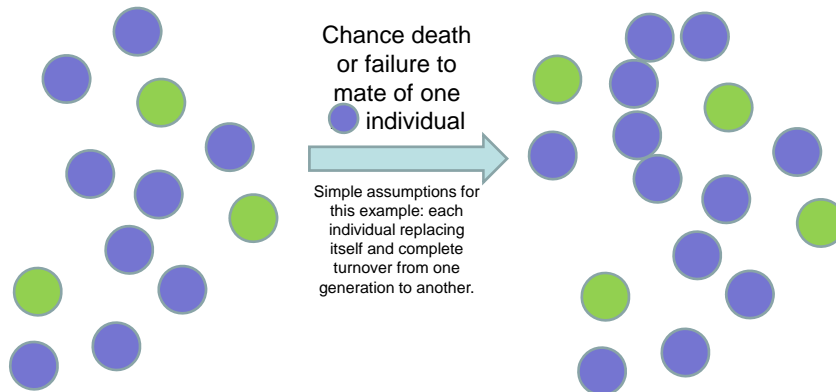
A. Forces of evolution

1. Mutation
2. Genetic drift

Chance-driven changes in trait frequencies.
Occurs more rapidly in small populations

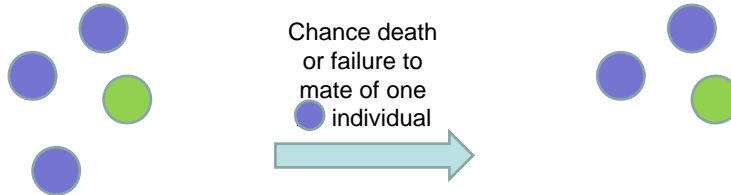
Scenario 1: Chance failure of an individual(s) of one phenotype to reproduce

Phenotype	Counts (Frequencies)	
	Gen 0	Gen 1
Purple	12 (0.75)	11 (0.73)
Green	4 (0.25)	4 (0.27)



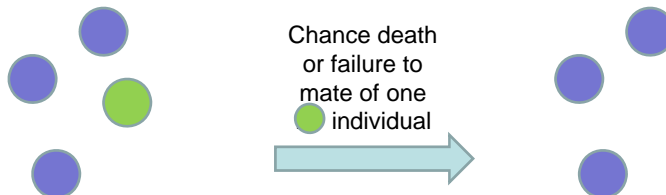
Scenario 1: Chance failure of an individual(s) of one phenotype to reproduce
Smaller Population

Phenotype	Counts (Frequencies)	
	Gen 0	Gen 1
Purple	3 (0.75)	2 (0.67)
Green	1 (0.25)	1 (0.33)



Scenario 1: Chance failure of an individual(s) of one phenotype to reproduce
Smaller Population

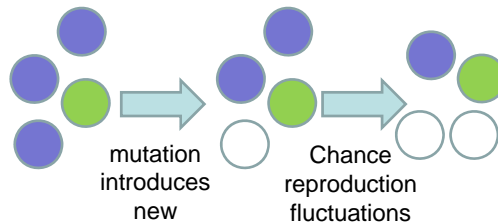
Phenotype	Counts (Frequencies)	
	Gen 0	Gen 1
Purple	3 (0.75)	3 (1.00)
Green	1 (0.25)	0 (0.00)



Scenario 2: Chance mutation followed by drift

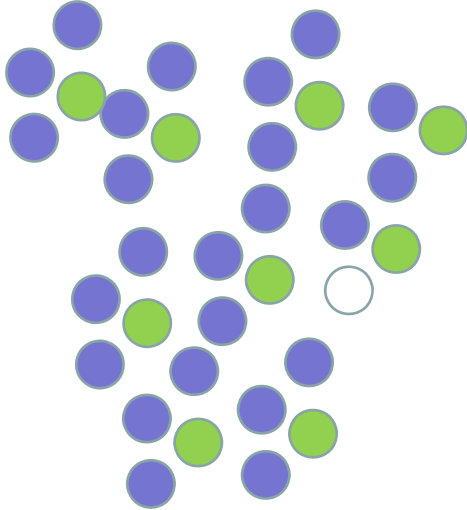
Scenario 2: Chance mutation followed by drift
Smaller Population

