NATURAL SELECTION REMINDER

- individuals DO NOT evolve

-it acts on individuals but the evolutionary impact of evolution is only seen in a population of organisms over time!

GENETIC VARIATION

-individual variation occurs in al species and often reflects **genetic variation**, differences among individuals in the composition of their genes or other DNA segments

- not all phenotypic variation is heritable. Phenotype is the prodcut of an inherited genotype and environmental influences. Only the genetic component of variation has evolutionary consequences

- genetic variation provides the raw material for evolutionary change, without genetic variation, **evolution** cannot occur

HOW DO WE MEASURE CHANGE?

population

-localized group of individuals that belong to the same species

species

a group of populations who have the ability to interbreed and produce fertile offspring in nature

gene pool

a collection of alleles within the population

allele frequency

how common is that allele with the population	think: A vs a

CONDITIONS FOR H-W EQUILIBRIUM

1. No mutations
2. Random mating
3. No natural selection
4. Extremely large population size
5. No gene flow

GENETIC DRIFT

- chance events that cause allele frequencies to fluctuate unpredictably from one generation to the next especially in small populations

- 2 ways genetic drift can occur in small populations:

1. Founder Effect
2. Bottleneck Effect

GENE FLOW

the transfer of alleles into and out of a population due to the movement of fertile individuals or their gametes

- tends to reduce differences between populations

MODES OF NATURAL SELECTION

directional selection

favors one extreme

disruptive selection

favors the 2 extremes and not the middle

stabilizing selection

favors the middle

HETEROZYGOTE ADVANTAGE

occurs when the heterozygote genotype has a higher relative fitness than either the homozygous dominant or recessive genotype

EXAMPLE: Malaria and Sickle Cell

Homozygous dominant (normal)- die of malaria (HbHb)

Homozygous recessive- die of sickle cell anemia (HsHs)

Heterozygote Carriers (HbHs)- relatively free of malaria sick cell anemia. They survive more, therefore are more common in the population

MICROEVOLUTION

the smallest scale we can define evolution occurs as changes in allele frequencies in a population over time

- **allele:** the different versions of the SAME GENE

VARIATION WITHIN A POPULATION

discrete characters

classified on an either-or basis

usually determined by a single gene locus

VARIATION WITHIN A POPULATION

quantitative characters

most traits vary along a continuum within a population

usually result from the influence of 2+ genes on a single trait

VARIATION WITHIN A POPULATION

population geneticists measure genetic variation in a population by determining the amount of **heterozygosity** at the gene level and the molecular level of DNA **(nucleotide variability)**

HARDY-WEINBERG PRINCIPLE

- describes the gene pool of a population that is not evolving

- states that the frequencies of alleles and genotypes in a population will remain constant from generation to generation as long as **ONLY** Mendelian segregation and recombination of alleles are at work

MUTATIONS, AND MATING

- although new mutations can modify allele frequencies, because mutations are rare, the change from generation to generation is very small

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MUTATIONS, AND MATING (cont)

- mutation can ultimately have a large effect on allele frequencies when it produces new alleles that strongly influence fitness in a positive or negative way

- *nonrandom mating* can affect the frequencies of homozygous and heterozygous genotypes, but it usually has no effect on allele frequencies in the gene pool

GENETIC DRIFT - 4 KEY POINTS

1. significant in small populations

2. causes allele frequencies to change at random

3. leads to a loss of genetic variation within populations

4. can cause harmful alleles to become fixed

ADAPTIVE EVOLUTION

natural selection consistently increases the frequencies of alleles that provide reproductive advantage and thus leads to adaptive evolution!!

-although we may refer to the relative fitness of a genotype, the entity that is subjected to natural selection is the whole organism, not the underlying genotype

-natural selection acts on the genotype indirectly, via how the genotype affects the phenotype

CREATING A PERFECT ORGANISM

Natural Selection cannot create a perfect organisms because...

1. selection can act only on existing variation

2. evolution is limited by historical constraints

3. adaptations are often compromises

4. chance, natural selection, and the environment interact

3 MAIN CAUSES OF ALLELE FREQUENCY CHANGES

1. Natural Selection

2. Genetic Drift	chance events that alter allele frequencies
3. Gene Flow	the transfer of alleles between populations

SOURCES OF GENETIC VARIATION

- **mutations**

- a change in the nucleotide sequence of an organisms DNA

* some mutations can alter gene number or position

= deletions

= duplications

=translocations

=inversions

SOURCES OF GENETIC VARIATION

sexual reproduction

- through the process of sexual reproduction we are mixing up the genes (DNA) of 2 parents to create 1 offspring with a mixture of the parental traits

H-W EQUILIBRIUM EQUATIONS

- useful in determining how fast a population is changing

-based on a simple Punnett square where **p** is the frequency of the **dominant allele** and **q** is the frequency of the **recessive allele**

-frequency of dominant and recessive alleles MUST equal 1 (100%)

$p + q = 1$

frequency of the genotypes must equal 1 (100%)

$p2 + 2pq + q2 = 1$

SEXUAL SELECTION

Charles Darwin was the first scientist to investigate sexual selections, which is selection for mating success

-sexual dimorphism

differences in secondary sex characteristics

-intrasexual selection

competition among individuals of one sex for mates of the opposite sex

-intersexual selection

mate choice- one sex is choosy in selecting mates from the other sex

NATURAL SELECTION

-based on differential survival and reproductive success

-individuals in a population vary in their heritable traits

-individuals with variations better suited to the environment tend to produce more offspring than those with variations that are less well suited

-as a result of selection, alleles are passed on to the next generation in frequencies different from their relative frequencies in the present population

-by consistently favoring some alleles over others, natural selection can cause ***adaptive evolution*** (evolution that results in a better match between organisms and their environment)