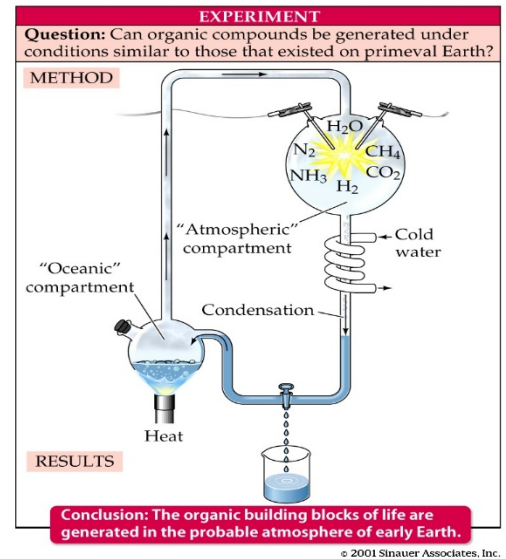


Origins of Life

- _____ molecules → _____ molecules → self-_____ molecules (can reproduce)

Stanley Miller

- Designed test to see if early earth conditions could allow for the molecules needed for life to form
- Re-created early Earth's _____ with _____, _____, methane, _____ gas and lightning
- Found that _____, sugars, and small _____ (carbon) were formed
- Amino acids and organic compounds are some of the molecules that are found in _____ things
- **Simple organic molecules formed**



First form of life

- _____ (bacteria)
- Anaerobic because there was no _____
 - Oxygen came from _____ organisms
- Prokaryotic because prokaryotes are the _____ cells

Abiogenesis

- Life that results from _____ matter
- Refers to theories of how the first and simplest forms of life (prokaryotic cells) originated.
- Different from _____ generation that was disproved by Pasteur with broth

Evolution of Cells

- The 1st cells were bacteria that were _____ (no oxygen remember).
- The 2nd type of bacteria to evolve were _____ (use chemicals in the ocean to get energy)
- 3rd, the _____ bacteria developed
 - THEY PRODUCED _____
 - Changed the atmosphere greatly
 - This made it possible for _____ respiration to evolve in bacteria- which is more _____ than anaerobic.

- Larger and more complex organisms now have the ability to _____.
- 4th, _____ cells – _____
 - Formed when _____ prokaryotic cells (bacteria) lived together.
 - The smaller cells lived inside a larger prokaryote and benefited
 - Smaller cells are thought to have evolved into _____ and _____.
- 5th event: Multicellular organisms

Next: The internal bacteria are _____ from generation to generation.

Evolution of Life

1. Early Earth was _____; atmosphere contained _____ gases.
2. Earth _____ and oceans condensed.
3. Simple _____ molecules may have formed in the oceans.
4. Small sequences of _____ may have formed and replicated.
5. First _____ may have formed when RNA or DNA was enclosed in microspheres.
6. Later prokaryotes were photosynthetic and produced _____.
7. An oxygenated atmosphere capped by the ozone layer _____ Earth.
8. First _____ may have been communities of prokaryotes.
9. _____ eukaryotes evolved.
10. _____ reproduction increased genetic _____, hastening evolution.

Biogenesis

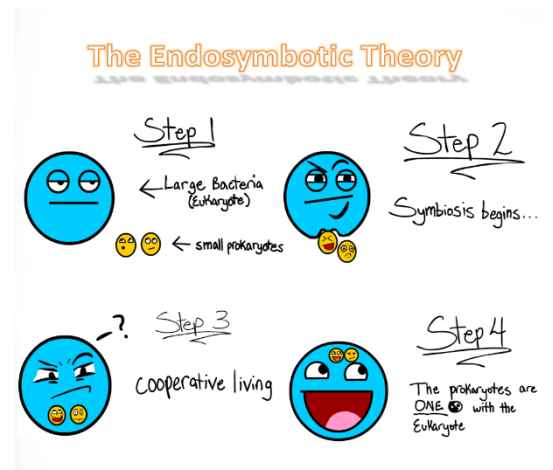
- Life results from existing _____

Fossils

- _____ of organisms from long ago
- Gives information about earlier forms of life on Earth
- Fossil layers on _____ are older than layers on top (if not disturbed)

Relative dating

- If the rock layers have not been disturbed, the layers at the surface (on the top) must be younger than the deeper layers.
- Which fossil is the oldest?