Phenotype	Counts (Frequencies)		
	Gen 0	Gen 1	Gen 2
Purple	3 (0.75)	2 (0.50)	1 (0.25)
Green	1 (0.25)	1 (0.25)	1 (0.25)
		*1 (0.25)	2 (0.5)



Scenario 2: Chance mutation followed by drift

Larger Population



II. Evolution

A. Forces of evolution

1. Mutation
2. Genetic Drift
3. Nonrandom Mating

-when prob. of one indiv. mating w/ another in pop. is not random.

II. Evolution

A. Forces of evolution

1. Mutation
2. Genetic Drift
3. Nonrandom Mating

a. At organismal level

e.g. assortative mating (a form of sexual selection)

e.g. breeding is geo-restricted

Inbreeding



outbreeding

II. Evolution

A. Forces of evolution

1. Mutation
2. Genetic Drift
3. Nonrandom Mating

b. w/ respect to individual traits

e.g. random w/ respect to handedness

e.g. likely non-random w/ respect to others
(sexual selection)

II. Evolution



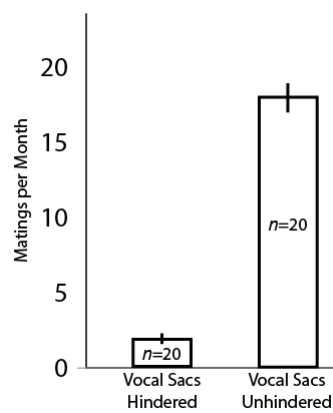
e.g. Male frog croaking

Force air through larynx,
but vocal sacs amplify.

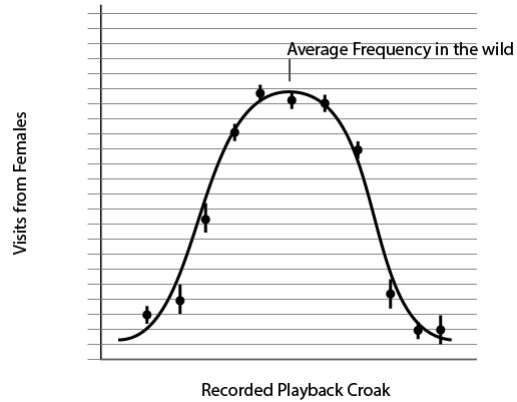
Species-specific
Which means its selected for.

II. Evolution

Experimental proof that croak volume is selected for



II. Evolution



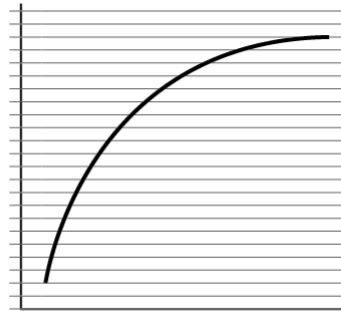
II. Evolution

Male peafowl (peacock) plumage
Displayed prominently during courtship

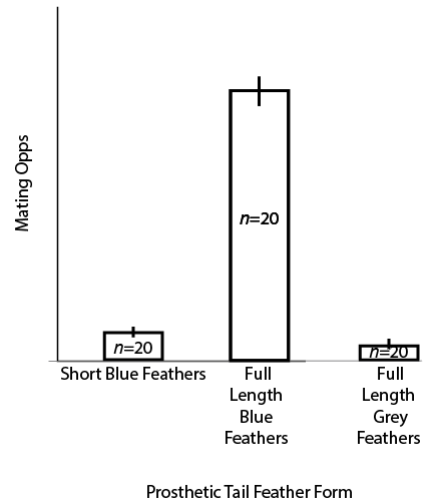
Fitness benefits
Attraction of peahens

Fitness Costs
Increase metabolic cost
Increased visibility & decreased flight speed
in relation to predators?

