Topic 09
Evolution

I. Populations

A. Evolution is change over time

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

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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. Macroevolutionary phenomena include:
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

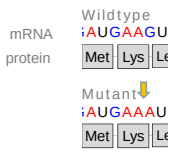
II. Evolution

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

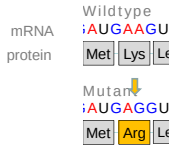
A. Forces of evolution
   1. Mutation
      a. When & How:
         1) Mitotic or meiotic DNA Replication errors
         2) Recombination errors (meiosis)
         3) Natural accidents or induction by mutagens
      b. Types:
         1) Base substitutions.
         In protein-coding genes, such mutations can be
            a.) Silent mutations
            b.) Missense mutations
            c.) Nonsense mutations

Silent



Silent

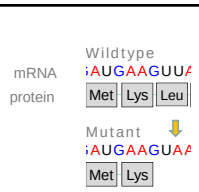
Missense



Silent

Missense

Nonsense



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) Base substitutions

a.) Silent

b.) Missense

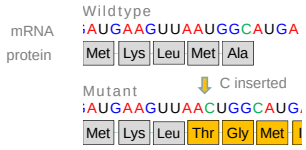
c.) Nonsense

2) INDELS

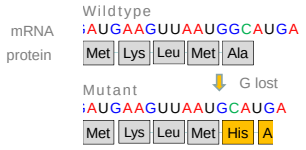
a) Insertions

b) Deletions

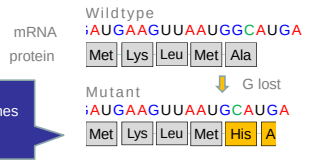
Insertions



Deletions



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

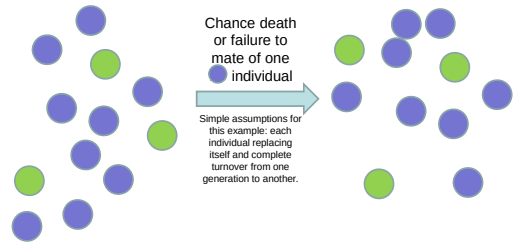
II. Evolution

A. Forces of evolution
   1. Mutation
   2. Genetic drift

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

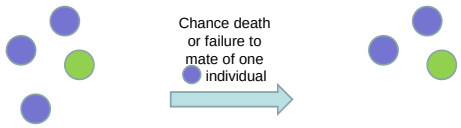
Scenario 1: Chance failure of an individual(s) of one phenotype to reproduce

	Counts (Frequencies)	
Phenotype	Gen 0	Gen 1
Purple	9 (0.75)	8 (0.73)
Green	3 (0.25)	3 (0.27)



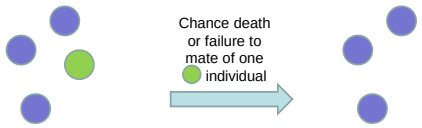
Scenario 1: Chance failure of an individual(s) of one phenotype to reproduce
Smaller Population

	Counts (Frequencies)	
Phenotype	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

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

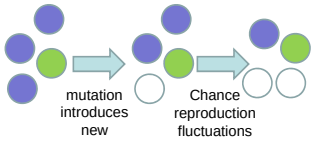


Scenario 2: Chance mutation followed by drift

Scenario 2: Chance mutation followed by drift

Smaller Population

	Counts (Frequencies)		
Phenotype	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)
White		*1 (0.25)	2 (0.5)

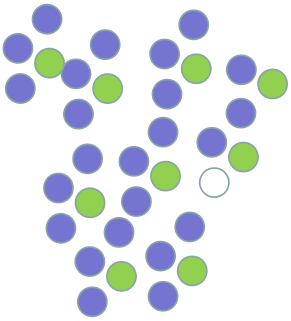


mutation introduces new

Chance reproduction fluctuations

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. geographical proximity has big influence on mating