Examples of Adaptations That Help Organisms Survive in the Environment

Structural Adaptations

- Physical attributes

-
-
-
-

Mimicry

- One species can _____ like another that is poisonous or bad tasting to predators
- Causes _____ to avoid organism
- Organisms mimic _____, poisonous organisms or plants (autotrophs) to avoid being eaten

EXAMPLES:

Camouflage

- Species _____ in with their surroundings
- Blending in allows organism not to be _____ by predator
- If not seen, it is not eaten

Physiological Adaptations

- Adaptations in the _____ (chemical) processes

Examples are

- Bacteria are genetically _____ to penicillin
 - Insects and weeds are _____ to pesticides and herbicides.
- The resistant organisms _____ in their habitat and _____ the resistance on to their children

Natural Selection

- Organisms with certain _____ have a better chance of surviving and reproducing
- Organisms that _____ and reproduce pass their traits on to their offspring.
- Species change and become better _____ to their environment.
- Evolution by natural selection occurs.
- Examples:
 -
 -
 -

Population Genetics and Evolution

Population

- Members of _____ species
- Live in same _____
- Able to reproduce _____ young

Gene pool

- _____ in a population
- Collection for _____ of all traits
- Gene pool changes due to _____ of traits
- All of the genes in a population = _____

Four Factors that Change the Gene Pool

1. Natural Selection

- Organisms that are well-adapted _____ and _____ on their _____ to the next generation.
- _____ of genes change from one generation to next

2. Mutation

- Adds a _____ type to gene pool
- May _____ or _____
- Mutation is _____ if organism is better able to _____ in environment
- Example: effectiveness of _____ and pesticides decreases over time
- Mutations enable some bacteria or pests to _____ and _____
- These mutations are _____ on to offspring
- Offspring are not _____ and continue to reproduce (resistance is developed)
- **Physiological adaptations can develop rapidly**
 - The bacteria in a population _____ in their ability to resist antibiotics.
 - When the population is exposed to an antibiotic, only the _____ bacteria _____.
 - The resistant bacteria _____ and produce more resistant bacteria.

Evolutionary Arms Race: Disease**REMEMBER—**_____ **MUST ALREADY BE PRESENT IN POPULATION**

- Bacterial resistance to antibiotics
 - _____
- Pesticides in various species
 - _____(ORKIN)
 - Rodents
- Passive/active immunity
 - _____ Immunity: infant inherits mother's immunity; short term
_____ (injection of antibodies)
 - _____ Immunity: bodies response to a
_____ infection (either artificial—live vaccine or natural—achoo!)
- Antivirals and vaccines
 - _____ strains resistant to retroviral medications

3. Migration

- _____ of members of a species into or out of a population
- Into – _____ genes to pool
- Out of – _____ genes from pool

4. Isolation

- _____ isolation
- Barrier between population divides it
 - Habitat _____
- Caused by rivers, mountains, human construction (buildings, roads)
- Often results in _____
 - development of a new species
- _____ isolation
 - Organisms can no longer _____
 - Caused by geographic isolation

The Evolution of Species through Reproductive Isolation

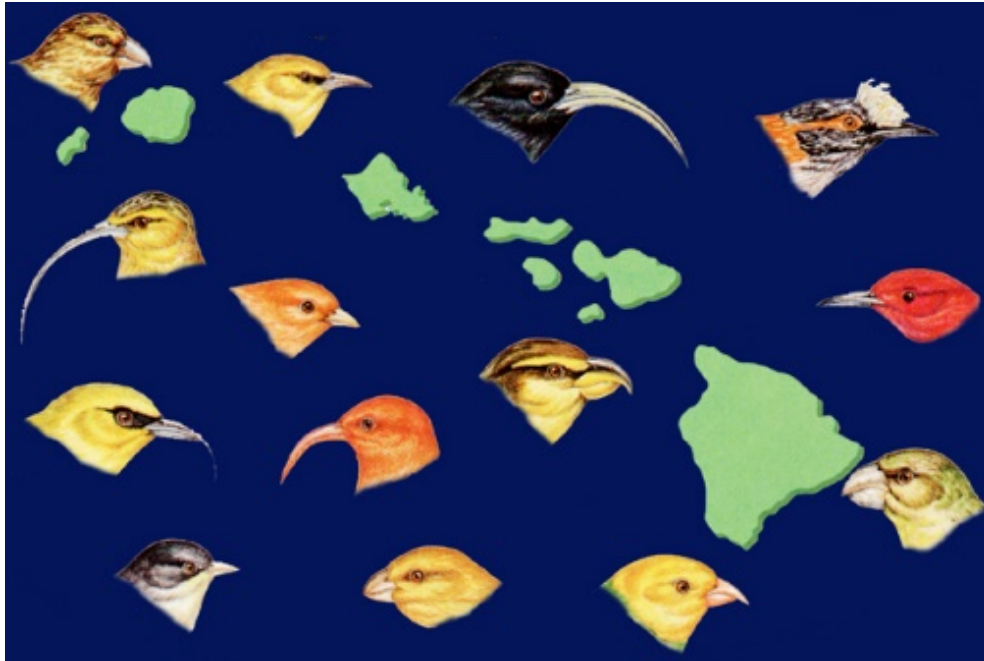
1. The tree frogs are a single population living in the same _____.
2. The formation of a _____ may _____ the frogs into two populations.
3. This is called _____ isolation.
4. The frogs can no longer _____ with each other because they can't easily get across the river.
5. Over time, the divided populations may become two species that may no longer _____, even if reunited.
6. Populations can change due to _____ and natural selection.