Mating
Opps



II. Evolution



Artificial selection (selective breeding) is human-induced non-random mating

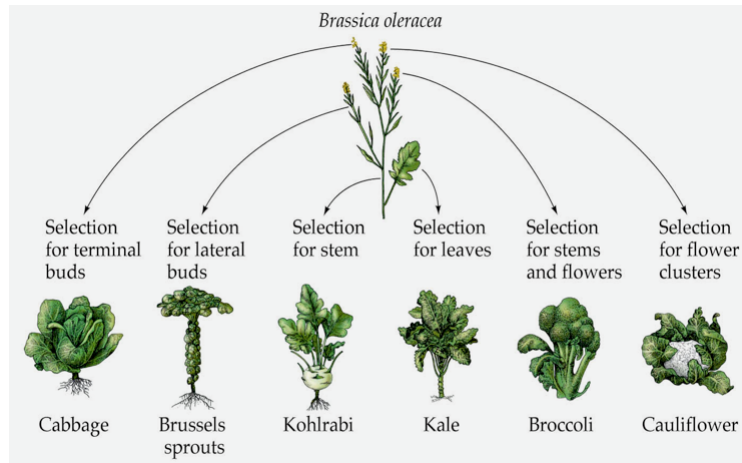


Canis lupus



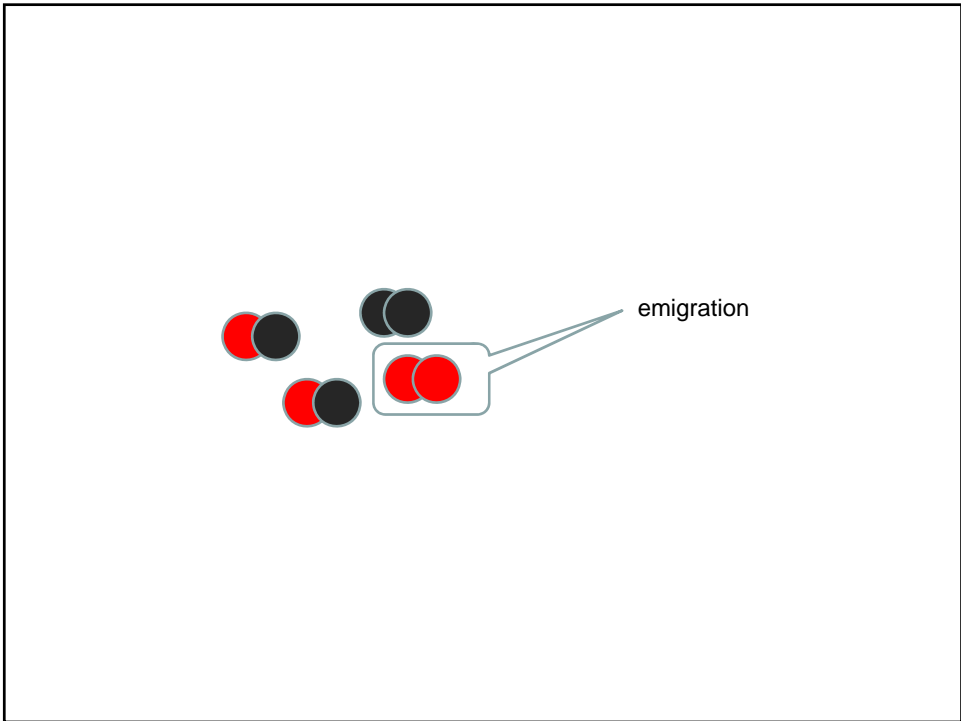
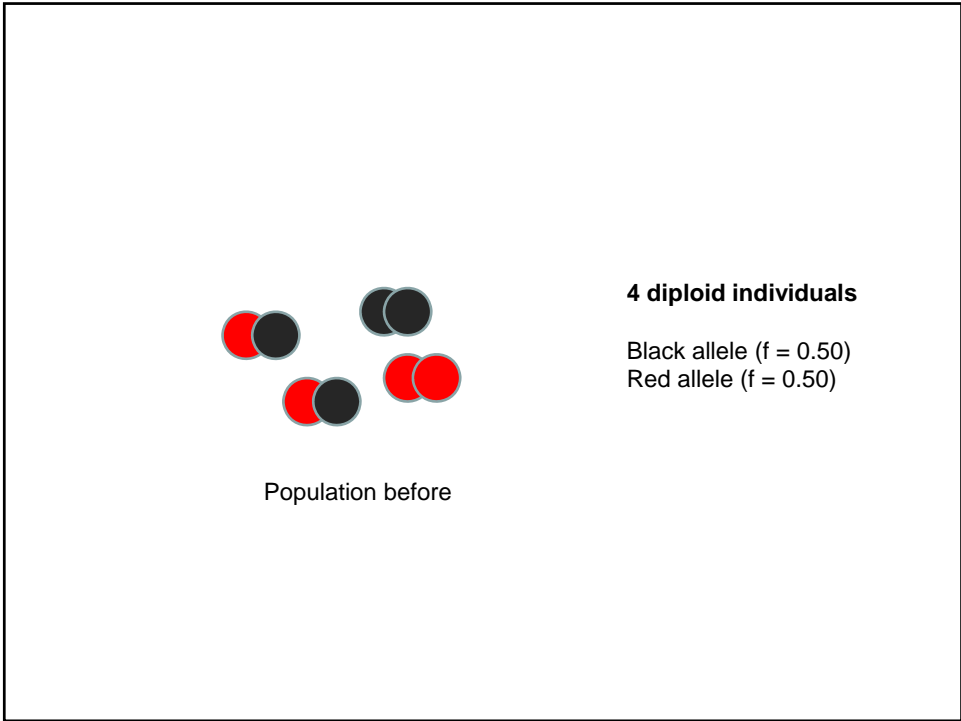
Canis lupus ssp. familiaris

