Today's Plan:

Unit 2: Cell Structure & Function

Topic 2.11: Origin of Cell Compartmentalization

Unit 5: Heredity

Topic 5.3: Mendelian Genetics

Unit 8: Ecology

Topic 8.7: Disruptions to Ecosystems

Unit 7: Natural Selection

Topic 7.1: Introduction to Natural Selection

Topic 7.2: Natural Selection

Topic 7.3: Artificial Selection

Topic 7.4: Population Genetics

Topic 7.5: Hardy-Weinberg Equilibrium

Topic 7.6: Evidence of Evolution

Topic 7.7: Common Ancestry

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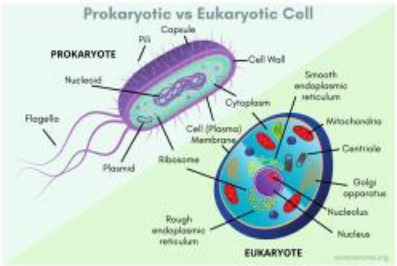
Marco Learning
AP Bio Insta-Review

MARCO LEARNING

Prokaryote

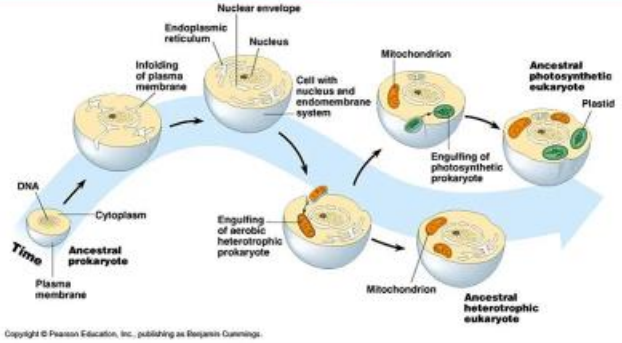
- NO membrane bound organelles
- ribosomes, plasma membrane, nucleoid
- DNA: single, circular, & lacks histones and introns



Eukaryote

- membrane bound organelles (nucleus, Golgi, ER, peroxisomes, mitochondria, etc.)
- DNA: multiple, linear, & has histones and introns

2.11: Origin of Cell Compartmentalization



Evidence of Endosymbiotic Theory

Mitochondria & Chloroplast:

- contain own circular DNA lacking histones
- can self-replicate
- ribosomes similar to prokaryotic ribosomes
- inner membrane similar to prokaryotic membrane
- perform transcription & translation
- approximately size of prokaryotes
- use prokaryote-like enzymes

Genetic Information Carriers

- All organisms have DNA/RNA
- DNA/RNA composed of pentose sugar, nitrogenous base, & phosphate

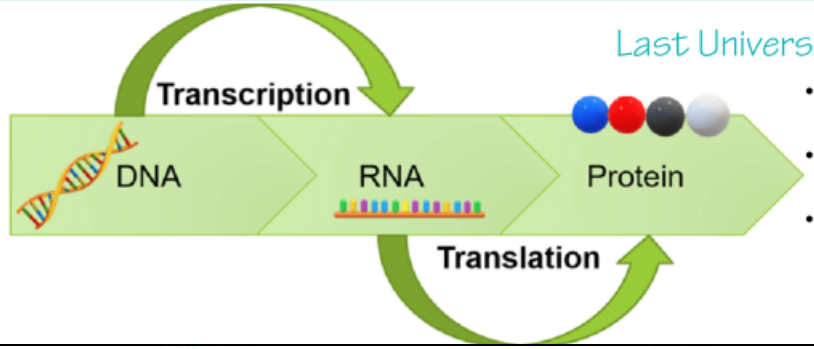
Genetic Code

- All organisms have ribosomes
- Genetic code is shared among organisms

Metabolic Pathways

- Core metabolic pathways conserved among domains
- Ex: glycolysis, creating/using carbohydrates, synthesizing phospholipids for cell membranes

5.3: Mendelian Genetics



Last Universal Common Ancestor (LUCA)