Charles Darwin

- Organisms _____
- Changes are caused by natural selection

Darwin's Finches

Ancestor Species →



DIFFERENT BEAKS EXPLOIT DIFFERENT FOOD SO THIS LEADS TO LESS COMPETITION!!!

FIVE STEPS of Darwin's Theory of Natural Selection**Overproduction**

- Before natural selection takes place, there must be an _____ of species
- Species produce more organisms than can _____ and reproduce
- They have the potential to _____ in numbers exponentially

1. Variations

- Variations
 - _____ among organisms
 - occur among the members of the _____ species
 - _____ are the primary source of variation
 - meiosis and sexual reproduction provide _____ genetic variation
- Darwin was NOT able to explain variations in terms of cause: _____, _____, and sexual reproduction (these were explained later)

2. Inheritance

- Individuals pass on _____ to offspring
- Genotype determines _____
- Genes code for _____!!!!
- Sexual reproduction _____ genetic _____!
- Meiosis _____ genetic variation
 - _____
 - Independent _____ of chromosomes

3. Competition

- Organisms _____ for limited resources
 - food, water, space to live, mates
- _____ amount of resources

4. Survival of the Fit

- Some organisms have certain _____ and are better adapted to their environment.
- These organisms have a much better _____ of _____ and reproducing.
- Those without beneficial _____ are less likely to survive and reproduce.

- CHANGING ENVIRONMENTS _____ FOR SPECIFIC GENETIC _____

5. Change in Population

- Organisms with favorable variations
 - _____
 - _____
 - PASS ON _____ TO _____
- Accumulation and change of favored _____ leads to changes in species over time
- Could result in a new species
 - _____

Variations in Bird Beaks

DRAW BEAKS HERE:

Red-tailed hawk: _____

Cardinal: _____

Pileated woodpecker: _____

Great blue heron: _____

Canvasback duck: _____

Types of Natural Selection in Populations

Stabilizing Selection

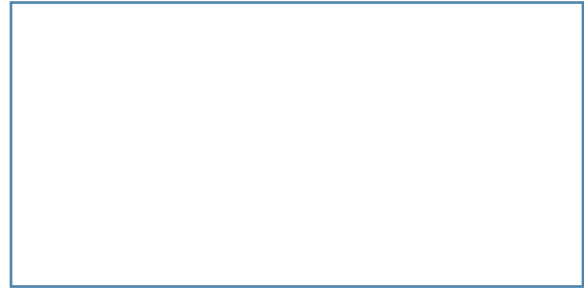
- _____ individuals in population benefit
- Increases in middle of graph

Natural selection acts on variations

- Stabilizing selection is a natural selection that favors _____ individuals in a population.

Directional Selection

- *One* _____ variation benefits
- Increases at one end of graph
- Directional selection occurs when natural selection favors one of the extreme _____ of a trait.



Disruptive Selection

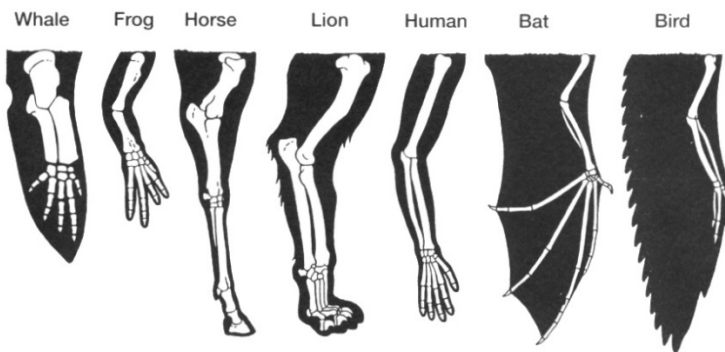
- Both _____ variations benefit
- Can result in formation of _____ species
- Increases at both ends of graph
- Decreases in middle of graph
- In disruptive selection, individuals with either _____ of a trait's variation are selected for.