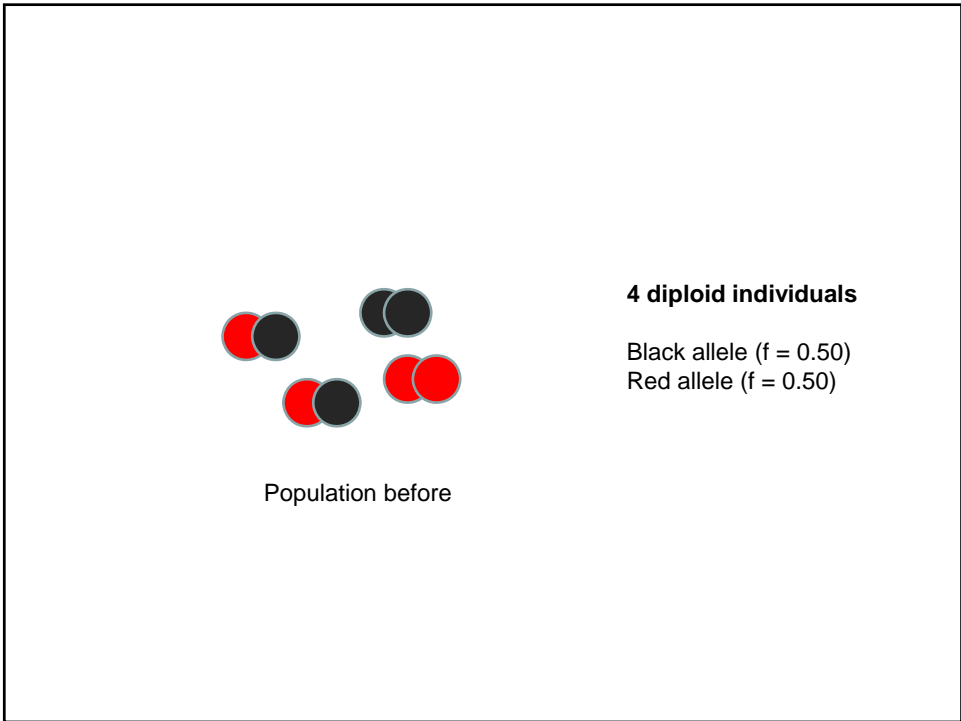
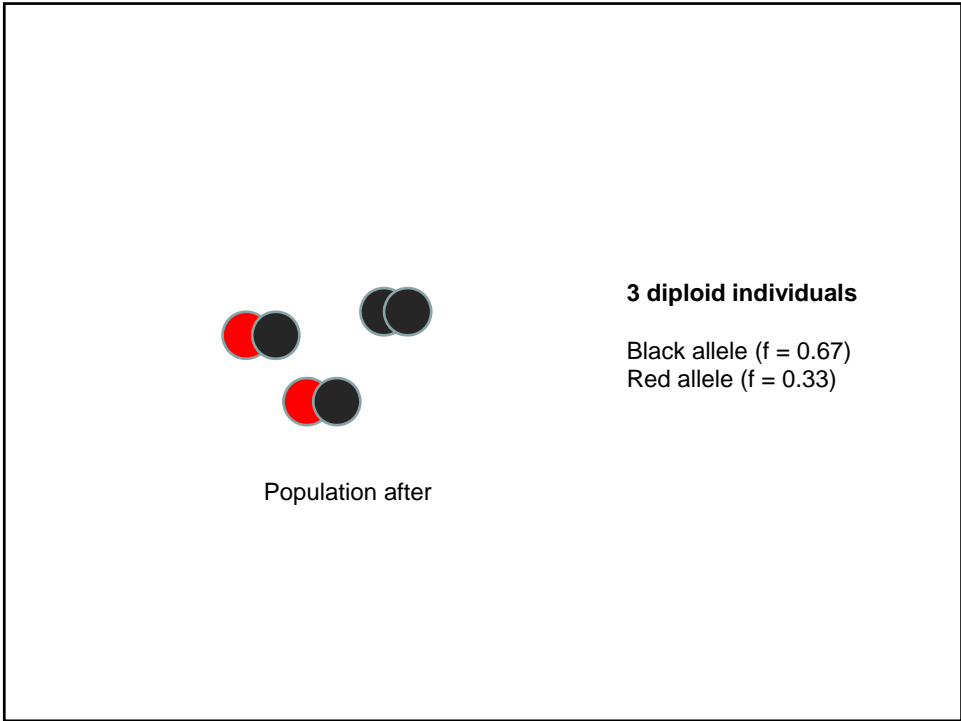
Artificial selection (selective breeding) is human-induced non-random mating