- Most recent common ancestor of all of life on Earth
- Shared features of modern genomes
- Including genes for: transcription/translation to convert DNA to RNA to proteins

EVO-1

- Evolution is characterized by change in the genetic make-up of a population over time and is supported by multiple lines of evidence

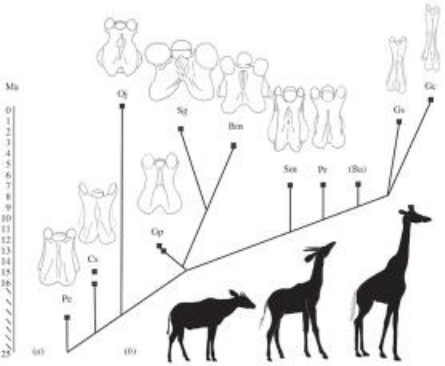
Adaptations

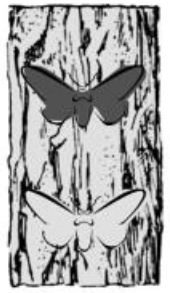
- Change to population to make better suited to environment
- Favored by selection
- Provides advantage in particular environment

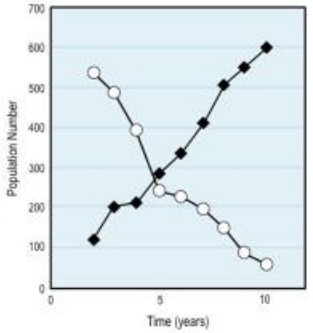
Mutations

- Changes in DNA
- Random
- Not directed by specific environmental pressures

8.7: Disruptions to Ecosystems







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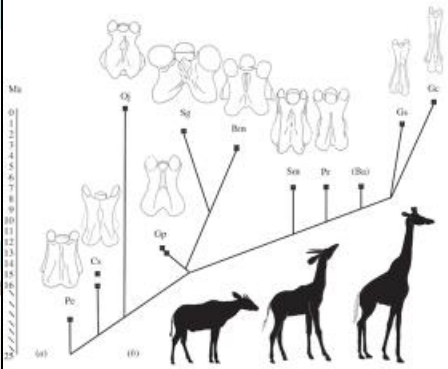
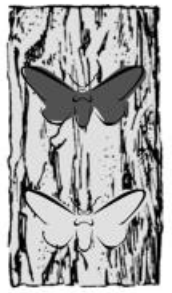
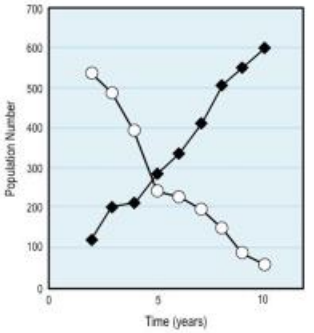
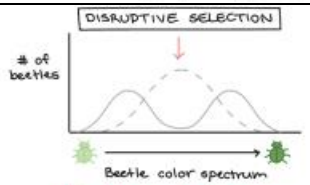






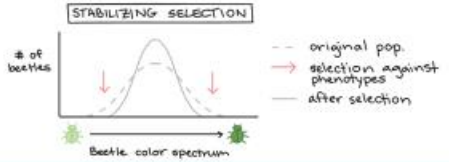


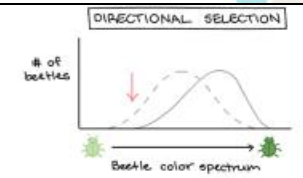
Disruptive Selection

Selection for the two extreme phenotypes
Selection against the intermediate phenotype

Stabilizing Selection

Selection for the intermediate phenotype
Selection against the two extreme phenotypes





Directional Selection

Selection for an extreme phenotype
Selection against the other phenotypes

7.2 Natural Selection

Natural Selection ACTS on phenotypes, but AFFECTS genotypes

Phenotypic Variations

- Population has a variety of traits strongly influence by genetic and environmental factors