II. Evolution

A. Forces of evolution
   1. Mutation
   2. Genetic Drift
   3. Nonrandom Mating

      b. w/ respect to individual traits
         e.g. in humans, mating may be random w/ respect to handedness
         But likely non-random w/ respect to others (this is called sexual selection)

II. Evolution

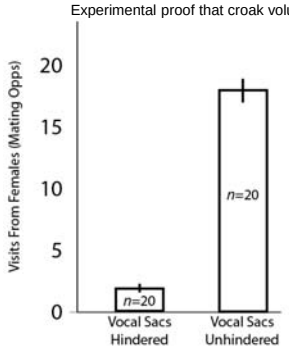
e.g. Male frog croaking

Force air through larynx,
but vocal sacs amplify.

Species-specific
Which means its selected for.

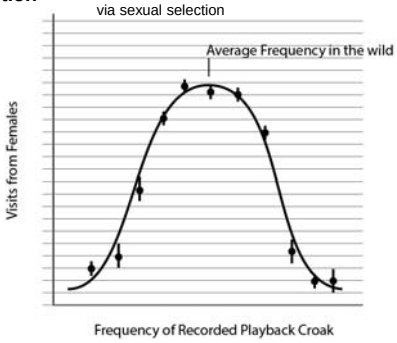
II. Evolution

Experimental proof that croak volume is selected for



II. Evolution

Experimental proof that the sound of a croak is maintained via sexual selection



II. Evolution

Male peafowl (peacock) plumage
Displayed prominently during courtship

Fitness benefits
Attraction of peahens

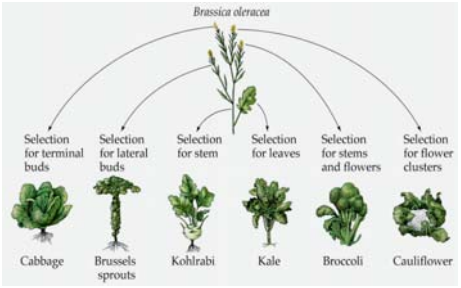
Fitness Costs
Increase metabolic cost
Increased visibility & decreased flight speed in relation to predators?

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)

4. Migration
Scenario 1

aa

Aa

AA

Aa

Population of 4 individuals before

f(A) = 0.50
f(a) = 0.50

4. Migration
Scenario 1

aa

Aa

emigration

AA

Aa

Population of 4 individuals before

f(A) = 0.50
f(a) = 0.50

4. Migration
Scenario 1

aa

Aa

Aa

Population before

f(A) = 0.50
f(a) = 0.50

Population after

f(A) = 0.33
f(a) = 0.67

4. Migration
Scenario 2

aa

Aa

AA

Aa

Population before
f(A) = 0.50
f(a) = 0.50

4. Migration
Scenario 2

aa

Aa

AA

Aa

AA

immigration

Population before
f(A) = 0.50
f(a) = 0.50

4. Migration
Scenario 2

aa

Aa

AA

Aa AA

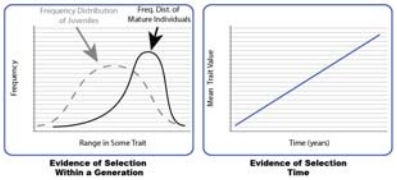
Population before
f(A) = 0.50
f(a) = 0.50

Population after
f(A) = 0.60
f(a) = 0.40

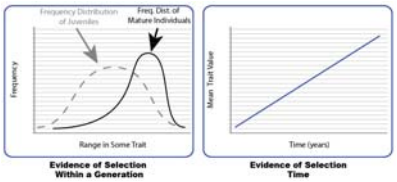
II. Evolution

A. Forces of evolution
   1. Mutation
   2. Genetic drift
   3. Nonrandom mating
   4. Migration
   5. Natural selection (differential "fitness" of organisms based on their heritable traits)

