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 ____________, ____________, 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
1. Bacteria are genetically ______________________ to penicillin
2. 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.
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

<table>
<thead>
<tr>
<th>Red-tailed hawk: ________________</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardinal: ________________</td>
</tr>
<tr>
<td>Pileated woodpecker: ______________</td>
</tr>
<tr>
<td>Great blue heron: ________________</td>
</tr>
<tr>
<td>Canvasback duck: ________________</td>
</tr>
</tbody>
</table>

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?

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 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.