INCREASE fitness of the organism in particular environment

DECREASE fitness of the organism in particular environment

Artificial Selection

- Organisms with certain traits are bred until population has that trait
- Humans affect variation in the population
- Examples:
  - Dog Breeds
  - Corn from Maize
  - Wild Mustard → Cauliflower, Broccoli, Cabbage, Kale, & Kohlrabi

Mutations

- Changes in DNA
- Random
- Not directed by specific environmental pressures
- Results in variation that natural selection can act upon

Genetic Drift

Bottleneck Effect
- Population is reduced by a natural disaster where there was no selection based on traits

Founder's Effect
- Small population is isolated from original population

These reduce the population size and could decrease genetic diversity making them more susceptible to environmental impact or could fix harmful alleles

Gene Flow

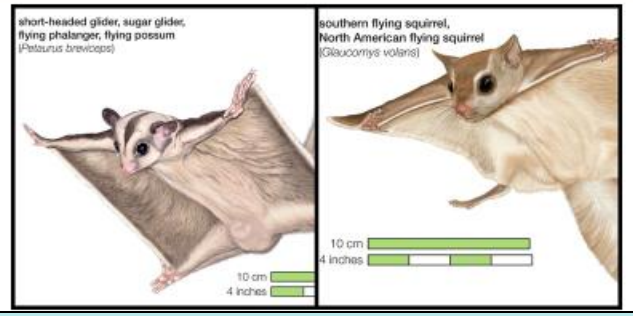
- Movement of organisms into (immigration) or out of (emigration) a population
- Brings NEW alleles into the population
- Removes alleles from the population

7.3 Artificial Selection

Convergent Evolution

- similar selective pressures result in similar phenotypic adaptations in different populations or species

Examples:
- Sugar Glider vs. Flying Squirrel
- Bat Wing vs. Bird Wing



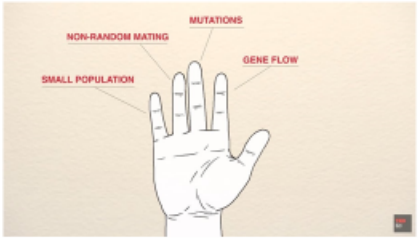
7.4 Population Genetics

Reduction of genetic variation within a given population can increase the differences between populations of the same species.

7.5 Hardy-Weinberg Equilibrium

Conditions for Hardy-Weinberg Equilibrium

1. a large population size
2. absence of migration
3. no net mutations
4. random mating
5. absence of selection



Did the population evolve?

If the allelic/genotypic frequency changes, the population has evolved.

Equations

Variables

p = frequency of the dominant allele
q = frequency of the recessive allele
p^2 = frequency of homozygous dominant
2pq = frequency of the heterozygous
q^2 = frequency of the homozygous recessive

Hardy-Weinberg Equilibrium

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

p	q	p^2	2pq	q^2

Counting Alleles

$$p = \frac{2AA + Aa}{2 \times \#\ individuals}$$

$$q = \frac{2aa + Aa}{2 \times \#\ individuals}$$

p^2 = #AA/total
2pq = #Aa/total
q^2 = #aa/total

Example Problems

The garden at your school always has red, pink, and white snapdragons. There are 200 red flowers, 300 pink flowers, and 500 white flowers. Determine the allele frequency of the flower allele color.

Red (p^2) = 200/1000 = 0.2
Pink (2pq) = 300/1000 = 0.3
White (q^2) = 500/1000 = 0.5

$$p = \frac{2(200)+300}{2(1000)} = \frac{700}{2000} = 0.35$$

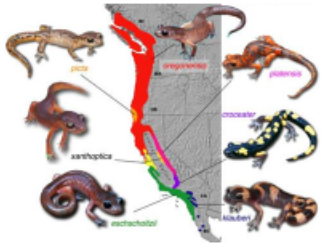
$$q = \frac{2(500)+300}{2(1000)} = \frac{1300}{2000} = 0.65$$

In a population that is in Hardy-Weinberg equilibrium, 36% of the individuals have the dominant phenotype for a certain trait.