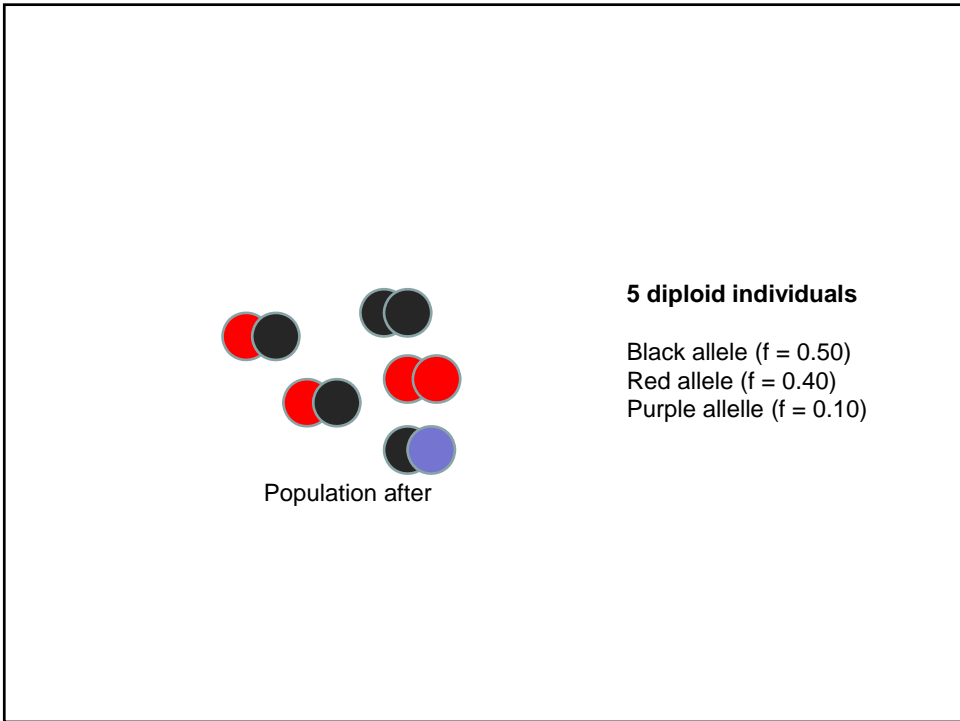
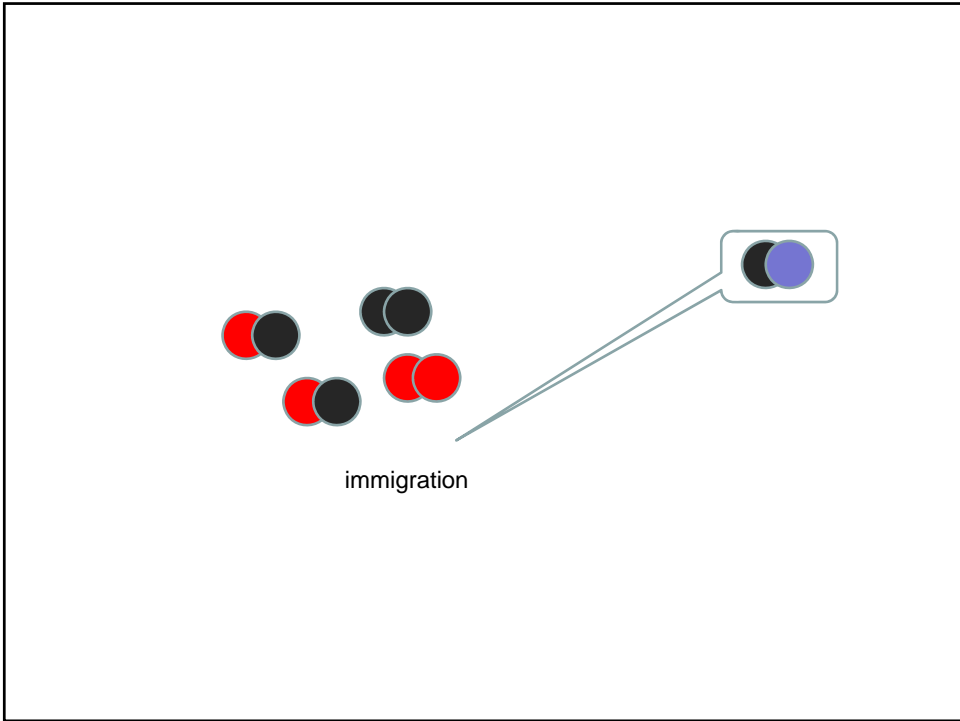