Evidence of Evolution that Suggests that Organisms Evolved from a Common Ancestor

Homologous structures (CAN STUDY FOSSILS)

- Body parts that have the _____ basic structure
- Whale flipper and arm
- Suggests organisms evolved from a _____



Vestigial structures

- Structures with no _____
- Snakes – _____
- Humans – _____
- Blind mole - _____
- Suggests organisms evolved from a _____
- Whales have a pelvis (hip bone)

Embryology

- Embryos of fish, birds, amphibians, reptiles and mammals have _____ (not real gills) and _____
- Suggests evolution from _____

Biochemistry

- _____
- Study molecules of _____, amino acid sequences, order of _____, and enzymes (proteins) that make up living things
- Similar _____ and information suggest similar ancestors

Higher percentage of same DNA = higher percentage of same amino acid sequences = closer in relation

According to the table, which of the following primates has the least amount of amino acid sequences in common with humans?

Which one(s) have the most?

Amino Acid Sequences in Primates				
Baboon	Chimp	Lemur	Gorilla	Human
ASN	SER	ALA	SER	SER
THR	THR	THR	THR	THR
THR	ALA	SER	ALA	ALA
GLY	GLY	GLY	GLY	GLY
ASP	ASP	GLU	ASP	ASP
GLU	GLU	LYS	GLU	GLU
VAL	VAL	VAL	VAL	VAL
ASP	GLU	GLU	GLU	GLU
ASP	ASP	ASP	ASP	ASP
SER	THR	SER	THR	THR
PRO	PRO	PRO	PRO	PRO
GLY	GLY	GLY	GLY	GLY
GLY	GLY	SER	GLY	GLY
ASN	ALA	HIS	ALA	ALA
ASN	ASN	ASN	ASN	ASN

Rate of evolution – two theories

Gradualism

- _____ process over long period of time
- Slow, gradual _____ of organisms
- Darwin’s finches

Punctuated equilibrium

- Species remain _____ for millions of years
- Within short time certain species _____ die off while new species suddenly appear
- Dinosaurs

Patterns of Evolution

Adaptive Radiation

- One _____
 - One species _____ into many different species
 - New species fit different _____ and/or _____
 - Darwin's finches
 - Form of _____ evolution
 - Species become less alike as they _____ to environmental changes

Convergent evolution

- Distantly related organisms _____ similar traits due to similar environments
- Shark (fish) and dolphin (mammal) _____ similar and live in similar environments.
- Dolphins and sharks are _____ organisms that have evolved similar traits because they share similar environmental pressures.

Characteristics of Primates

- Opposable _____
 - Thumb can touch all other fingers
- Frontal, _____ vision
 - Focus on one object with both eyes and see _____
- _____ joints
- Ex: Humans, chimpanzees, lemurs

Jane Goodall

- Studied and documented _____ behavior

Modern humans

- _____

- Walk upright on two legs
- Large, highly developed _____
- Jaw does not _____ out from face
- Broad human _____ allows humans to stand erect and supports internal organs.

Review

Definitions

- _____ 1. the strongest evidence for evolution from a common ancestor
- _____ 2. shows how organisms are related by descent from common ancestors
- _____ 3. structures that are similar in related organisms because they were inherited from a common ancestor
- _____ 4. scientists who find and study fossils
- _____ 5. structures that are similar in unrelated organisms
- _____ 6. provide clear evidence that evolution has occurred
- _____ 7. reduced structures that are no longer used
- _____ 8. the process by which a single species evolves into many new species to fill available niches
- _____ 9. the study of the similarities and differences in the embryos of different species
- _____ 10. the study of how and why plants and animals live where they do
- _____ 11. the study of the similarities and differences in the structures of different species

Terms

- | | |
|---------------------------|-------------------------|
| a. adaptive radiation | g. DNA sequences |
| b. analogous structure | h. fossils |
| c. biogeography | i. homologous structure |
| d. cladogram | j. paleontologist |
| e. comparative anatomy | k. vestigial structure |
| f. comparative embryology | |

Writing prompt:

Explain how a species can evolve through natural selection.