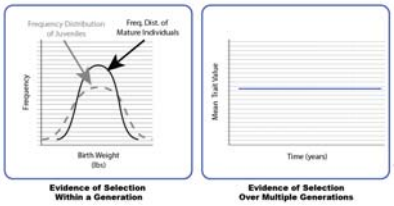
a. Directional Selection

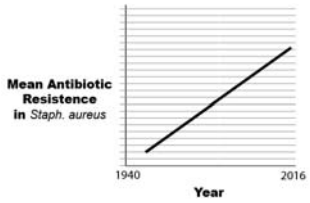


a. Directional Selection

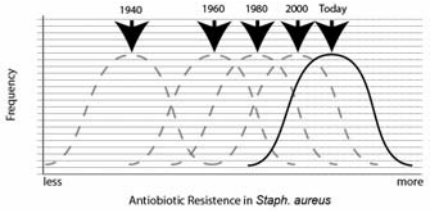


b. Stabilizing Selection



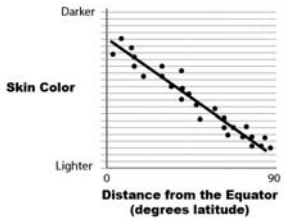


Directional or Stabilizing?

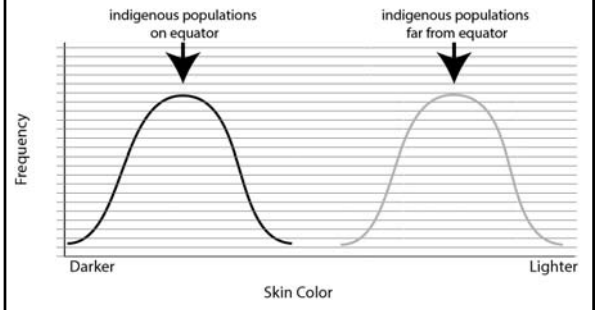


To elements involved here:

1. Prexisting variation and new variation in resistance via mutation
2. Natural selection (selective agent: antibiotics)



Is this the result of directional or stabilizing?



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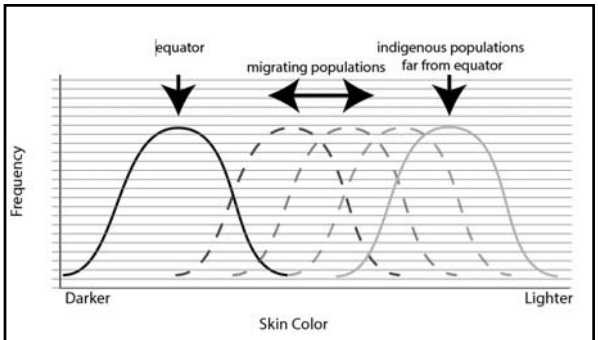

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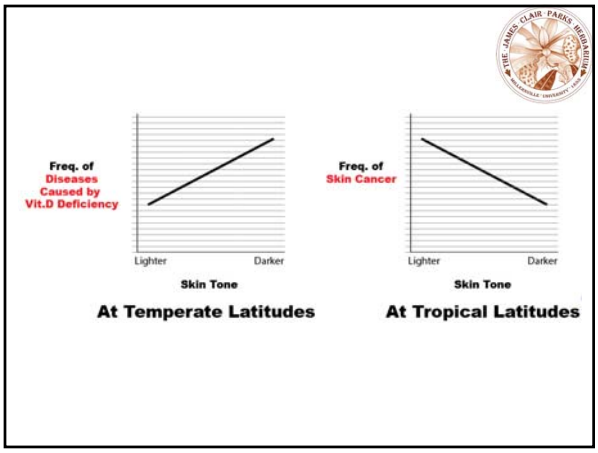

II. Evolution

A. Forces of evolution
   1. Mutation
   2. Genetic drift
   3. Nonrandom mating
   4. Migration
   5. Natural selection (differential "fitness" based on phenotype)
      a. Directional Selection
      b. Stabilizing Selection

Stabilizing Selection in Humans