II. Evolution

- A. Forces of evolution
 1. Mutation
 2. Genetic Drift
 3. Nonrandom mating
 4. Migration (gene flow)





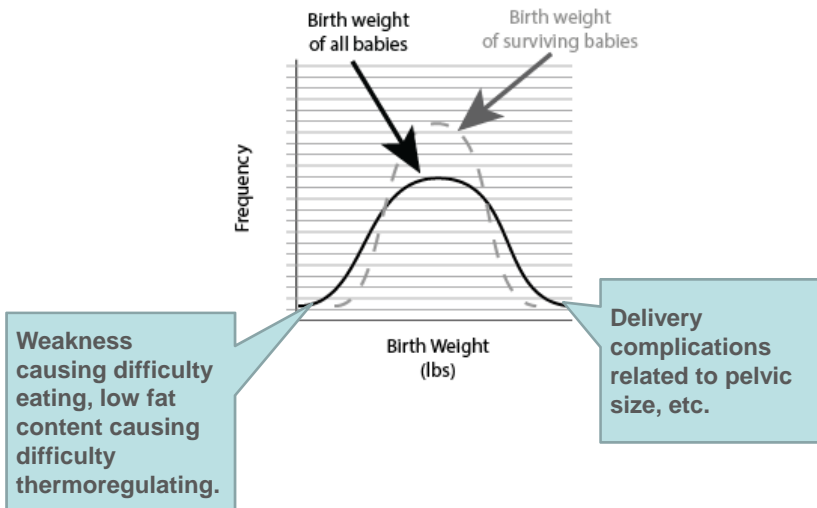


II. Evolution

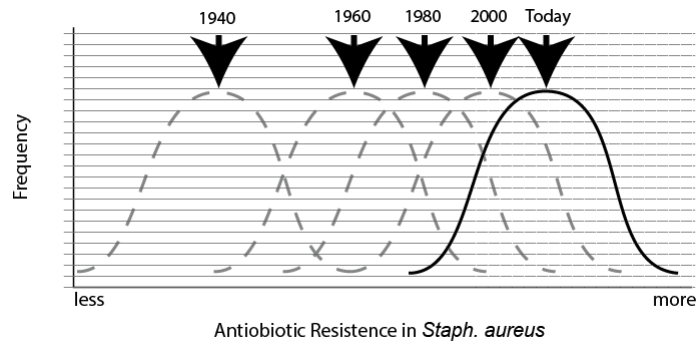
- A. Forces of evolution
 - 1. Mutation
 - 2. Genetic drift
 - 3. Nonrandom mating
 - 4. Migration
 - 5. Natural selection (differential “fitness” based on phenotype)

- a. Types of natural selection:
 - 1) Stabilizing, 2) Directional

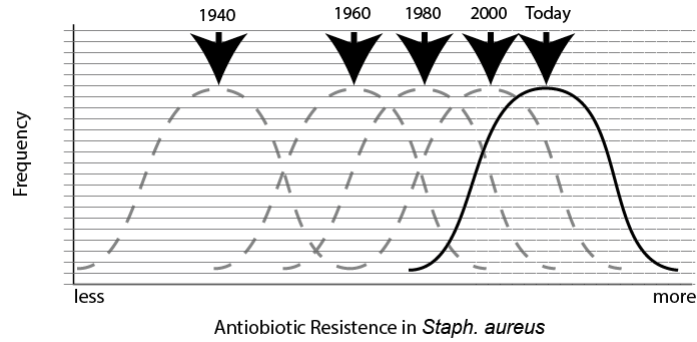
Stabilizing Selection in Humans



Directional Selection in *Staphylococcus aureus*



Directional Selection in *Staphylococcus aureus*



Two Primary Forces of Evolution Here

1. Mutation introduces variation in resistance among *S. aureus*.
2. Natural selection (selective agent: antibiotics)

Directional Selection in *Staphylococcus aureus*