p	q	p^2	2pq	q^2
0.2	0.8	0.04	0.32	0.64

Tip: Always start with q^2 for H-W problems

Geographical

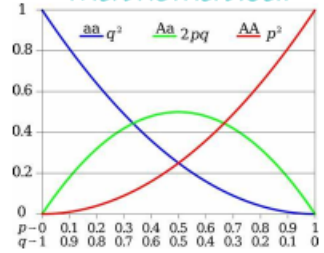


Geological/Fossil Evidence

Fossil Dating:
- The age of the rocks where a fossil is found
- The rate of decay of isotopes including carbon-14
- Geographical data

Morphological Homologies:
- Homologous/Vestigial structures

Mathematical



7.6 Evidence of Evolution

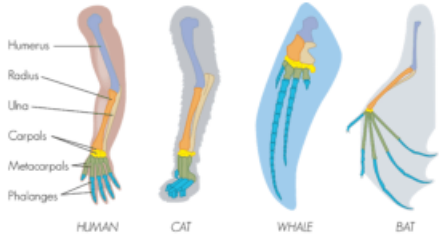
Biochemical

Species	Sequence of Amino Acids in the Same Part of the Hemoglobin Molecules
Human	Lys–Glu–His–Iso
Horse	Arg–Lys–His–Lys
Gorilla	Lys–Glu–His–Lys
Chimpanzee	Lys–Glu–His–Iso
Zebra	Arg–Lys–His–Arg

DNA or protein

Comparison of the number of differences

Physical



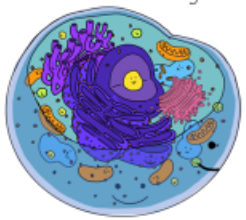
Homologous Structures:
Similar structures due to common descent

Vestigial Structures:
Anatomical structure with no apparent function still present from ancestral species

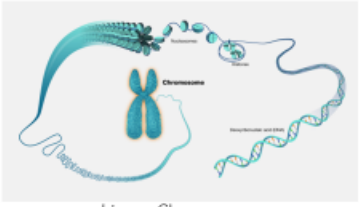
BEWARE: Analogous structures are due to convergent evolution

7.7 Common Ancestry

Membrane Bound Organelles

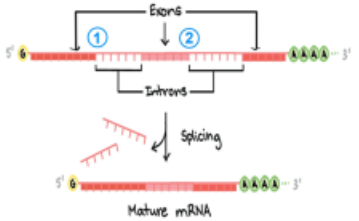


Evidence of Common Ancestry

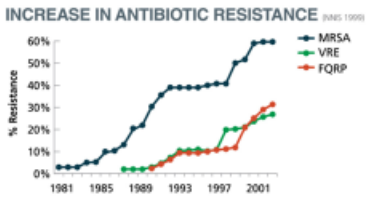


Linear Chromosomes

Genes the contain introns

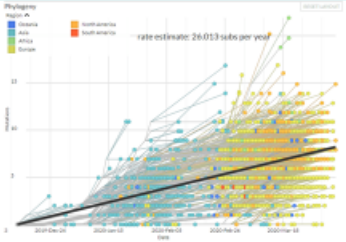


7.8 Continuing Evolution



Evolution is a continuous process

- Genomic changes over time.
- Continuous change in the fossil record.
- Evolution of resistance to antibiotics, pesticides, herbicides, or chemotherapy drugs.
- Pathogens evolve and cause emergent diseases.

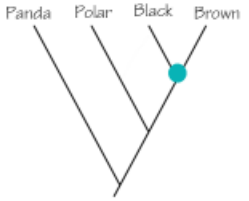


7.9 Phylogeny

Cladogram

TABLE 1. AMINO ACID DIFFERENCES IN THE LYST PROTEIN AMONG BEAR SPECIES

	Panda	Black	Brown	Polar
Panda	–			
Black	33	–		
Brown	34	1	–	
Polar	40	7	8	–



Outgroup

least closely related to the remainder of the organisms in the phylogenetic tree or cladogram.

What does it show?

- Shows relationships
- Amount of change over time (fossil/molecular clock evidence)
- Characters gained or lost
- Recent ancestors

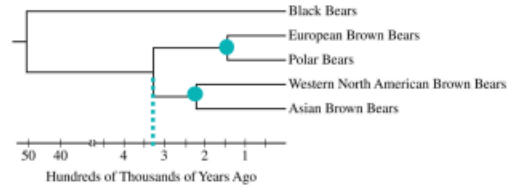


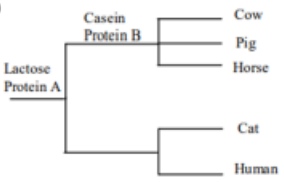
Figure 1. Phylogenetic tree representing the evolutionary relatedness among bear populations based on mitochondrial DNA sequence comparisons

Phylogenetic Tree

MILK COMPONENTS IN DIFFERENT MAMMALS

Character	Cat	Cow	Horse	Human	Pig
Lactose	+	+	+	+	+
Protein A	+	+	+	+	+
Protein B	–	+	+	–	+
Casein	–	+	+	–	+

+ indicates the presence of the character, and – indicates the absence of the character



Prezygotic

Before zygote is created

Behavioral
Two organisms have different mating rituals (dance, song, etc)

Temporal
Two organisms mate at different times (day, month, year, etc.)

Geographic
Two organisms are separated by a geographical barrier

Habitat/Ecological
Two organisms mate in different ecological environments

Mechanical
Two organisms are incompatible anatomically

Gametic
Two gametes are unable to fuse

Biological Species Concept:
two organisms are of the same species if they can INTERBREED and produce FERTILE, VIABLE offspring

Postzygotic

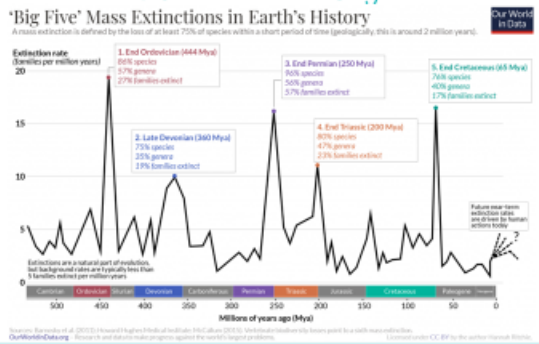
After zygote is created

Reduced Hybrid Viability
Hybrid is not healthy/viable

Reduced Hybrid Fertility
Hybrid is not fertile

Hybrid breakdown
First generation hybrid is ok But second and more generations the hybrid starts decreasing viability and fertility

Earth's History



Ecological Changes & Human Activity

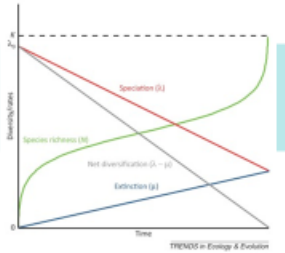
Ecological Changes

- Ocean levels change
- Climate change
- Decrease in oxygen levels in ocean
- Atmospheric and ocean chemistry

Human Activity

- Introduced species
- Over-harvesting
- Burning Fossil Fuels (global climate change)
- Pollution
- Over-population

Increase Extinction



The amount of diversity in an ecosystem can be determined by the rate of speciation and the rate of extinction.

7.10 Speciation

Creation of new species

Sympatric

New species from a surviving ancestral species while both continue to inhabit the same geographic region

Habitat isolation, Behavioral isolation, Sexual Selection, Polyploidy

Allopatric

Occurs when biological populations of the same species become isolated due to geographical changes

7.11 Extinction

Advantages

Opens up opportunities for new species to emerge.

Animals and plants evolve to fill available niches within an existing ecosystem.

Disadvantages

- Wipes out biodiversity
- Destroys existing ecosystems and the special niches that species occupy
- New ecological niches must arise
- New species arise by filling broad ecological niches within a recovering ecosystem